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The Homage Due to Edison

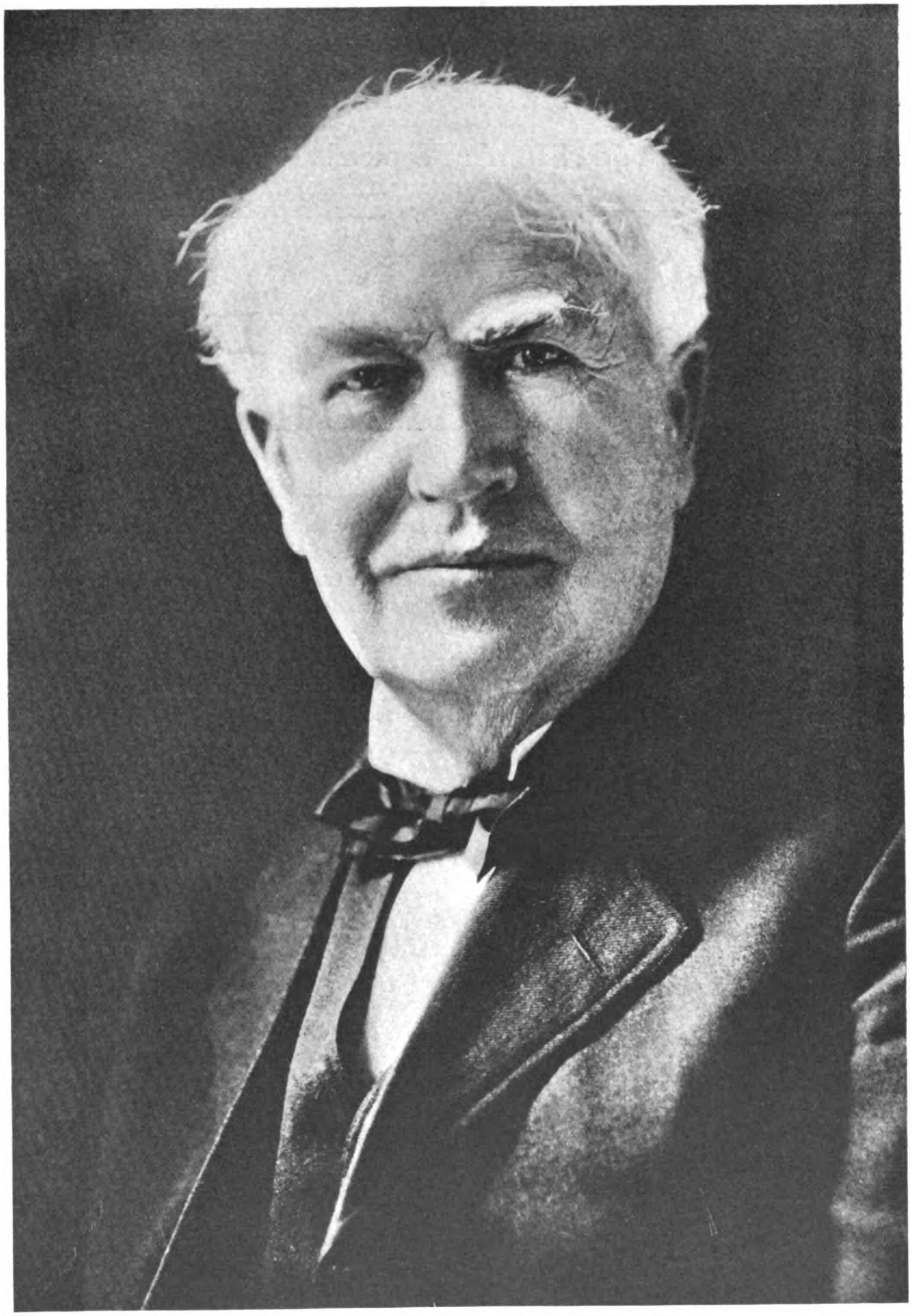
THE United States, like many other nations, has produced men of renown in the field of electrical science and invention. Some possessing remarkable attainments and gifts, like Franklin, Morse, Henry and Bell, received praise and honor from beyond the seas. Their work was for the world and their fame was a tribute to their eminence.

No man in electrical science, however, from Thales of Miletus to Steinmetz, gained a wider fame than Edison, and the forty years which have elapsed since he founded the new art of electric generation and distribution have added to rather than modified his extraordinary popularity and repute. The more his accomplishments and achievements are studied, the more clearly is his greatness established and the world's indebtedness to him enlarged. His genius and labor have reflected glory upon his country, and his name has become part and parcel of our national heritage and treasure.

DISREGARDING his work outside the electrical industry, but pausing to mention that even there his inventions of the phonograph and of the motion picture entitle him to immortal fame, let us contemplate his benefactions to civilization in the narrower channels of electricity alone. When Edison invented the incandescent electric lamp and produced on Pearl Street, New York, the prototype of the modern electric central station he subjugated all the various elements to one idea, making not a patchwork, but a complete and unified system. And in that creation we have proof of his genius and vision, for not one of the essential principles in the generation and distribution of electrical energy as they exist today was lacking in the original system. To be sure, such a feat involved a great deal of work and study, for a new art was being born. It also called for faith courage and determination. Many skeptics insisted that the thing could not be done. It was done, however, and in its accomplishment Edison ushered in the electrical age and laid the foundation of one of the most wonderful developments the world has ever seen.

EVOLUTION in the art then followed very rapidly. Not less marked was the influence of the electrical industry on older and well-established ones. Water power, which was used thousands of years before the Christian era, assumed an entirely new aspect and began to be developed with skill and efficiency. In fact, it was only when long-distance electrical transmission became a fact that most water powers became serviceable to man at all.

Steam-engine design was revolutionized. The small slide-valve engine gave place to the Corliss engine, only to be supplanted by the steam turbine, which in less than a decade grew from 5,000 hp. to 60,000 hp. Electric power stations grew larger and larger. Engineering practice was standardized and developed. Illumination took on a new meaning. Transmission voltages have increased to 220,000 volts, and with every refinement in generation and transmission have come economies in utilization. Most wonderful of all has been the phenomenal growth in the use of labor-saving household and other devices. Thus an industry unknown less than twoscore years ago now, thanks to the genius of Edison, ranks among the most important in the world, with an output in this country this year of approximately fifty billion kilowatt-hours.



Thomas A. Edison

The most widely known man in all the world, in practical genius the greatest and in invention the most fertile, who conceived and executed in detail forty years ago a new art and a new industry

Editorial Comment

Electrical World, September 9, 1922

Volume 80 Number 11

Past, Present and Future

FORTY years is a short term in human affairs. At that age men are still counted young and few have done their best work. Yet could one go back for that space of time and look about the world he would find himself in another era; for two score years of electricity have transformed material civilization as no period of like length ever did before, and in externals 1882 bore a far closer resemblance to 1842 than 1922 does to 1882.

Forty years ago was still the era of steam and gas, before either had been put on its mettle by the springing into being of the double-functioned giant that challenged both. Meanly lighted streets aided crime. Few women ventured upon them after nightfall, and in some districts of the large cities even muscular men hesitated to go. In their homes the people injured their eyes as they read by open-flame gaslights, and in newspaper offices and other places of night work the toilers ruined theirs. Chinese lanterns were the main resource for illumination on festive occasions. In the factories and workshops ponderous steam engines roared and pounded amid stifling heat. On the rivers and streams crude hydraulic machinery utilized an infinitesimal fraction of the power running to waste. Horse-drawn cars dragged slowly along the streets, and the elevated railways of New York, driven by small steam locomotives coupled backward, were the wonder of the nation. The telephone was still a novelty of which the ordinary citizen's home was as innocent as it was of all the electric labor-saving devices that every progressive housewife boasts today.

So much for the past. The present speaks for itself, and of Edison and all his co-workers in the transformation may be said as the memorial tablet in St. Paul's Cathedral says of Sir Christopher Wren: "Would you see their monument, look around you." A hundred large cities and innumerable small ones in North America alone depend on their electric light and power company as on no other single institution for both the necessaries and the luxuries of life. Electricity turns the wheels of industry in ever-increasing proportions, and over dark streets and dim towns and even little frontier settlements in the Far West it has spread its radiance as if in obedience to the creative edict, "Let there be light!" To the workingman's flat in the crowded town and the isolated farmhouse alike have come through its agency comfort and help undreamed of forty years ago. What is true of America is true in greater or less degree of other lands, even the remotest and the most backward. Electricity has penetrated to the outposts of Siberia, the villages of interior China, the islands of the South Seas and the frozen zone of the Arctic Ocean.

What will another forty years bring? Will 1962 show no further advance over 1922 than 1882 showed over 1842? Is electrical development approaching its zenith, and will it display henceforth only a slow rate of growth and be applied in few new ways, if any?

No man imbued with the spirit of the electrical industry will believe so. We shall not indulge in specific prophecy. It would be rash to predict that some new discoverer is going to find a way to convert electrical energy into heat at a cost which will make the householder forever independent of mine owners and mine workers. It might not be safe even to aver that before 1962 steam will surrender its last independent fortress, already besieged, and transportation by rail be universally electrified. But if these things do not come, others will. In the approaching days, when unwired buildings will be things of the past, humanity will be aided in ever-increasing degree by the youngest and greatest of its invisible servants. No other result is possible from the research, the enterprise and the industry of those to whom electricity is more than a business, an art or even a science—to whom, indeed, it is hardly too much to say it has become a religion.

Present Improved Status of the Code

IN THINKING back over the forty years of active evolution in the electrical industry the development of the National Electrical Code is not one of the least interesting details. For the code has stood for a desire to make the installation and use of electricity safe, and as the utilization of electric service has become more diverse and extensive, so has the code grown and become particularized. C. M. Goddard's story in this issue of the origin and growth of the code is an interesting sidelight on the early days. Working only by moral suasion and without any applied authority, it is remarkable perhaps that the code has become as influential as it is today, with all the inconsistencies that continue in inspection standards and irritate electrical men so sorely at times. But this clear statement of the manner in which the code operates is impressive proof of the opportunity that there is for electrical men to exert a constructive and liberalizing influence by contact and co-operation with local boards of underwriters and inspectors.

The recent acceptance of the code by the American Engineering Standards Committee should impart a very helpful impulse toward the more practical standardization of code requirements as locally interpreted. Until now the code has had no legal status. There was no police power behind it. It could not be enforced save as a regulation of insurance companies under which rates might be raised or policies withheld. It was, after all, an insurance code, and though state and municipal inspectors have the power of government behind them and their laws and ordinances are enforceable, the insurance inspector was free to apply his own interpretation, and enforcement of the code could go no further than recommendation or objection. But now that code has become an American standard backed by the official recognition of all the dominating authorities, it is another matter. Provisions and extensions will be effected by amendments adopted by speciallly appointed committee "sections" representative of all the interests concerned—engineering, labor, government and so on. This official code should be enforceable in court, and any local inspector who elects to disregard it should be enjoinable. The influence of all this on the standardization of safety regulations will be tremendous.

Engineers Will Form Friendships at Rio de Janeiro

ENGINEERS are more fortunate always than other mortals in that they speak a common language and have developed similar habits of thinking whereby they act in unison in developing their work. This circumstance warrants the prediction that the International Congress of Engineering to be held at Rio de Janeiro from Sept. 14 to Sept. 21 will be successful in every way. South American engineers, whose native language is Spanish or Portuguese, are naturally more likely to be familiar with French than with English, but they are beginning to see the value of a greater familiarity with engineering practice in the United States as a guide in the new era of expansion now under way in their countries.

South America is particularly fortunate in that it can take and build upon the engineering experience of other nations which have more largely developed their industrial resources. Of all nations this country most nearly parallels the conditions existing among its southern neighbors, and therefore it can offer helpful examples of engineering developments.

Whatever experience or knowledge our engineers have which might prove of value to their South American confrères will be freely given at the congress with that open-handed spirit so prevalent among the engineering fraternity. The Rio de Janeiro gathering, we feel sure, will form new links in the chain of international engineering friendships.

High Standards of Service Will Qualify Any Store

THE inevitable conquest of fact over theory seems to be indicated in advices from California that the State Association of Contractor-Dealers has recognized the department store and similar agencies as legitimate distributors of electrical wares. The association at its annual convention at Santa Cruz adopted a resolution wherein it was frankly admitted that present-day tendencies lean toward the broadening of distribution channels through means other than the contractor-dealer. This action was followed by the outlining of a tentative program on the part of the advisory committee of the California Electrical Co-operative Campaign to invite department stores, hardware stores and other independent agencies into the campaign, provided these agencies live up to the standards to be prescribed by the campaign.

Herein is a most interesting admission on the part of the contractor-dealer of his own inability to handle the enormous growth of sales in electrical appliances, doubly significant coming as it does from a state where merchandising activity has reached such an advanced stage. Statistics, of course, show that even now fully 50 per cent of the merchandising of electrical appliances, is passing through hands other than those of the electrical dealer.

If this is the forerunner of a national awakening to the broadening of the channels of distribution of electrical wares and if these other agencies are actually to become the principal merchandisers, a new responsibility devolves upon central-station men—as a matter of fact, upon all men of the electrical industry as a whole. The continued good will of the public toward electric service depends upon the continued good and standard performance of the apparatus and appliances in the homes of consumers. The only way to maintain high standards of service and performance with such broadened channels of distribution, in the hands of those not primarily interested in or conversant with the electrical industry, its troubles and its aspirations, is to define standards of service in words that are easily understood and to educate these new distributors to the necessity of living up to them.

The maintenance of high standards of service is a duty which cannot be shunned, and the stamp of approval, carrying with it the full power and prestige of the electrical industry, should be given to every competent agency that engages in the merchandising of electrical appliances and adheres to these standards. For such standards will in fact qualify any store.

Reminiscences of a Veteran

THERE are comparatively few men who have been forty full years in active central-station work, thus going back to the very beginning of the art, but Etienne de Fodor, whose reminiscences we publish this week, is one of this little group. He is further distinguished by having consistently kept on the firing line of progress through all the various phases of advance. Moreover, he has made a distinguished success as a central-station operator, and it is with particular pleasure that we realize his still continued activity after all the terrible stress of war to which his country has been subjected. He is a contributor to the *Electrical World* of at least thirty years' standing, for about as long ago as that we published an account from his pen of the central station in Athens, Greece, of which he was then manager.

Looking back over the years which his reminiscences cover, one is struck more forcibly than ever with the really prodigious work which Edison and his little band of associates did in the early eighties in laying the foundations of the central-station industry. A great many things that are perfectly simple and obvious today were then mysterious and demanded unlimited hard work for the solution of the many problems connected with them.

It was even less in the incandescent lamp than in the development of a complete line of entirely new and necessary auxiliaries that Mr. Edison's genius for hard work showed with the most telling effect, and these early struggles were on just at the time of which Mr. de Fodor writes, when not only the lamp but the dynamo and the whole system of distribution had to be worked out from the very start. Forty years ago nobody had any proper conception of an electrical network and the feeder system that made distribution possible. Only by the development of these fundamental ideas was it possible to distribute light at the pressure of 110 volts, then regarded as the maximum. A little later the three-wire system came to lessen the burden of investment in copper. The 110-volt lamp, in fact, held on until it became rather a fetish, and it is a little hard now for Americans to realize that their country is the only one in which the distribution service of 110 volts to 120 volts still remains practically the standard.

Forty years has made great changes in the details of the art of distribution, and it does not in the least dim the luster of the early achievements that those engineers who had learned to have faith in low-tension distribution hung on to it beyond the time when its rightful claim to continued existence had been vigorously disputed. It is well to remember, too, that even respectably good insulated copper wire was scarce in the early days of which de Fodor speaks, and that simultaneously with the incandescent lamp came the storage battery and the beginning of electric traction. The next ten years placed the electrical arts firmly on their feet, the period of trial was over, and all the story of that decade of struggle still lingers in the memory of the group of pioneers, not yet old, though veterans, of which Etienne de Fodor is an active member.

Testing a Factor in the Development of the Industry

THE importance of reliability and efficiency early brought home to both manufacturers and operating companies the need for research, investigation and testing. As a result of their broad-minded recognition of this need the development of the art has undoubtedly been accelerated. Where dictated by community of interest on the part of operating companies, there is a growing tendency to co-ordinate testing activities, bringing them under the supervision of a technical committee of the industry which administers the testing in the interests of all concerned. Where this practice has been followed notable advances have been made, and the growing recognition of the need for such testing and the obvious economies to be effected through consolidation of testing activities will bring about further co-ordination of the work in the interests of the rapid advancement of the art.

Proper Credentials Essential to Obtain Information

REQUESTS for information addressed by representatives of the public to utility managers deserve courteous consideration and completeness of reply unless such inquiries transcend the limits of good breeding. The modern well-managed utility has nothing to conceal from honest inquiry, and in countless instances companies have more than "gone the limit" to open their books, plants and papers to even hostile investigators employed by petitioners to reduce rates, change service practices or alter capitalization plans. The amount of information which some companies have prepared at the request of their opponents in commission proceedings cannot be measured, and if at times executives suggest that their employees should not be expected to devote inordinate amounts of time to facilitate the attacks of others upon the properties involved, reasonable men will agree that this position is just. By going about nine-tenths of the way to supply data many managers have found that the impression made upon the public as to the open-mindedness and fairness of their companies is worth a great deal. When individuals seek varied and special information for their own purposes, a more cautious policy is warranted, and unless such self-constituted investigators produce proper credentials, managers will do well to "put the soft pedal" upon their co-operation. Out of sheer good nature great abuses are sometimes permitted, and it is no cause for criticism if executives insist on knowing with just whom they are dealing before turning their affairs inside out.

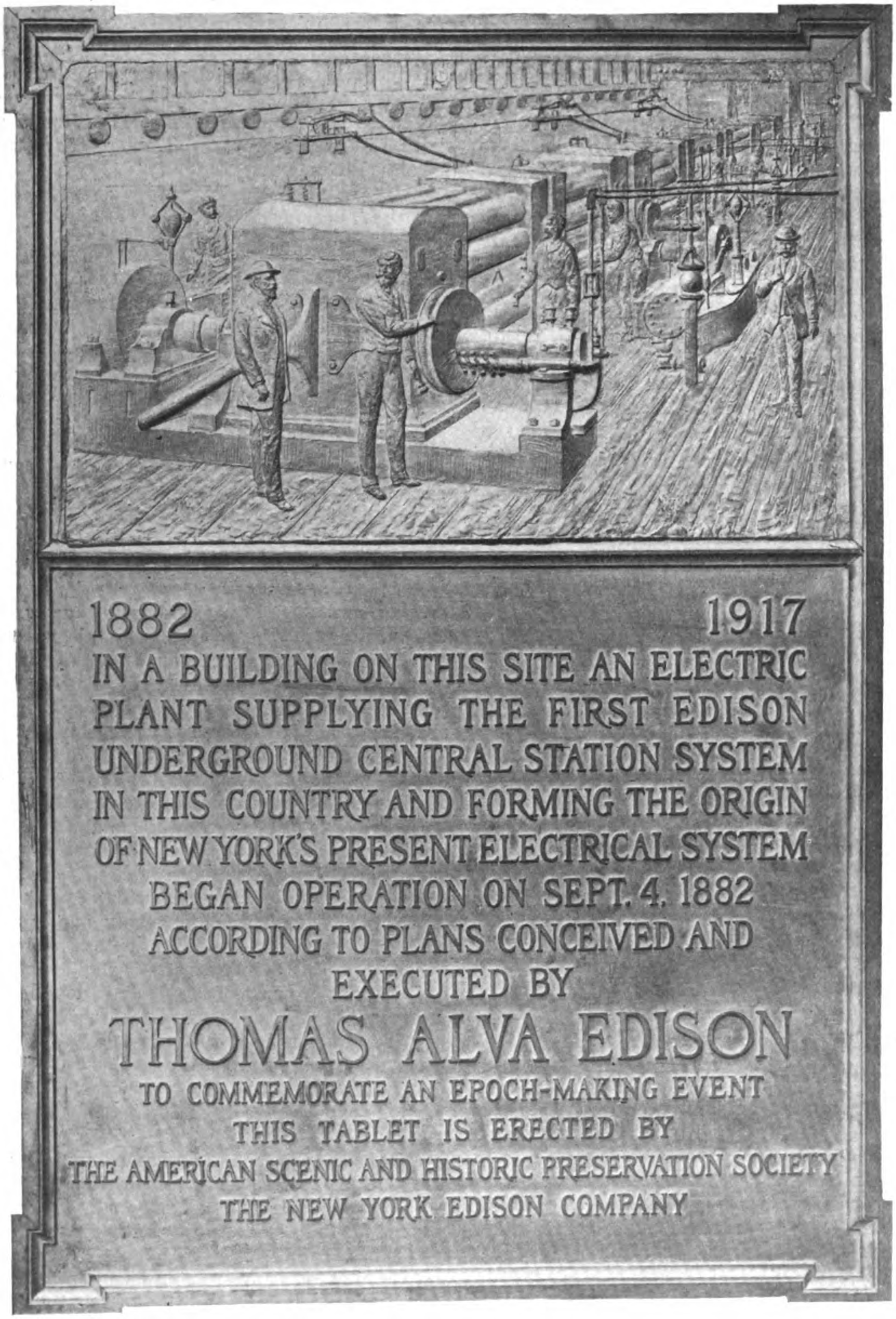
On the Threshold of Commercial Progress

COMMERCIAL evolution in the electrical industry has been unique, for it has reversed the usual sequence. In a word, the electrical business has been built backward. Most industries have originated with barter and trade and have progressed from the cottage stage into larger and larger production to meet growing demand which has been developed by selling activity and an increasing popularity. But the electrical business began with large-scale production. The engineer conceived the possibility of manufacturing electric power in quantity and had confidence in the opportunity for its profitable sale. So he proceeded to generate this unknown power, expecting that it would be—not sold, but bought.

And it was bought promptly and eagerly. People saw the advantages of electric light and wanted it. The demand came first from stores and factories and then from homes. From one town to another the engineers proceeded building generating stations and transmission systems, and the public came and asked to be served. There was a natural unsatisfied demand that absorbed all the output until well up to the year 1900, when the central station began to approach perceptibly the point where this voluntary ready demand slackened and the industry awakened to the fact that electric service would have to be sold.

Meanwhile the engineer, fascinated with the wonders of electricity, had been inventing one appliance after another. Fans, flatirons, percolators, chafing dishes—almost the full assortment of small domestic heating devices that we have today—were devised in the late "eighties" or the early "nineties" as ingenious demonstrations of what electricity would do. And the electrical man thought that the public would welcome and adopt them promptly. But the householder looked upon them as curiosities, luxuries, extravagances, and did not buy.

We stand today on the threshold of a great era of electrification. The spirit of utilization will dominate it. Only one-third of the homes of America and a part of our business buildings are wired as yet, but the conquest is proceeding with ever-increasing rapidity, and the idea of complete equipment is firing the minds of electrical men to recognition of the fact that business development offers the key to a great prosperity. The industry at last is constructing a commercial organization and a commercial purpose on a more adequate scale, with the attention of manufacturer, jobber, contractor-dealer and central-station executive focused on the common objective. In short, the long-neglected sales department of the entire industry is being built up into balance with the other two fundamental elements of production and finance. We may safely say that from the business sense our formative period is past.



Tablet on Site of Original Central Station

The historic Pearl Street station was destroyed by fire in 1890. On the structure now occupying the site is the plaque reproduced above, commemorating the beginning of central-station operation in this country

The Birth of an Industry

Forty Years Ago Electric Central-Station Service Began in New York City Under Edison's Own Direction with About Fifty Customers—An Auspicious Start Followed by Gigantic Strides

By John W. Lieb
Vice-President New York Edison Company

NO POLITICAL convulsion, great war or extraordinary public happening marked the year 1882. None the less, it deserves to be recorded forever among memorable dates, for it saw the birth of the electric central station. The incandescent light, theretofore little more than a display or a curiosity, then became a commodity; scoffers and skeptics were confuted, and the knowledge that another great and beneficent discovery, with inherent possibilities beyond computation, had been made was brought home to intelligent persons everywhere.

The younger generation of today has, of course, no remembrance of the Pearl Street revelation. To its members, as they journey about the country, the stacks that rise not ungracefully from innumerable steam power houses of attractive design, the pipe lines that carry to huge waterwheels the impounded energy of swift streams, and the conductors that stretch across whole states, conveying light, heat and power to mammoth factories and humble homes alike, are as commonplace as the railroad and the telegraph; but to older men, whose memory goes back for two score years, these things are visible evidences of the miracle wrought within the span of a short life.

The enormous difficulties with which the pioneers in the art had to contend are not always realized today. Without precedents to follow, without manufacturers to produce the requisite machinery, early central-station work was largely a pioneering effort, an endeavor to meet instinctively or by the expenditure of personal energy and resourcefulness the unexpected problems which daily presented themselves and which often needed instant solution.

NO PUBLIC SENSATION ATTENDS OPENING

When the epoch-making event took place it attracted wide interest, but can hardly be said to have caused a sensation commensurate with its importance. The New York newspapers, which were then all in the district served by the pioneer central station, gave extended accounts of the novel lighting system and praised the quality of the product, but none of them prophesied that a new industrial era had begun. Even the predecessor of the *Electrical World*, the *Operator*, whose field had expanded from that of a telegraphic organ to take in the newer manifestations of the electrical art, devoted less than ten inches to the subject, most of which was taken up by a report of Mr. Edison's own comments. "His countenance showed that he was greatly pleased," observed the reporter, and the inventor was quoted as saying:

"I have accomplished all that I promised. It was not without some fear that I started the machinery this evening. I half expected that some new phenomena would interfere with the working of the light. But it has been entirely successful. You will see that we have only one engine running now. It supplies 800 globes with light.* We have six engines which will all be in successful operation before the end of the winter. We expect to have three running next week. We have a greater demand for the light than we can supply at present, owing to the insufficiency of men to put down the wires. We have to educate the men to the use and management of our machinery. We have only one experienced engineer here now."

FIRST SYSTEM OF EXTENSIVE DISTRIBUTION

The power house thus opened at 3 p.m. on Monday, Sept. 4, 1882, in a converted warehouse at 257 Pearl Street, New York City, embodied the first system of extensive distribution of electrical energy, the first attempt to generate electricity in bulk and supply it underground for lighting and power purposes to scattered customers. It was the fondly recalled privilege of the writer, who was then electrician of the plant, to close at Mr. Edison's direction the switch which first connected one of the "Jumbo" dynamos to the station bus which in turn supplied energy to the feeders of the underground network. Prior to this time (on July 5) the dynamos had been operated to light a large bank of test lamps in the station. It is true that eight months earlier the Holborn Viaduct central station had been opened in London to feed four circuits extending for half a mile from Holborn Circus to the General Post Office. This system embraced 164 street lamps rated at 32 cp. and 774 8-cp. and 16-cp. lamps scattered in about thirty buildings. Eventually the number of lamps was raised to about 3,000. The plant was not operated on a commercial basis, being largely a public demonstration of the system. In 1884 it was abandoned. It has been confidently asserted also that two weeks before the opening of the Pearl Street power house a little station at Appleton, Wis., operated by water power, had energized 250 10-cp. incandescent lamps, using for that purpose an Edison "K" dynamo; but a careful investigation has revealed the fact that this station was not put into service until the latter part of September.

ONLY ISOLATED PLANTS BEFORE PEARL STREET

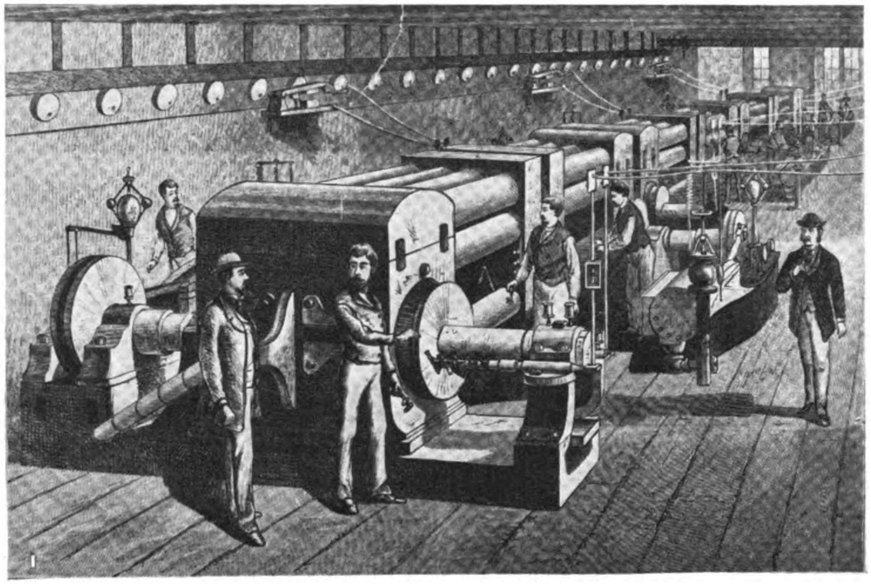
There had, of course, been numerous isolated plants supplying individual customers before the Pearl Street station was open. The first of these, involving sixty platinum-filament incandescent lamps lighted by a man-power dynamo, was installed in the middle of 1879 on the ill-fated steamship Jeanette which went down in the Arctic seas. Another installation went into opera-

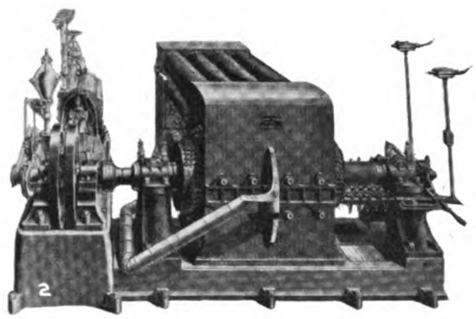
*Evidently a reportorial slip. The number was 400.

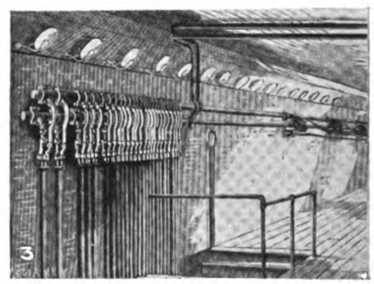
Pearl Street Was the Father of Them All

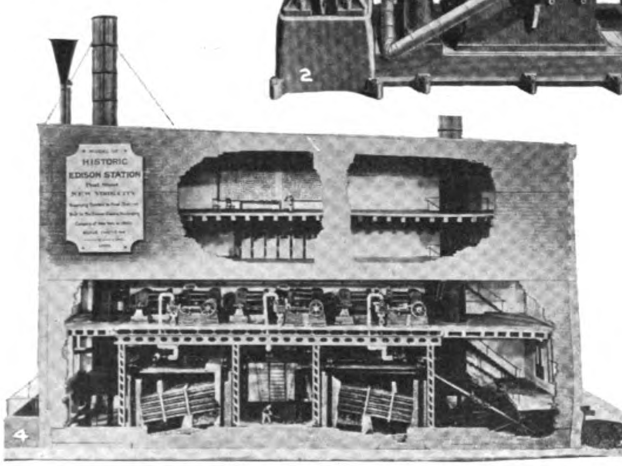
Nos. 1 and 6 show artist's drawings of the Pearl Street Station generators and switchboard control rheostats. No. 2 shows the Armington & Sims unit used in the station with a blower on the engine which gave forced ventilation on the generator. No. 3 shows the busbars and the connections to the underground tubes. No. 7 shows the first generator disconnect switch. No. 4 shows a model layout of the original station which was planned on the basis of large power per unit of floor area.

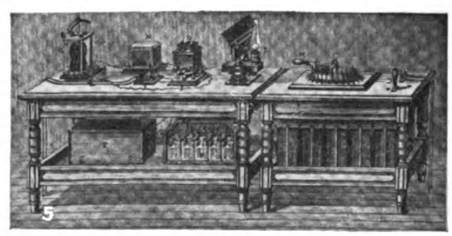
No. 5 was a photometer used to determine whether the voltage was of proper value for lighting the lamps, and No. 8 was the first automatic voltage regulator.

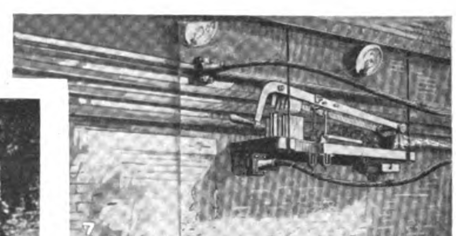


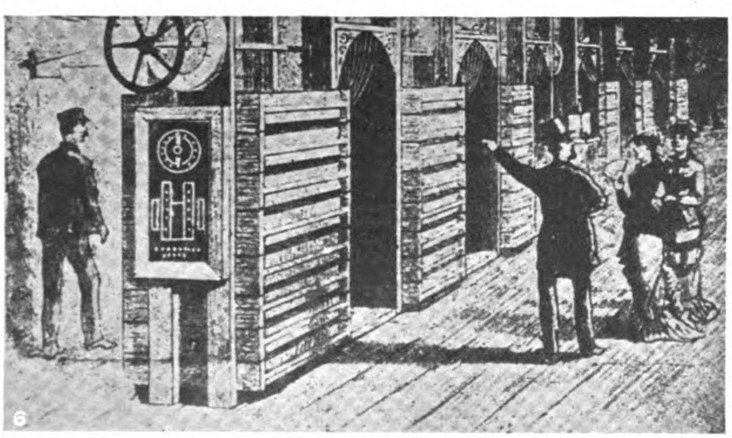


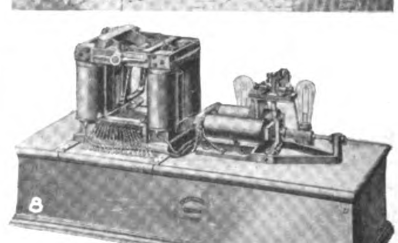






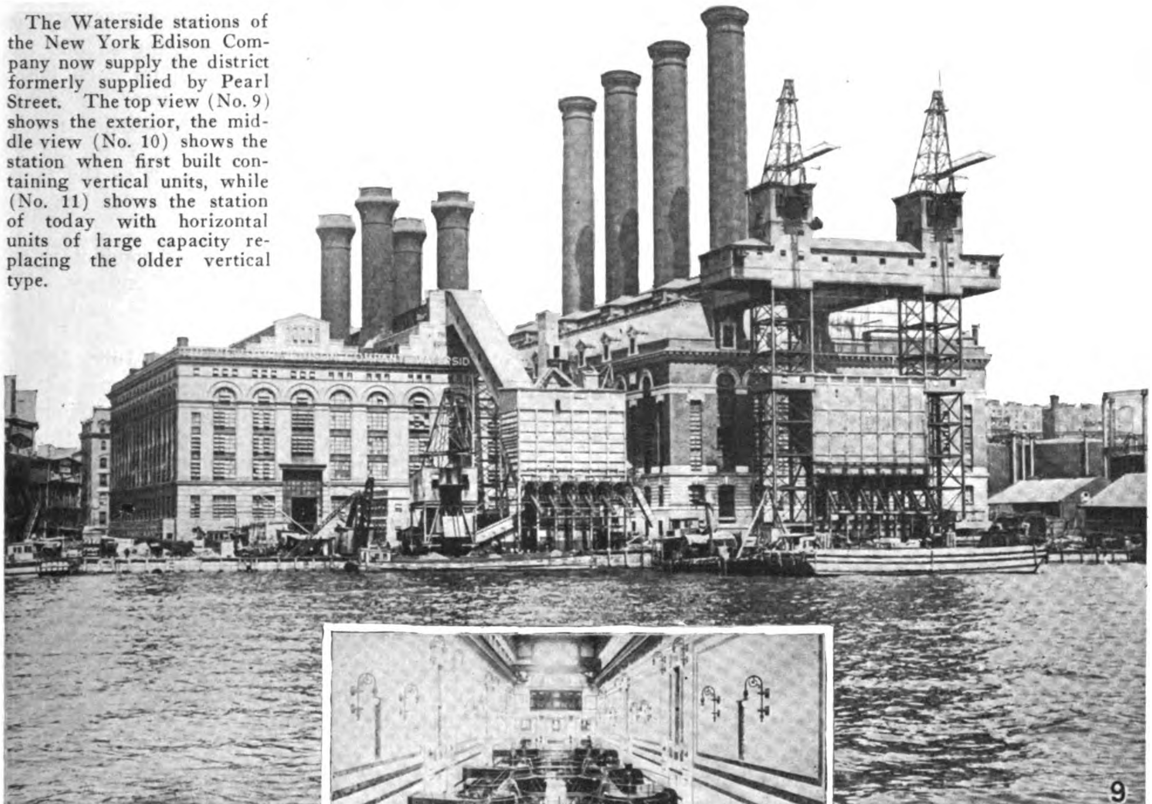






Waterside Is the Son of Pearl Street

The Waterside stations of the New York Edison Company now supply the district formerly supplied by Pearl Street. The top view (No. 9) shows the exterior, the middle view (No. 10) shows the station when first built containing vertical units, while (No. 11) shows the station of today with horizontal units of large capacity replacing the older vertical type.



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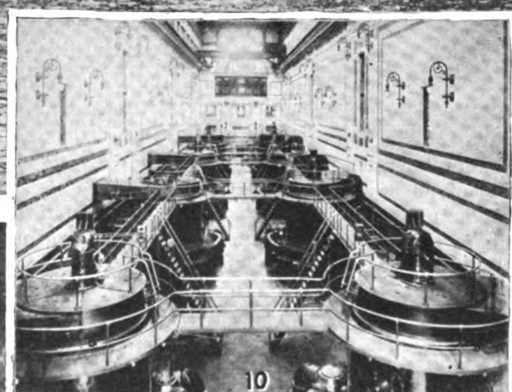

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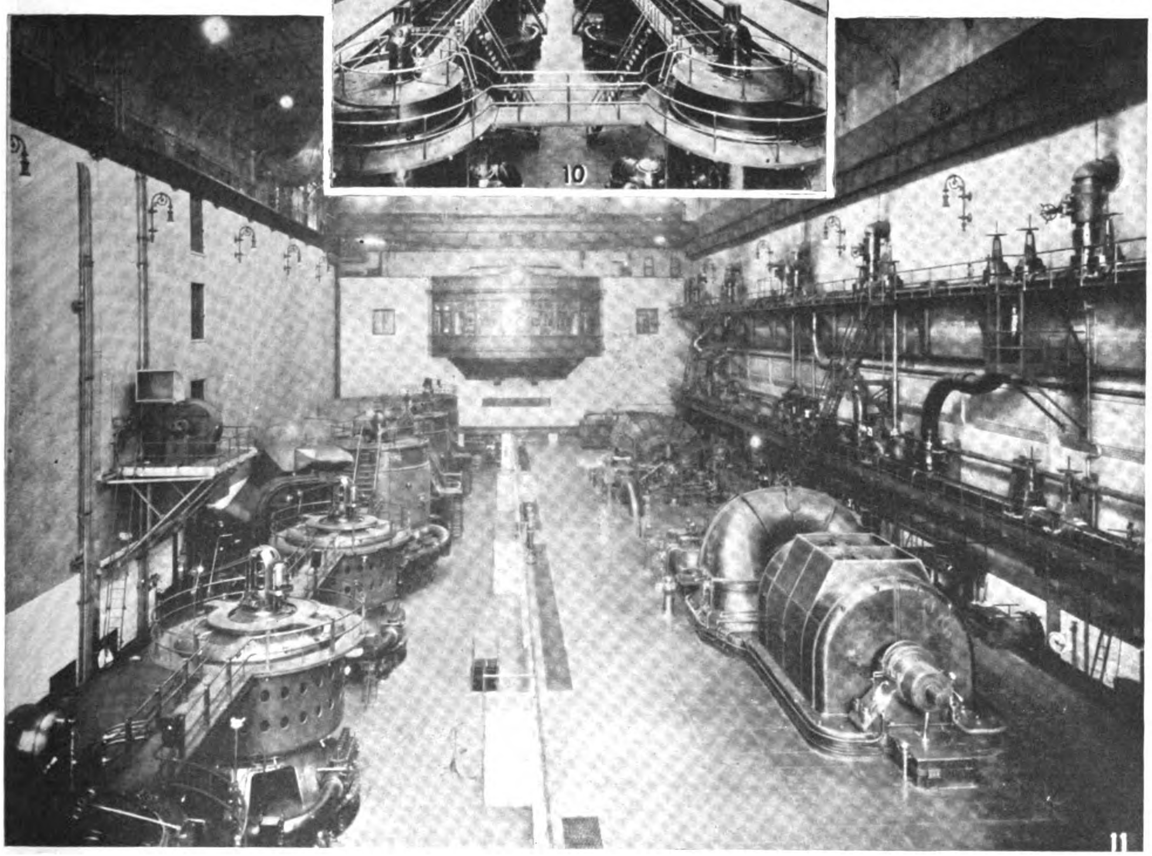

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tion in May, 1880, on board the steamship Columbia, belonging to the Oregon Railway & Navigation Company, which sailed from New York to Portland, Ore., fitted with three separately excited 100-volt constant-potential dynamos built at Edison's Menlo Park laboratory. Each dynamo was capable of supplying sixty 16-cp. lamps. In January, 1881, a dynamo of the old "Z" type had been placed in the establishment of Hinds, Ketcham & Company, lithographers and printers of labels and show cards, at 449 Water Street, New York. This was the first land plant, and the ease of distinguishing colors with the incandescent lamp was the reason for its adoption. In September of the same year a mill plant had been started in the woolen factory of James Harrison, Newburgh, N. Y. A month later the Blue Mountain House, in the Adirondacks, put in a plant of two "Z" generators to energize 332 lamps, including the first ever placed in an elevator car. In 1881, too, the residence of J. Hood Wright of New York City was lighted from a private plant—possibly the first dwelling to be thus illuminated, though that distinction has also been accorded to the residence of J. Pierpont Morgan. The Everett House in lower New York City adopted the new lighting system in February, 1882. About the same time James Gordon Bennett lighted his yacht, the Nanouma, by 120 lamps rated at 8 cp. each. The Fall River Line steamer Pilgrim had the largest of all the isolated plants, with 802 lamps in circuit.

Details of the Pearl Street Plant

All these plants, however, and all the other pioneer installations, reaching in September, 1882, a total of 123, supplied, as already stated, individual customers from individual plants. Distribution of energy from a central plant on a commercial basis actually began in Pearl Street, and it is a noteworthy fact that it began with underground conductors and on a plan which in its essentials is that of the vastly greater central stations of today. From fifty to two hundred and fifty men had been employed for many months by the Edison Electric Illuminating Company in laying the mains and installing the machinery. The district served extended from Nassau Street to the East River and from Wall Street on the south to Ferry and Spruce streets on the north—an area of about 2,000 ft. in each direction, or approximately one-sixth of a square mile. The distribution system, including feeders and mains, measured about 14 or 15 miles. The total number of buildings in the district which it was possible to reach by the company's wires was about 1,300, including banks, office buildings, newspaper offices and warehouses.

The Pearl Street station lighted 400 incandescent lamps before the first night's work was over, and by the end of September served fifty-nine customers, who had 1,284 lamps in circuit. At the end of the next month the station was serving ninety-four customers, wired for 2,323 lamps. By the end of the year it was serving 231 customers, wired for about 5,328 lamps. At the beginning of November, 1883, 508 customers in all were wired for 12,732 lamps, of which 10,664 were actually in circuit.

Dynamos and Conductors

The power house was a four-story brick building, divided into two parts by a fire wall. One part was used as a storehouse and repair shop. In the other part of the station were the six historic Edison "Jumbo" dynamos. These were the largest that had yet been made and weighed with their engines and base plates about 30 tons apiece. The engines were rated at 125 hp. each. Four boilers, with a total rating of 1,000 hp., were installed in the basement. Each of the six dynamos, direct-connected to an engine operating at 350 r.p.m., was capable of supplying energy to 1,200 16-cp. lamps at 110 volts, each lamp consuming 0.75 amp. The dynamos were numbered from 4 to 9, three earlier machines having been shipped to Europe, No. 1 to the Paris Exposition of 1881 and Nos. 2 and 3 to the Holborn Viaduct station in London to which allusion has already been made.

At first the underground system of conductors was a two-wire so-called "feeder and main" system. Workmen began to lay it in the fall of 1881, and, in spite of the lack of competent mechanics deplored by Mr. Edison, it was virtually completed in July, 1882. In this work 20-ft. Edison tubes were employed which contained two half-round conductors† of various sizes, depending on the load to be served. These tubes and inclosed conductors were completely assembled at the tube works prior to their installation by supporting the conductors at first with heavy cardboard and later by rope while hot asphaltum compound was forced into the interstices. After the tubes had been laid in the trenches which were dug for them, the conductors in abutting tubes were connected and inclosed by coupling boxes. Filling of these boxes with hot asphaltum compound completed the operation of installation. It is interesting to observe that substantially the same character of tubes and couplings are used today in new installations.

Lamps and Meters

The wiring of buildings and erection of the machinery proceeded simultaneously with the laying of the mains. The original "diagram of dynamo connections"—the first plan of electric power-station connections ever drawn—is still in existence and has a unique interest of its own, particularly to the writer, who prepared it. The lamps themselves, of which the commercial manufacture had been begun at Menlo Park in November, 1880, embodied the method described in the patent which had finally assured to Edison his deserved triumph as the discoverer of the long-sought method to "subdivide the electric light"—ridiculed as an *ignis fatuus* by many contemporary scientists. As every electrical student knows, the lamps consisted of "a carbon filament of high resistance in an all-glass globe, conductors sealed into the glass, all inclosed in an exhausted glass globe."

Electric metering was almost unheard of forty years ago. Edison, however, had invented a chemical meter to go with his incandescent lamp system. This consisted of an extremely accurate electrolytic cell containing a solution of zinc sulphate with zinc plates for electrodes or terminals. When a continuous current was passed through the solution metallic zinc was removed from one plate and deposited on the other, the change of weight of the plates affording a measure of the lamp-hour or ampere-hour consumption. A definite part of the current supplied to the consumer—less than one-thousandth—was diverted through the electrolytic cell, which was protected against variations in registration by a compensating resistance spool and against freezing by a lamp controlled by a thermostat. The original charging for light in the Pearl Street district was

†Later, with the introduction of the three-wire system, conductors of circular cross-section were employed.

1.2 cents per lamp-hour, and consumers were invited to check the accuracy of the charge based on the meter by multiplying the price by the total number of lamp-hours used.

A TEMPORARY HITCH

When the long-desired moment for operation at last arrived only one generator (No. 9, which was nearest the Pearl Street front) was cut into service, and, as already mentioned, it carried a load of only about 400 lamps. Everything went smoothly, and Mr. Edison and his assistants, who had been working for months without any regard for time or rest, snatching sleep in the plant as best they could, felt that complete success was at once to crown their self-denying labors. But not yet; for when after a little while a second generator was started and connected with the busbars in multiple with No. 9 the two machines began to "hunt," the engine governors first cutting off and then giving full steam admission and causing the machines to seesaw alternately between standstill and a terrific rate of speed. The second machine was at once disconnected from the line and stopped, and for some time the station was operated with only one.

Dashpots were applied to the governors with no practical success. Finally, Edison overcame the difficulty for the time being by means of a complicated system of pivoted rods, levers and shafting by which the governors of all the engines at any time in operation were mechanically connected together rigidly so that any tendency of a governor to race its engine was communicated to and absorbed by the governors of all the other engines. Subsequently the Porter-Allen engines with their sensitive governors that had been used in the station were removed and Armington & Sims engines with more powerful and less sensitive governors substituted; thus the necessity of tying the governors together disappeared.

SPLENDID QUALITIES OF "JUMBO" MACHINES

The excellence of the materials, design and workmanship in the machines was signally demonstrated by an endurance test lasting from March 10 to 27, 1883. One of the "Jumbos," driven by an Armington & Sims engine and in normal commercial operation, ran continuously day and night for these seventeen days and showed not the slightest wear or need for overhauling. Subsequently one of these engines was operated continuously for nearly a year without a moment's stoppage.

As the number of customers and the connected load of the system increased the district too was extended, and toward the end of 1883 there were 95,000 ft. of mains and feeders. Two additional "Jumbos" were installed in the basement next door to the original generators in the spring of 1884, and in that year the first electric motors on customers' premises were connected to the wires and power service was born.

For more than seven years the Pearl Street station continued in successful commercial operation. Then, on Jan. 2, 1890, fire broke out, and when it was extinguished all the dynamos save No. 9 were found to be ruined. The boilers, however, were intact, and service was resumed with belt-driven engines and generators. But, in the words of Charles L. Clarke, chief engineer of the Edison Electric Light Company from 1881 to 1884 and now a consulting engineer with the General Electric Company, "the glory of the old Pearl Street station, unique in bearing the impress of Mr. Edison's personality and, as it were, constructed with his own hands, disappeared in the flame and smoke of that Thursday morning fire." The station was dismantled and sold in 1895, and nothing remains of the old station to distinguish it from the neighboring warehouses but a bronze plaque on its front. (See reproduction on page 522.)

"Jumbo No. 9" still survives and has been shown at several electrical exhibitions. It is a relic of the puissant youth of the central-station industry well worth preserving till that distant day when its massive frame shall fall apart from sheer decay. It will be exhibited with many other memorabilia of great historical interest at the historical exhibit of the electrical industry and the museum of Edisonia to be shown at the electrical show to be held at Grand Central Palace, New York, early in October.

PRESENT AT THE BIRTH

Before leaving the topic of Pearl Street it is right that the names of the men present on the memorable afternoon that saw the birth of central-station service should be again recorded. Besides Mr. Edison those actually present at the start or who dropped in during the day included E. H. Johnson and Charles L. Clarke, engineers of the company; John Kruesi, F. R. Upton, S. Bergmann, Samuel Insull, Charles S. Bradley, Dr. Schuyler Skaats Wheeler, F. A. Scheffler, Calvin Goddard, W. H. Meadowcroft, Julius Hornig, engineer in local charge of station construction, and his assistant, H. M. Byllesby; W. A. Anderson of the Board of Fire Underwriters, Charles Dean of the company's Goerck Street machine shops, Joseph Wetzler, J. H. Vail, H. A. Campbell, W. S. Andrews, John Langton, "Jack" Hood and the writer, who claims the distinction of having been the first electrician of the plant. Many others, whose names cannot be recalled, were on the premises. Unfortunately Charles Batchellor, who was, as it were, Mr. Edison's right-hand bower, was in Europe at the time, as were William J. Hammer and Francis Jehl.

Some of these men rose to eminence in the central-station industry. Every one of them must have felt great pride in after years that he was present on so extraordinary an occasion, for then and there was demonstrated not only the practicability but also the commercial success of the Edison electric light system—that series of inventions all springing from one brain which included the dynamos and regulators, feeder and main system, underground distributing system, safety fuses, cut-outs, switches, sockets, meters and last, but not least, the crowning achievement—the incandescent lamp.

NEW YORK EDISON COMPANY PAYS TRIBUTE

"From the beginning," says the New York Edison Company in a commemorative announcement published in the New York newspapers of Sept. 4, paying tribute to Edison's genius and all-embracing foresight, "coal and ashes were handled by machinery, engines and dynamos were coupled together as a single unit, electrical and mechanical appliances of original conception were introduced to prevent variation in voltage and candlepower, safety fuses protected the entire system from generators to customers' lamps. Edison then introduced his system of feeders, upon which the stability and control of the system depends. Underground conductors were used, a method previously considered by the best scientific minds impossible of attainment. Further, the customer's service was measured by a scientifically accurate meter—another invention of greatest importance, and the only medium by which essential fairness could be assured to the public."

OTHER PIONEER INSTALLATIONS

The successful inauguration of central-station service in New York was followed by the establishment in rapid succession of Edison companies and plants in all parts of the country. A few of these deserve special mention as the first in which some new device or method was tried.

At Sunbury, Pa., the pioneer three-wire station went into operation on July 4, 1883, Edison starting up the two "L" 150-light dynamos that supplied the energy. Only 100 lamps were connected at the start. A larger three-wire plant was started at Brockton, Mass., on Oct. 1 of the same year under Edison's supervision. Here there were three "H" dynamos, the third being so adjusted that by means of a break-down switch it could supply both sides of the system during light loads. This station was able to supply about 1,600 lamps, though only about 200, rated at 10 cp., were at first connected. The Brockton installation was quickly followed by similar ones at Lawrence and Fall River, Mass., and Newburgh, N. Y.

At Roselle, N. J., an overhead plant showing the possibilities in illuminating small towns was started in the fall of 1882. A 330-volt dynamo and a two-wire multiple system with three lamps in series in each branch supplied stores, hotels and some residences and continued in operation for ten years. It was the only representative of its kind, a system designed to supply small towns and villages where the lighting is very sparse.

The first example of the lighting of large spaces by incandescent lamps was in connection with the Louisville exposition of 1883. A plant on the three-wire plan was started in August of that year with its full capacity of 5,000 16-cp. lamps. During the hundred days of the exposition there was never a failure of the lighting, and four medals were awarded to the Edison company —for the best incandescent light system, for the best dynamo, for the best electric lamp and for the best incandescent light. This successful illumination of a floor space of 14 acres, including an art gallery 800 ft. from the main building, gave a tremendous impulse to the growth of incandescent lighting.

A similar success was scored at Boston a month later when 1,500 lamps lighted the "foreign fair" of 1883, in addition to several hundred strung in a great Christmas tree.

SEVEN-LEAGUE STRIDES BEGIN

By 1885, it is estimated, there were in the country fifty or sixty Edison central-station systems distributing electrical energy twenty-four hours all the year around. Such systems were at this early date greatly outnumbered by the series-arc lighting companies, of which there were between three and four hundred. The three-wire system, reducing greatly the cost of distribution, caused the Edison plants to undergo a tremendous expansion, and about 1889 stations began to be built in great numbers throughout the world. Modern types of vertical marine engines, condensing and non-condensing, simple, compound, triple and quadruple expansion, were developed and were first installed in the New York, Chicago and Milwaukee stations. Rotary converters had their first practical application in Chicago, Brooklyn and New York.

The introduction of the alternating-current system of generation and its facile transmission and distribution to cover large areas from one source of power, the growth of the vast central-station systems in the cities just named and in Philadelphia, Boston, Baltimore, St. Louis, Detroit (which won early electrical fame by its spectacular method of general street illumination throughout the city by means of arc lamps mounted on high towers), Denver and a score of other large cities, the tremendous hydro-electric systems of the Pacific Coast, the harnessing of Niagara, the great power companies of the South and Middle West—all these are "other stories" to tell which adequately would require many special issues of the *Electrical World*, which, for that matter, has been faithfully recording their history year by year for a generation.

CONTRAST BETWEEN "NOW" AND "THEN"

For the purpose of this article the contrast between "now" and "then" may be pointed in a few short paragraphs, conveying a slight idea of the tremendous progress of the industry.

In the first days of operation in New York City 1,284 incandescent lamps were connected with the Pearl Street generators. In corresponding units the present installation of the New York Edison Company exceeds 21,500,000.

In 1882 the customer paid 1.2 cents for a 16-cp. lamp-hour. Now he obtains for the same price nearly 150 candle-power-hours. Today one pound of coal burned in the central station develops in the lamp twenty-five times as much illumination as in the days of "old Pearl Street."

In 1882 there was one electric light and power company in the United States, serving one-sixth square mile of territory. In 1922 there are nearly 5,700 operating companies, serving approximately 15,000 communities.

In 1882 central-station service was launched with fifty-nine customers. Today there are in the nation nearly ten and a half million consumers of electrical energy, of whom eight and a half million live in wired houses.

In 1882 the only commercial central station in the nation supplying a general underground house-to-house service had a total generating capacity of about 600 kw. In 1921 the total generating capacity of the central-station plants of the United States was 14,500,000 kw. and the output was 43,100,000,000 kw.-hr.

Nor is this to be regarded as the completed achievement, to be proudly looked back upon, of an industry that has attained its full stature in a nation ever ready to absorb more and more electrical energy. It is, on the contrary, merely the evanescent mark, to be superseded tomorrow, of an industry still pulsating with youth and vigor, continually translating into commercial service the never-ceasing developments of a still growing art, and appealing for billions of new capital that its benefits may become not merely widespread but universal and that every man, woman and child in this broad land may have a share in the enjoyment of the comforts and conveniences that electricity has conferred upon mankind.

Thus in the starting of the Pearl Street station by Mr. Edison, his associates and assistants we see the vigorous germ of the electric light and power companies as we know them, the solid foundation on which the great development of today has been built.

An Interview with

The Father of the Central-Station Industry

By L. W. W. Morrow
Associate Editor *Electrical World*

"TAKING everything into consideration, I found that the subdivision of the electric light must be done by the multiple system or not at all, so I worked on that plan only," said Mr. Edison. The statement typifies the man in that it shows the power of his analytical mind and the strength of his determination to secure results.

Sitting at his desk in his West Orange laboratory, Mr. Edison cheerfully gave the interviewer some recollections of the old days when the electrical art was in its infancy. His keen analysis of past and present conditions, combined with his sense of humor, his friendly welcome and his enjoyment of an idle hour, was convincing evidence that the master inventor was still actively engaged in doing things for the benefit of mankind.

In the opinion of Mr. Edison, the Pearl Street station marks the birth of commercial activity in electrical enterprises. It was built solely because Mr. Edison was convinced of the commercial feasibility of electric lighting and had the strength and courage to overcome all opposition.

The art of telephony gave him no experience by which to establish a light and power system, and the existing arc-lighting companies fought the introduction of the incandescent lamp by competitive commercial practices. The gas companies fought the plan in every possible way, and yet they gave Mr. Edison a good idea. "I found that one gas company used a feeder," he said, "and this gave me the idea of electrical feeders."

The engineers and scientists opposed the installation in every way and scoffed at its possibilities. As Mr. Edison put it, "They put themselves on record after I knew experimentally that I was right, therefore I encouraged them to go on record."

The scientists said Mr. Edison needed five megohms insulation resistance per mile, but "I was happy to get one ohm per mile. A little study of the energy used by a lamp, that used in line loss and that used in the engine and generator led me to conclude that the cost of coal would be very small and that the system was economically sound even if the insulation resistance was only a few ohms," said Mr. Edison.

He Estimated the Load

Mr. Edison knew the monthly gas bill of every customer south of Canal Street. He put "spotters" out who tabulated the number of gaslights burning on each customer's premises each hour of the twenty-four. He was able to predict from these studies the economic results of the Pearl Street installation.

"We had little money, and I picked the Pearl Street location because I thought the property could be purchased for about $10,000 a lot as it was in a slum district. I wanted a plot 50 ft. x 100 ft. and was stunned when they quoted $75,000 a lot. This led me to use direct-connected units which I wished to run at high speed. I wanted a great amount of generating equipment on a small plot because real estate was so expensive," said Mr. Edison.

In order to convince those interested that his system would work, and in order to secure experimental data, Mr. Edison said he reproduced his distribution system on a miniature basis by laying out a german-silver wiring diagram on the side of a wall and connecting the lamps. He measured the actual voltage drops on this experimental circuit in order to fix his feeder sizes.

"I had familiarized myself with the balance sheets of the gas companies, and knew I was up against stiff competition, so I used all available labor-saving devices for handling coal and ashes in the plant," said Mr. Edison. "The whole question was in my mind one of economy and reliability, for I knew the system would operate satisfactorily."

Those First Engines

Let Mr. Edison tell about his first engines: "When I started there were no high-speed engines on foundations except a few small ones invented by Charles H. Porter which operated at 300 r.p.m. All the larger stationary engines ran at from 80 r.p.m. to 125 r.p.m. I couldn't see why I couldn't build an engine to run at 300 r.p.m. on solid foundations when locomotives of 500 hp. were running successfully on such a poor foundation as a railroad track. But every engineer I approached gave reasons why it couldn't be done, with the exception of Mr. Porter, who agreed with me. I asked him to build a 175-hp. engine to operate at 700 r.p.m. This Porter refused to do unless I paid him in advance. I paid. The engine was built and brought to Menlo Park and placed on its foundations. The throttle valve was controlled by a long chain running outside through the window of the engine room. We started the engine, but at 300 r.p.m. it shook the building. For three weeks we kept at work balancing the parts and increasing the speed until at last it operated at 700 r.p.m., but still vibrated badly. Everybody said it would never be practicable. I then slowed it down to 300 r.p.m., and it ran so quietly one could hardly hear it or detect any vibration. I then told the boys that all I was after was 300 r.p.m. Several of this type were built and put into the Pearl Street station."

After the units were built they operated very well until the first attempt was made to parallel two machines. Mr. Edison laughed heartily over that exciting episode, because, as he said, "I never anticipated or expected such a performance." First one unit would increase its speed to about 700 r.p.m. and the other slow down; then conditions would be reversed with respect to the two units. The loud noise, the smoke and the molten copper thrown around the room created great excitement."

This experience showed that the Porter-Allen gravity governors would not hold, so Mr. Edison tried to improve operations by mechanically connecting the governors, using a solid iron rod more than 60 ft. long. This helped, but there was sufficient torsion in the rod to give bad operation. Mr. Edison then gave a capital example of his ingenuity when a practical difficulty arose. "I took the solid rod and placed it inside a gas pipe. I then twisted both in opposite directions until all the torsion was taken up and pinned the ends of the rod and gas pipe together. This device worked splendidly, although over 100 ft. long." Not long after this the Armington & Sims engine with its centrifugal governor replaced the older units.

"I investigated the available boilers," said Mr. Edison, "and decided to use the B. & W.; by the way, I tried to burn powdered coal under a boiler about this time, but only succeeded in burning fire brick walls because the combustion chamber was too small. Our coal at Pearl Street was anthracite, which, as I remember, cost about $5.50 per ton. We used 28 lb. to 32 lb. of water per horsepower in the old plant."

Why the Underground System

"I adopted the underground system of distribution," said Mr. Edison, "because I knew that the public never would approve of a wilderness of overhead wires and also because the electrical system, so similar to gas lighting, could only be made reliable through underground distribution.

"I used 120 volts, so that safety was not a factor in the problem. I was after reliability."

This consideration of reliability is the chief reason why the winter of 1881 saw Mr. Edison supervising the laying of the underground system. He snatched about two hours' sleep in the twenty-four, and this usually on top of a pile of gas pipes in some dark basement room. He was fought tooth and nail by the gas companies, and then to add to his worries the Commissioner of Public Works sent for him. "You are laying tubes down there and the city will have to furnish inspection," said the Commissioner. "Five men will report to you Monday, and you will pay each of them $5 a day."

Still more remarkable was the dry statement of Mr. Edison to the interviewer: "None of those inspectors ever appeared to inspect, but they all appeared, however, at the office each Saturday to get their pay." So, in spite of all the troubles and the presence of the existing pipes of the gas companies, the tubes were installed.

The educational side of the problem was also important. A demonstration was given to the Board of Fire Underwriters of all the ways in which a short circuit could be caused. Hundreds of restrictive rules and regulations had to be changed to conform to the new conditions, and these little troubles caused more worry to Mr. Edison than many of the larger technical problems.

"Copper cost was a big item in those days, and in studying how I could save copper and increase the area of distribution I figured out the three-wire system," said Mr. Edison. "But it seemed too good to be true, and I believed it only after I tried it out. It was an amusing experience we had in trying to explain the system to a group of scientists. They argued and attempted to prove by mathematics it was impossible in spite of the fact that we said it was working in New York. At last John Hopkinson said there was something in it, and the session ended by the scientists proving by mathematics that the system was sound."

Amusing Anecdotes

Some rather amusing episodes were mentioned by Mr. Edison in connection with the early days of lighting. The superintendent came into his office one day and said: "Mr. Edison, a saloonkeeper down on Nassau Street is trying to age eight barrels of whiskey by burning three lights day and night in the barrels where the whiskey is kept." "Very well," said Mr. Edison, "let him try anything that uses our lights." A month afterward the superintendent came rushing into Mr. Edison's office with the announcement: "That whiskey aging works, Mr. Edison. I tasted the liquor and all the shudder was out of it."

Upon another occasion a witty Irish customer had his first bill in July. This amounted to $10. The next month his bill was $20. This increase continued as the nights lengthened until his December bill was $52. The Irishman called in the superintendent and said: "Say, sixty dollars is my limit; if you go over it, take the whole outfit away from my house."

After the successful operation of the Pearl Street station the industry grew by leaps and bounds. The use of belt-driven units in many following installations was explained by Mr. Edison. He stated that lack of capital handicapped the small towns so that the cheapest installation was the low-speed engine with belt drive.

The Future Trend

In the generation, transmission and distribution of energy Mr. Edison thinks electricity will have no competitor. He believes transmission and interconnection will continue and advocates mouth-of-mine stations in coal districts at least to supply the peak loads. He believes such plants could burn low-grade fuel and help materially by feeding into power systems.

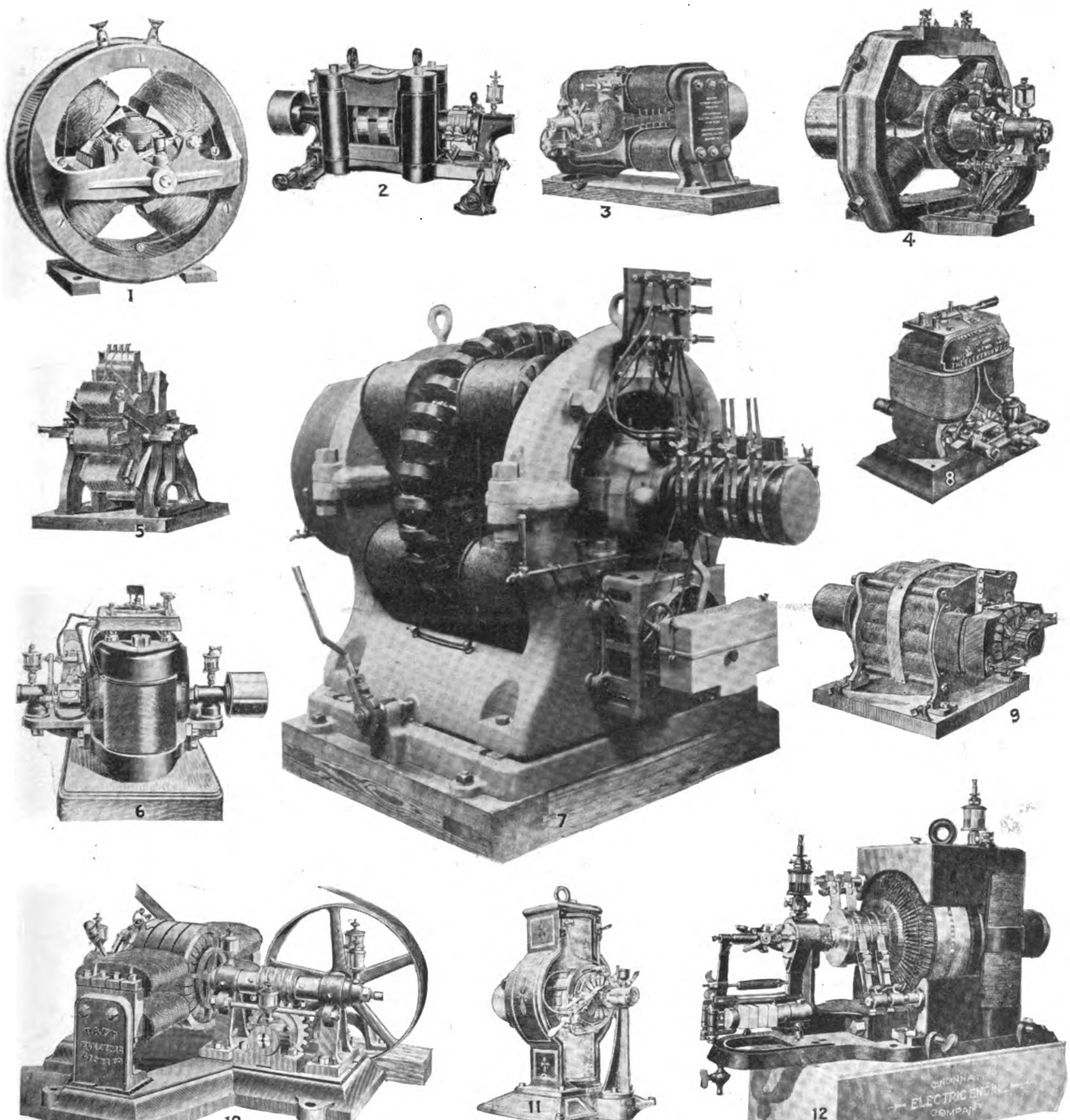
An original suggestion was made by Mr. Edison which he said would have to be worked out to see if there was any value in it. This was to pump back into reservoirs the water which escapes in most hydraulic developments during off-peak load periods. He stated that the storage battery is too expensive for the storage of electricity in large quantities, but that there might be some economy in off-peak water storage by using highly efficient pumps.

In the opinion of Mr. Edison, the future will see a development of electrical labor-saving devices on a par with the past. "There is no apparent limit to the development of labor-saving equipment through the use of electricity," he declared.

In the presence of the great inventor, surrounded by mementos of his past accomplishments and enthused with his spirit of optimism, one could not but feel that the electrical industry was still growing by leaps and bounds under the continued stimulus of a great personality.

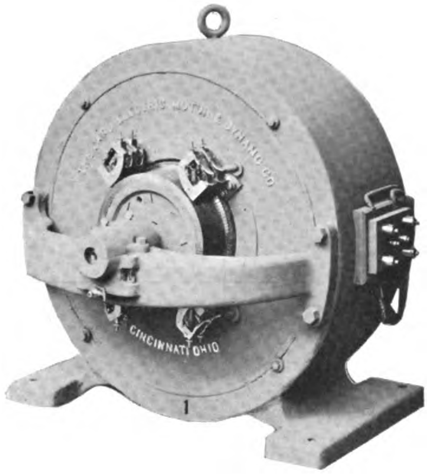
Pictorial Section of *Electrical World*
September 9, 1922

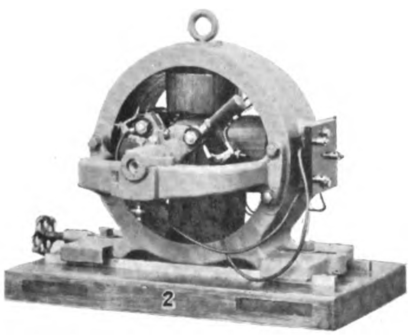
Evolution of Electric Power Equipment



Early Direct-Current Machines Differed Greatly

No. 1. Gérard type generator, 1884.
No. 2. High speed Detroit motor, 1889.
No. 3. Weston generator, 1884.
No. 4. Standard generator, 1889.
No. 5. Klimenko arc generator, 1884.
No. 6. Kester motor with open coil armature, 1889.
No. 7. Brush four circuit arc generator, 1889.
No. 8. Perret motor, 1889.
No. 9. Oppenheim generator, 1884.
No. 10. Daft elevator motor operated in New York in January, 1884.
No. 11. Excelsior generator operated both arcs and incandescents in 1884.
No. 12. Cincinnati motor operated on an arc circuit, 1889.





Odd Units Excite Interest as Types

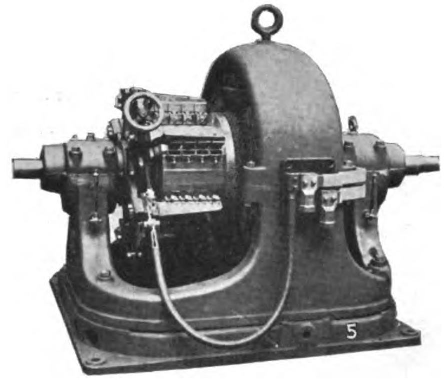
No. 1. A motor of 1895; No. 2, one of 1896; No. 3, motor of 1897, and No. 4, motor of 1922. These show the diversity in design changes for one company only.

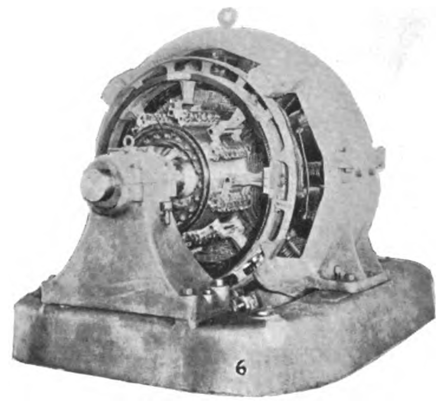
No. 5. A generator of 1900 type compares favorably with the one shown in No. 6, which is of modern interpole design.

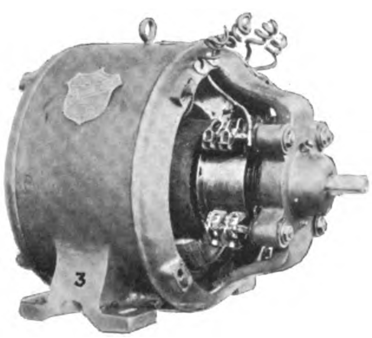
No. 7. An old motor of 1893.

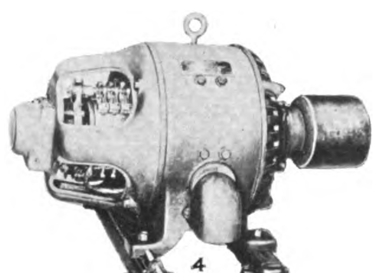
No. 8. Two 110-volt d.c. generators of original design.

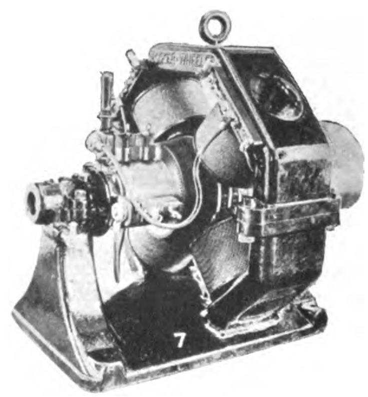
No. 9. An early type of motor generator set with a single-phase commutator motor with centrifugal forces utilized to remove the brushes when speed is attained.

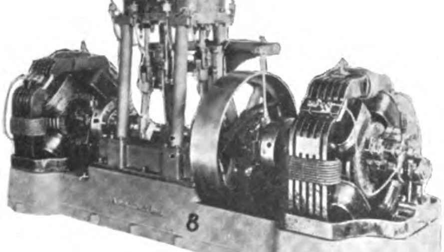


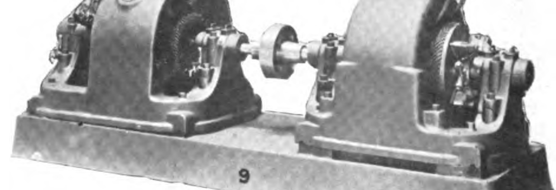




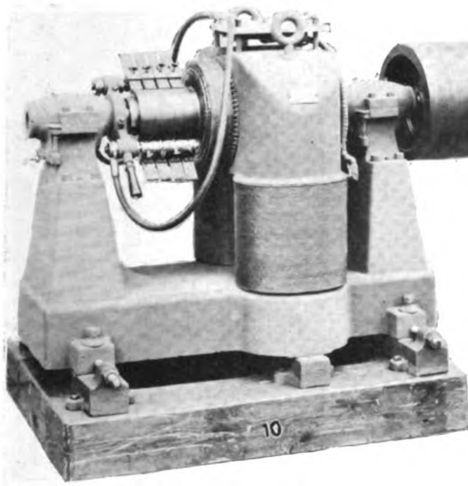








Changes in Design Improve the Appearance



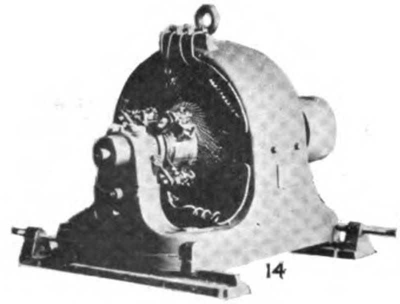
Nos. 10, 11 and 12. An evolution in design —No. 10, 1891; No. 11, 1901, and No. 12, 1922. All were built by the same company.

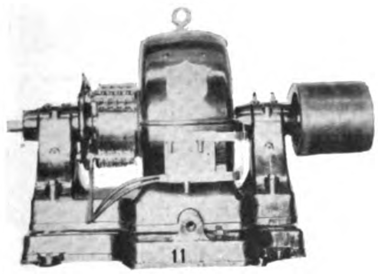
No. 13. An engine type generator of 1913.

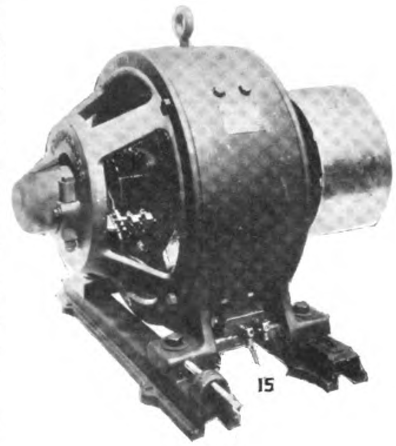
Nos. 14, 15 and 16. Another company shows the evolution in its motor design. No. 14, 1893 to 1901; No. 15, 1902 to 1911, and No. 16, 1911 to 1922.

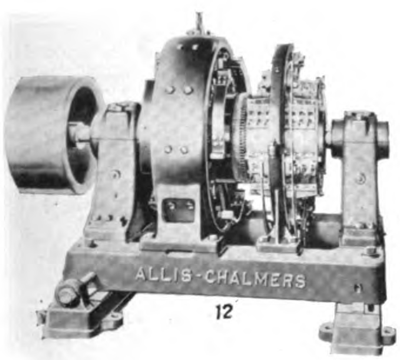
No. 17. A 20-kw. generator of 1904 for use with a turbine.

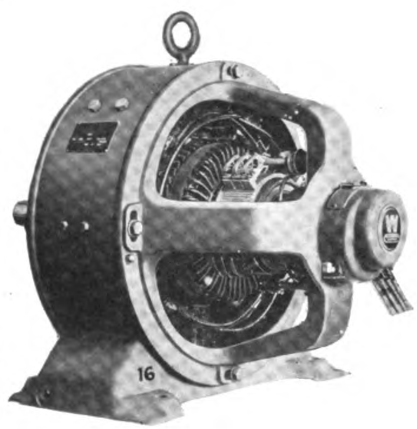
No. 18. A 1915 generator for direct connection to a turbine.

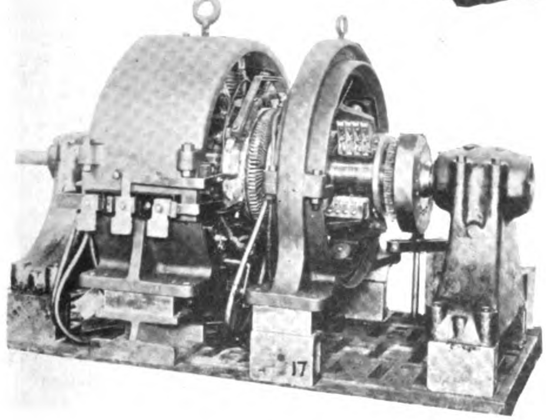


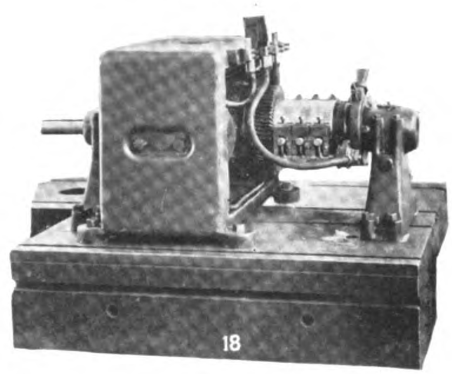


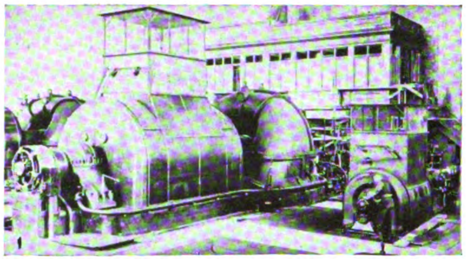


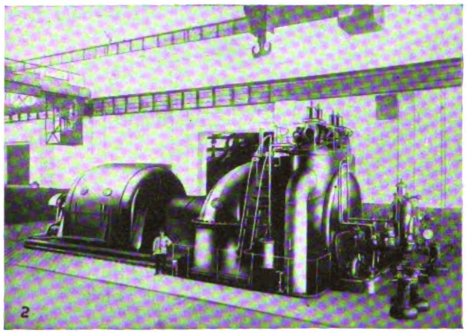












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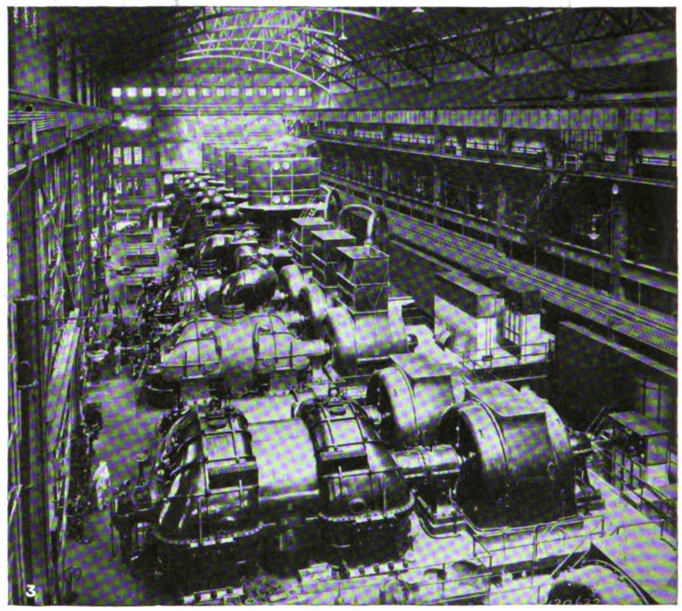

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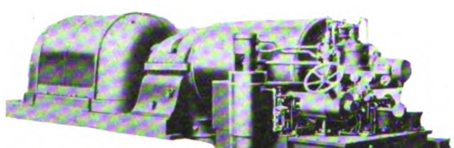
Steam Turbo-Generators Monopolize the Central-Station Field



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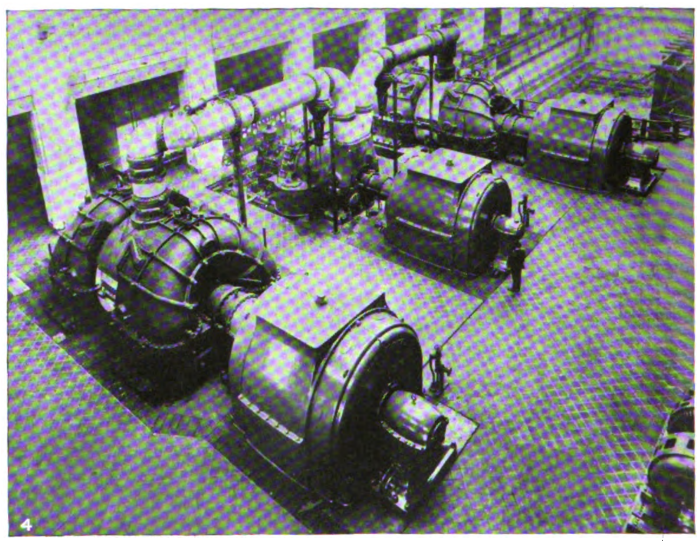

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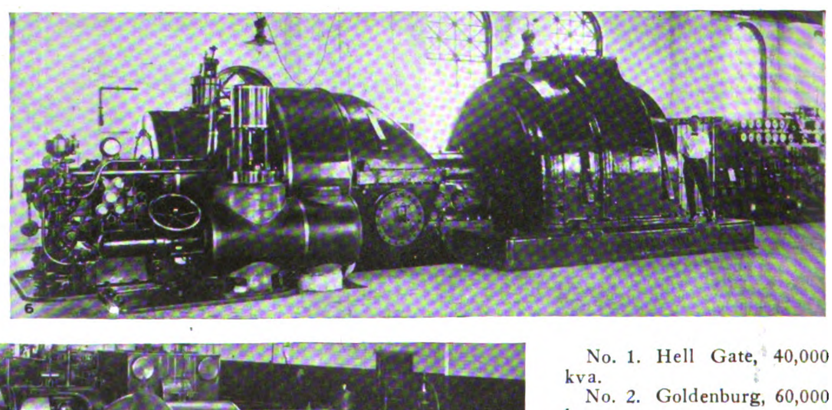

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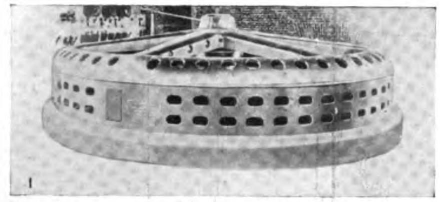
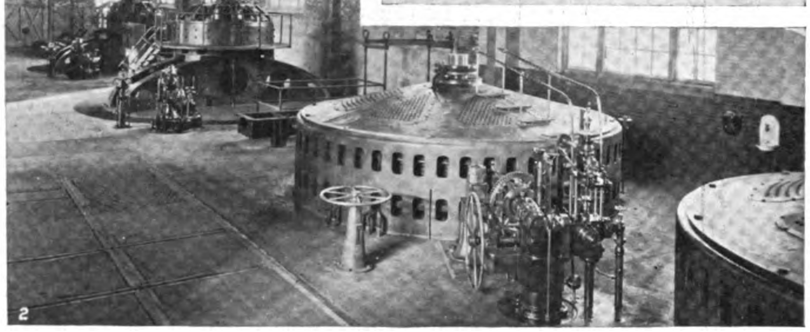
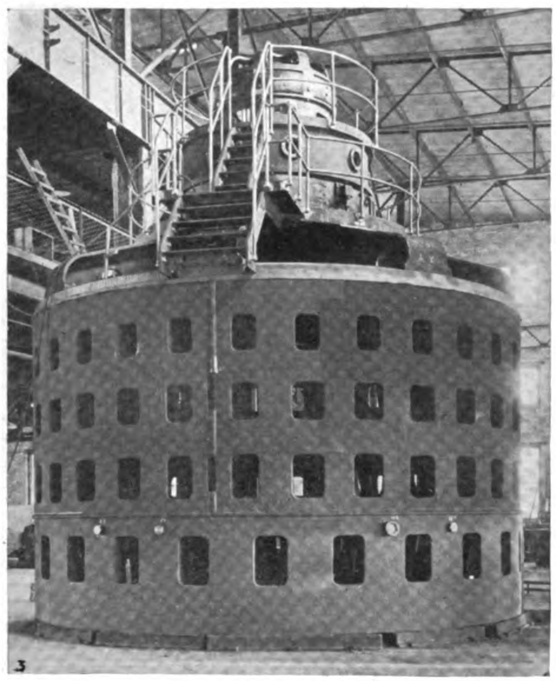
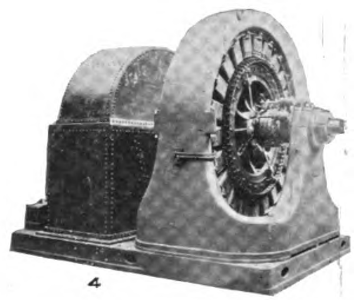
No. 1. Hell Gate, 40,000 kva.
No. 2. Goldenburg, 60,000 kva.
No. 3. Interborough, 60,000 kva.
No. 4. Colfax, 60,000 kva.
No. 5. A design of 1907; No. 6 of 1913, and No. 7 of 1922, all by the same company.

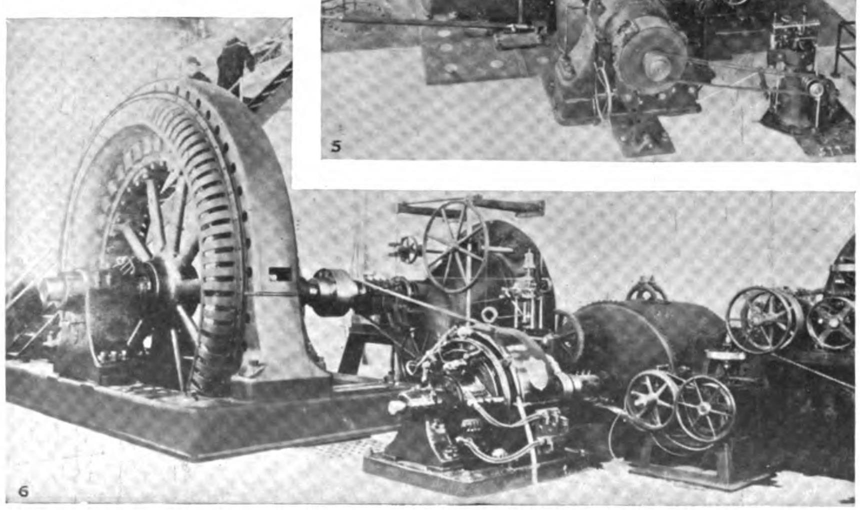
Waterwheel Units Develop Rapidly After the Installation at Niagara Falls in 1895











No. 1. A vertical type generator of 1905.

No. 2. A modern installation of vertical units in New England.

No. 3. One of the largest vertical units, 1921, at Niagara Falls.

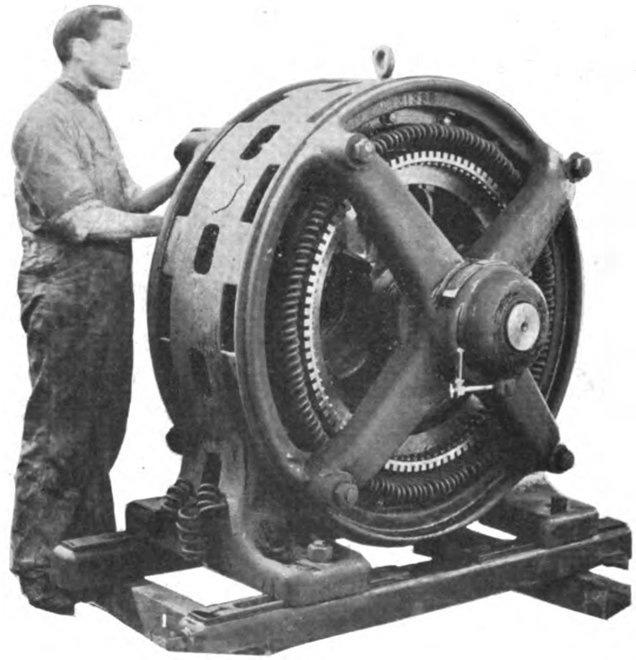
No. 4. A direct-connected unit of 1895.

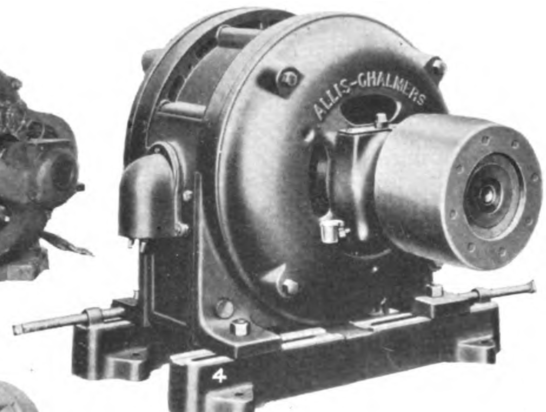
No. 5. A modern installation of horizontal units on Puget Sound.

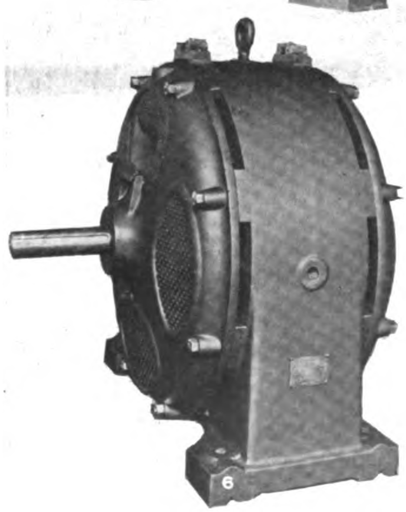
No. 6. A 1903 installation gives an appearance of complexity and crude arrangements for control.

Induction Motors Popularized Alternating-Current Systems for Power Purposes

THE commercial use of the induction motor was due largely to the American engineers. It added a simple and convenient motor to the many transmission and generation advantages of the alternating-current system and has made it possible for central stations to secure isolated plant loads located at great distances from the stations. The low cost of the motor and its operating advantages please the users.







No. 1. A squirrel cage type of 1895.

No. 2. A slip ring type of 1906.

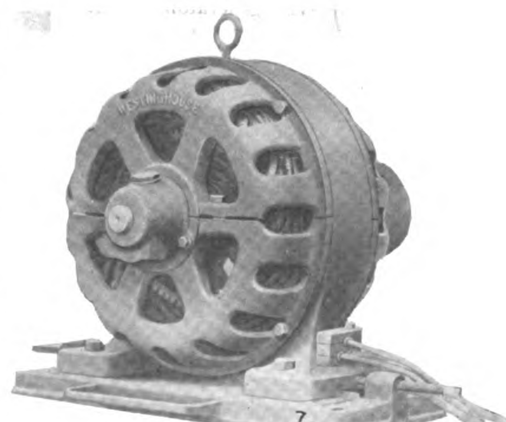
No. 3. A modern slip ring type.

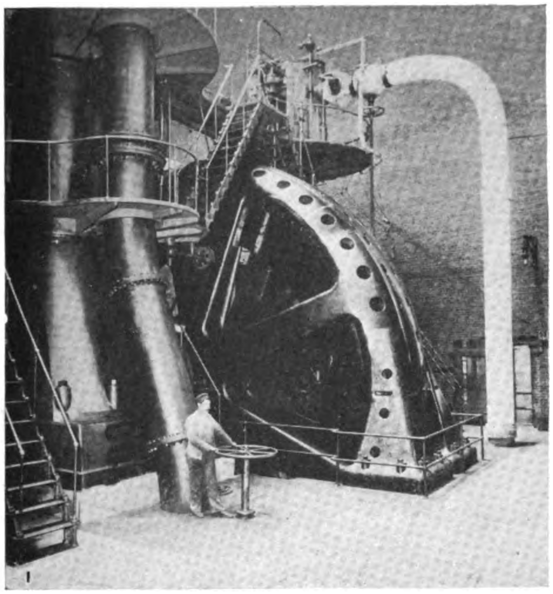
No. 4. A modern squirrel cage type.

No. 5. Early Tesla motors and parts

No. 6. Type of motor that was used from 1896-1907.

No. 7. Type of motor dating 1907-1912.

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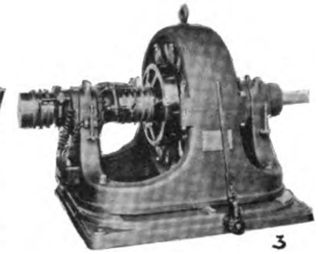
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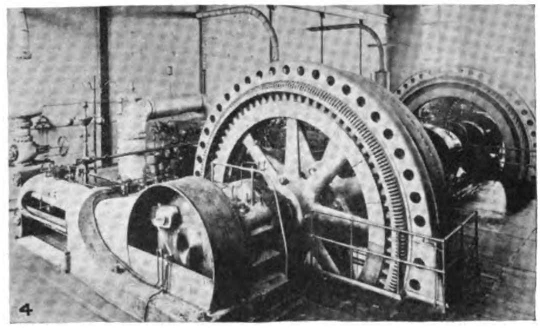
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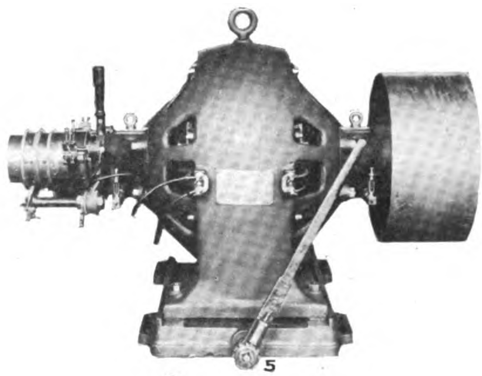
Early Alternators Used Magnets for Excitation

The heavy flywheel type of alternator is shown as of 1895 in No. 1, and as of 1908 in No. 4. Small belted alternators of a type used in 1890-1895 are shown in Nos. 3 and 5. The bracket and pedestal types of bearings had their respective advocates and great differences occurred in the treatment of the terminals.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No. 6 shows one of the earliest Alliance types which used permanent magnets for excitation and was used to supply lighthouses. No. 7 is a more modern belt-driven machine. No. 8 is a self-excited alternator of 1889.

No. 9 is a Gérard machine of 1884 and No. 10 a De Meritens alternator of a magnet type of 1884.


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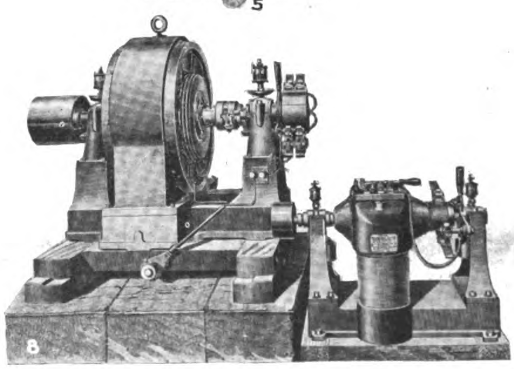
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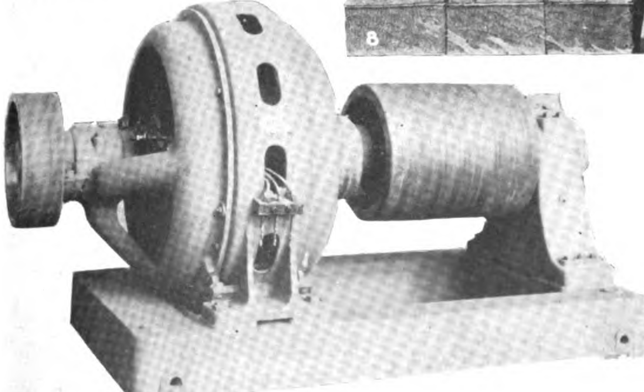
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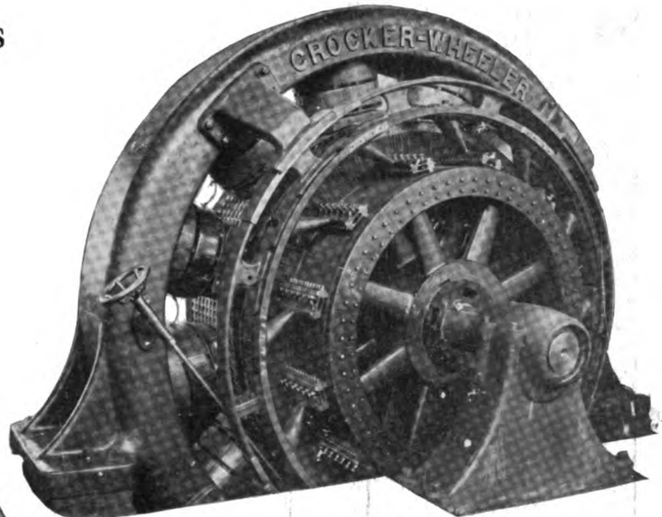
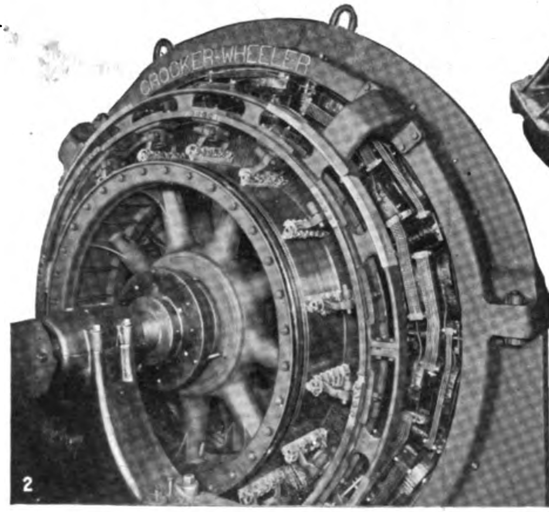
Engine Type Generators Contrasted Show the Greatest Changes Occur in Materials

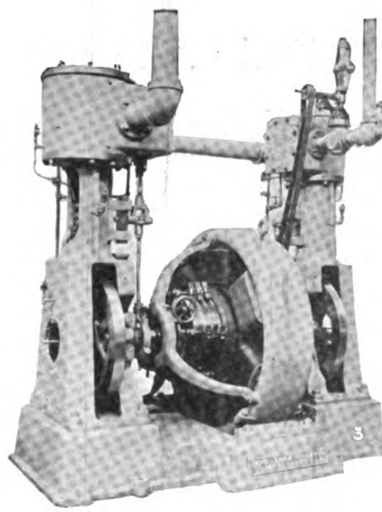


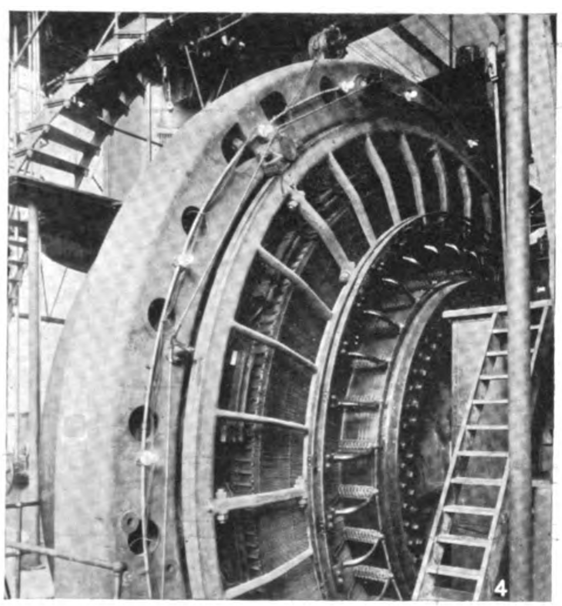


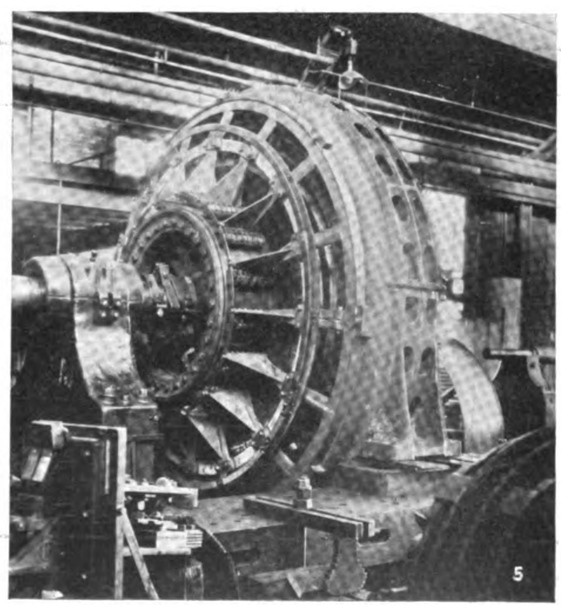
A comparison of Nos. 1 and 2 shows the change in design of one company between 1899 and 1920. The interpole apparently adds to the complexity.

Another comparison is indicated in the lower figures where No. 3 dates back to 1895, No. 4 to 1907 and No. 5 to 1921.

The use of cast-steel, the interpole, and better systems of ventilation enabled designers to reduce the bulk of materials required per unit of capacity.







The Term "Subdivision of the Electric Light"

By Elihu Thomson

WERE it not that there seems to have arisen a misconception of what was meant in the early days of our art by the term "subdivision of the electric light," there would have been no occasion for writing what follows.

It is not far from fifty years ago that "the electric light" when spoken of or written about meant the electric arc light, the luminous source, constituted, as now, of a current passing the gap between separated electrodes, generally of carbon. It was the manner in which electrical energy from the dynamo then best known, the historic Gramme, was made to yield light of high efficiency, the superior in brilliancy, color and even in economy (per candle) of all other sources of illumination except the sun. It was the electric light, but unfortunately it was inherently a large-unit source, and it was known that the economy of light production for the power increased as the energy in the arc increased more than in direct proportion. The desirability of cutting up such an admirable source, the *electric light*, the only one known, gave rise to the discussion among interested persons, even scientific men, of the possibility of subdivision. Hence the term "subdivision of the electric (arc) light" was two or three years before Edison brought out his incandescent lamp.

Now the fact is that the problem, such as it was—the cutting up of an admirable source into bits of that source or into smaller units retaining the economy and characteristics of that source—has not in the fifty years of discussion really been solved, and under its terms never will be solved, as its solution would violate physical principles. In spite of all that has been said and written about the problem, there has been no solution of the "subdivision of the electric light" without shifting the original meaning to something different, the shift consisting in substituting for division of the *light* division of the delivery of the *energy* into small bits to work an entirely different light source, the later incandescent not included or regarded as the electric light to be subdivided.

Edison Invents Incandescent

In the midst of the discussion in 1878 Edison began work on the platino-iridium wire incandescent as a small unit whose efficiency of light production per horsepower expended was confessedly only a fraction of that of the electric light, the arc. It was the announcement of this platinum-wire lamp which caused that phenomenal drop in London gas shares, well remembered as a sort of tragio-comic effect; for, indeed, those who did not know thought the problem had been solved. Two years of further work on such lamps without much avail was succeeded by the production in the fall of 1879 of the first high-resistance carbon-filament vacuum lamps, exhibited at the Menlo Park Laboratory in December, 1879, about six to eight lights of gas-jet (not Welsbach) power requiring an expenditure of a horsepower. There was no "subdivision of the electric light" here. On the contrary, to Edison's credit, it may be said that he did not ruminate on the question of subdivision of a something already existing, but set about to secure a small source, boldly accepting and wisely accepting the low economy as a sort of tax to be paid for the smaller units distributed, thus creating a new system of lighting, distribution, etc., which, with the improved lamps evolved in later years and culminating in the drawn-wire tungsten and the gas-filled half-watt units, bids fair to make electric incandescent lighting, except for special units and purposes, well-nigh universal. In connection with such a development there is no appropriateness in the use of the term "subdivision of the electric light," which historically and actually has a meaning altogether different from the production of a small light unit entirely different from the electric light in question, which was the arc light) and the subdivision of the energy to feed such units.

Given the small unit, the incandescent lamp and the subdivision of the energy, a new problem was solved. The two came together, it is true, but they have no necessary connection, as is witnessed by the working of single incandescent lamps by dry batteries or other sources of electricity.

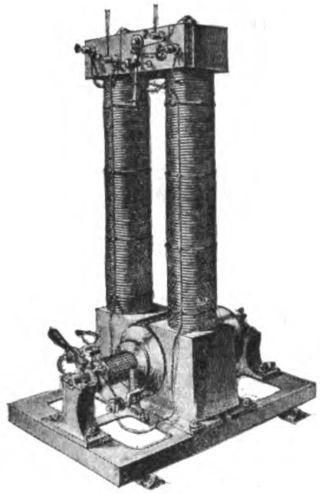
The arc light was originally run as a single light from a single dynamo. The running of a series of arcs from one dynamo was no more a "subdivision of the electric light" than the running of one or more incandescent lamps in parallel was a "subdivision of the electric light" in the sense of the original and later historic use of the term.

How Confusion Arose

It is certainly true that in the early discussions much confusion arose, and errors of judgment were made even by some of the scientific men concerning the general subject. They did not always apparently bear in mind just what the term "subdivision of the electric light" meant, and they were drawn into discussions of irrelevant matters which for a time passed under the same heading. I think that those men who had a practical working knowledge of the conditions—and there were such men—were less likely to get tangled up in discussions of this character, and their absence from the discussions indicates that they were not ready to commit themselves or to be drawn aside from the real original meaning of the term "subdivision" in this connection. However, no matter whether the reasoning used was correct or incorrect, the conclusion was that the division of the application of electrical energy to work a number of small lights instead of one large arc light could only be done by a heavy sacrifice of efficiency.

There is another aspect of the matter which should not be neglected. In those early days electricity developed from power was regarded as considerable of a luxury, not to be wasted. The engines themselves were not highly economical, and the dynamos also were low, relatively, in efficiency. The plant, compared with a modern plant of the same output, was simply gigantic, involving an immense capital expenditure. The machinery too was costly. Thus it was natural that there would, as it were, be focused on any electric proposition a certain regard for the economical use of power and the economical use of the capital invested. Even to consider that the output to be obtained was only, say, eight to ten 16-cp. lamps per horsepower expended in driving a dynamo was, in itself, a staggering circumstance; and if there be added to this the cost of the lamps themselves and the cost of the copper required for the mains and the short life, one can but admire the courage which led to the establishment of the early station distributions of incandescent lighting.

Construction Methods and Equipment of 1882 Are Still Followed in Principle



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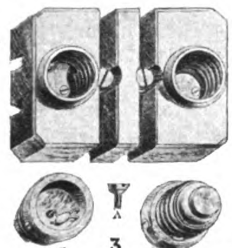
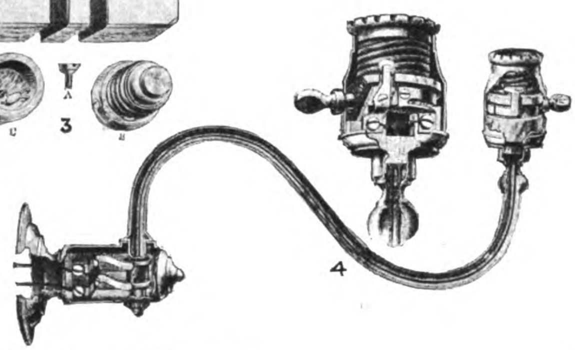




No. 1. The early Edison generators were made in five sizes for supplying 15, 60, 150, 250 and 1,200 16-cp. lights. The illustration shows a sixty-light machine built in 1884.

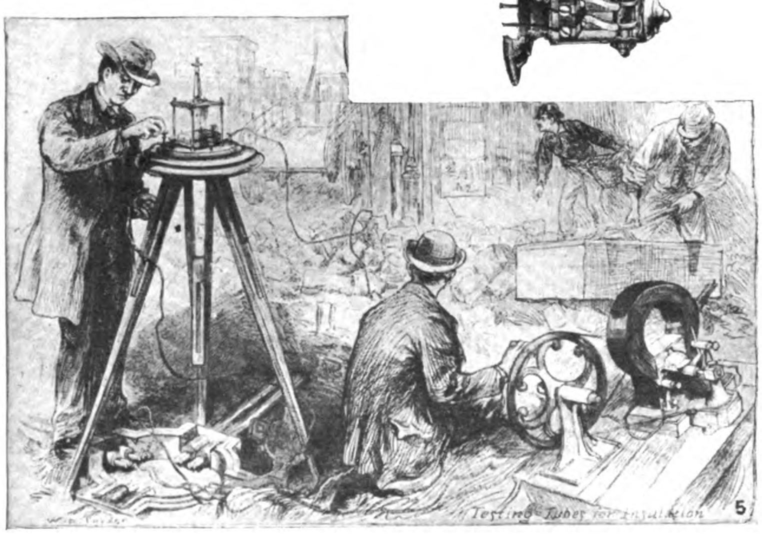
No. 2. The laying of tubes in 1881 was a delicate operation which required the active aid of Mr. Edison.

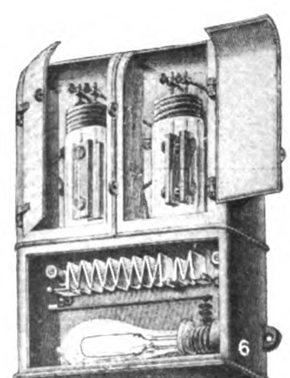
No. 3. An Edison safety cut-out of 1884. The first fuse plug was placed in the hardwood cut-out.

No. 4. A hinged bracket fixture invented by Edison in 1884.

No. 5. Magneto testing of tubes for insulation breakdown in 1884.

No. 6. The Edison electrolytic meter had its plates weighed once a month in order to measure the energy used by the customer.





Early Days with Edison

By Arthur Williams
New York Edison Company

YOU have asked for a brief personal contribution to the event we are now celebrating—the completion of forty years of Edison service in New York City. My connection with the Edison work there began in August, 1884, when as an office boy I entered the office of Rennie & Smith. These gentlemen composed a firm of electrical contractors occupying an office in the front of the first floor of the old Pearl Street station. Arthur H. Rennie, now a minister doing fine work in his parish on Long Island, was a brother-in-law of Charles E. Chinnock, the superintendent of the New York Edison Company and its first dividend record maker, while Harry J. Smith afterward became general operating superintendent of the company, a position he held when he met his death by a fall from the rafters of his barn in New Jersey. In February, 1885, Mr. Chinnock's offer to me of a position as assistant in the meter department of the company brought me into it less than two years after the station was opened, at a time when it was full of relics and traditions of Edison's own work—a legacy which has since served as our guide.

One of these traditions was the disregard of time in its relation to work—either day or night—because that was the way Edison worked. The historic bedroom provided for Mr. Edison's convenience is not a myth. However, any story that he frequently used it would be a myth. According to common report, he more often slept on a pile of Edison tubes on the first floor of the building than in his bedroom on the third floor. As for us, in one instance when the connecting feeder at Wall and Broad Streets which supplied the Morgan offices and the Stock Exchange burned out we worked sixty consecutive hours to repair it. The movement of the hands of the clock or the position of the sun, whether above or below the horizon, meant nothing to an Edison man worthy to be called by that name.

As early as 1885 the impression of greatness made by Edison upon all who came in contact with him is proved by the pleasure with which customers recalled that they had seen, met or shaken hands with him. For example, a customer would point to a chair in which the great Edison had sat discussing matters with him, thus betraying something of the feeling that one finds today in Europe, where in one of the larger cities a window may be seen upon which has been inscribed: "The great American, Thomas A. Edison, once looked through this window." Indeed, there is ample testimony to the fact that the fine quality, the genial temperament and the devotion to the work in hand, regardless of consequences to himself, characteristic of the Edison of today were easily discernible then.

How Edison's Personality Helped Others

Another impression left on my memory is the extent to which Edison's personality inspired self-development in others. He possessed the power, whether conscious or subconscious, of selecting potentially big men, and it is significant that the men then chosen by him became the master minds, in the best sense of the word, of our great industry. Many of the men who began their careers with him then have retained their mental and physical powers and still seem young men after forty years of continuous and strenuous effort.

Were I asked what has impressed me most during my years of acquaintance with Mr. Edison, I think I should say his almost indescribable warmth of personality. I have besides been greatly impressed by his concentration upon and ability to analyze essentials, his apparent forgetfulness of self and his complete absorption in the matter in hand. Things that seem of great importance or very troublesome to others he passes over with a wave of the hand, an expression of the face or a casual word which places the matter in its proper relation. I have heard men eminent in different ways mention interviews with Edison during which he displayed an astonishing grasp of the fundamentals of subjects in which they had specialized. I have never heard of a case where a technical problem presented to him had not already been given consideration, and from every angle.

Choate and Edison Meet

It was my privilege to bring Mr. Edison and Joseph H. Choate together. One morning Mr. Choate called with a large check for a fund for the blind upon which we had been working together. While the great lawyer was in my office one of our photographers looked in, and I asked Mr. Choate, then sitting beside a bronze bust of Mr. Edison, if he would allow us to take his photograph in that position. He willingly assented, and the picture was so successful that I sent a copy to Mr. Edison, who, in his acknowledgment, replied he had always wanted to meet Mr. Choate and asked if a meeting could be arranged. I sent the letter to Mr. Choate, who immediately responded that he would go anywhere at any time to meet Mr. Edison.

At the invitation of Mrs. Edison, both Mr. and Mrs. Choate went to the Edison works at Llewellyn Park. Later in the day their son joined the party. When we were ushered into the library Mr. Edison was seated at his desk in a distant corner, talking with some of his people. I had given some thought to the manner of introduction of these two great Americans, but an introduction proved unnecessary. The moment Mr. Edison was informed of Mr. Choate's arrival he dropped everything, rushed across the floor and without formality grasped Mr. Choate by the hand, telling him that he had always wanted to meet him but had never had an opportunity. It was a greeting of deep appreciation and warm hospitality, to which Mr. Choate responded, with his magnetic smile and a hand on Mr. Edison's shoulder: "I never turn out at night the light at the head of my bed without blessing the name of Edison." After a wonderful day, Mrs. Edison entertaining the party at luncheon, not only did Mr. Edison speak of the great pleasure which the visit had given him, but later, before we reached the city Mr. Choate declared that it had been the red-letter day of his life and that he felt, after meeting "the great Edison," as if he had looked in upon another and a greater world.

One of Edison's first inventions, long before the beginning of Marconi's work, was in the field of wireless telegraphy; yet one can never forget his message to Marconi on the night of the dinner which commemorated the first message across the ocean without wires. No suggestion of his own previous work in that field was contained in the message. It was simply a word of compliment and congratulation to "the young man who had the audacity to first span the Atlantic Ocean without the aid of wires"—if, after all these years, my memory is correct.

Development of Arc Lighting

Although Not the Originator, America Made Many Valuable Contributions—Improved Electrode Feed and Current Regulation, Inclosure of Arc and Production of Luminous Arc Constituted Important Developments

By Elihu Thomson

WHEN, at almost the beginning of the last century, Sir Humphry Davy, in London, used charcoal electrodes with his many-hundred-cell battery and drew the first carbon arc, he had no conception of the great future of this arc in lighting. It was to him a scientific discovery in the form of a "glorious experiment" having no relation to practical illumination. Up to the time of the invention of suitable dynamos for generating electricity from power the electric arc was seldom seen. It remained much of a curiosity, notwithstanding that arc lamps in simple form were invented even for use, at large expense and great inconvenience, with batteries furnishing the current. Besides this, the magneto machines of Holmes and the Alliance machines, which were, in fact, alternating dynamos, were in some isolated cases applied to run single arcs in lighthouses. Indeed, a single carbon arc from a single dynamo was the rule, even when dynamos began to be developed, some years before the Centennial Exhibition was held at Philadelphia in 1876, and at that exhibition there were only two exhibits of arc lights, namely, of the Gramme and the Wallace-Farmer types, consisting of single large arcs each run from the current of a single dynamo separately.

Arc lighting on a more extensive scale, especially in streets, may be said to have begun with the use of the "Jablochkoff candle" in 1878 in Paris, the Avenue de l'Opéra being so lighted, but the "Jablochkoff candle," owing to its expense and complexity, was a form of arc lighting which was very short-lived and soon disappeared. It should be mentioned, however, that in the same year, which was that of the Paris Exposition, there was in operation at the Gare St. Lazare in Paris a circuit of six or eight lamps in series, run from a dynamo.

Charles F. Brush in those early years was building single arc lights and single dynamos to run them, and not until 1879 was the Brush system so developed as to involve the running of a number of arc lamps in series. But from that time the arc lamp began to be a commercial factor in lighting, especially for streets and large spaces.

First Series Arc Machine

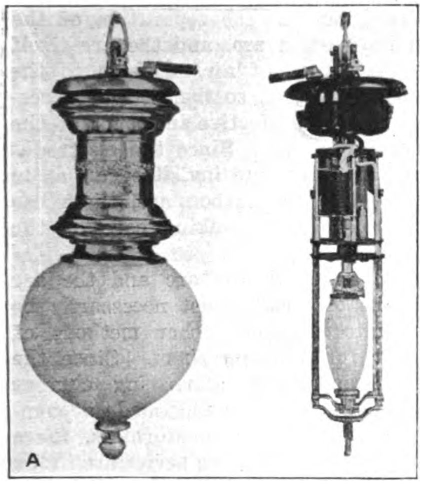
Early in the same year the first Thomson-Houston arc dynamo was built in Philadelphia. It was a machine which ran its lights in series, one which would carry a maximum of nine arc lights. It is interesting to mention that in this case there was no forerunner in the shape of a single arc from a single dynamo. The system sprang into existence with series connections of the arcs, and the first machine had a capacity of nine arcs with about 10 amp. of current flowing. It was on the subsequent development of this type of apparatus that the Thomson-Houston Electric Company was built up, and it afterward acquired the Brush Electric Company of Cleveland.

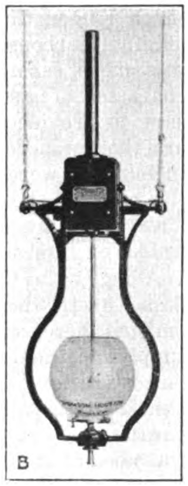
In the early days the applications of the carbon arc to lighting the lamps, which were often called "regulators," because they regulated the supply of carbon as fast as it was consumed and tended also to regulate the current in the circuit, were frequently based upon the clockwork principle of feeding the carbons by means of a set of clock wheelwork, such as racks, pinions and escapements. It is significant that the arc lamps which reached the greatest extension of application entirely discarded clockwork, the separation and feed of the electrodes being by means of clutches. In the case of the Brush arc lamp the famous ring clutch was supplemented in its action by a glycerine dashpot inside the upper holder, making it essential that the lamp should never be turned on its side or upside down. The clutch was controlled by the differential magnet, which was a double solenoid wound with series and shunt windings opposed to each other.

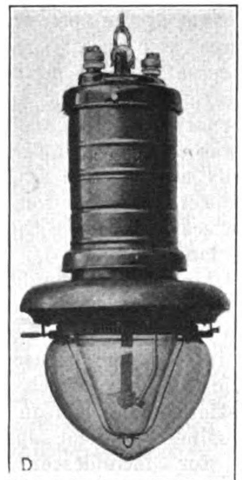
The original Thomson-Houston arc lamps made by the American Electric Company in New Britain, Conn., were also clutch lamps, the clutch being of a special type, and the control was by a differential system, in which the series magnet pulled oppositely to the shunt magnet, its smoothness of operation being insured not by a long glycerine dashpot, but by a simple mechanical slow-feed device which gave the lamp a great advantage in its installation and operation. This was known as the type D lamp, but on the removal of the works to Lynn it was replaced by another type of lamp, called the M & K, in which the carbons were separate at the start and were brought together and then separated to form the arc, the regulation of the length of the arc depending on a shunt magnet around it. The slow-feed device was retained, however, as well as the clutch.

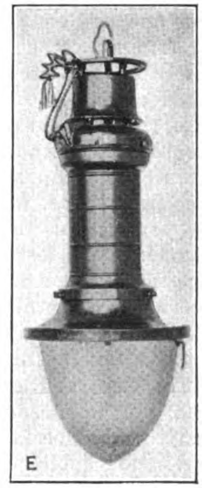
All of these lamps had, of course, open carbon arcs with the carbons exposed to the atmosphere, and the consumption of the electrodes was comparatively rapid. There was considerable advantage found in the use of the shunt-controlled feed of the carbons in the M & K Thomson-Houston lamps as compared with the former differential types, of which the Brush lamp was a good example. The advantage consisted in the fact that the separation of the carbons was, in a sense, independent of the current on the line, so that a leaky line would not spoil the effect of the lights by causing the carbons to approach too closely together during burning.

The problem of regulation of current to a standard or constant value was accomplished in the Thomson-Houston system by the provision of an effective regulator on the dynamo. This regulator not only kept the current in the lights at a constant value during the









THE COMMERCIAL DEVELOPMENT OF THE SERIES ARC WAS MARKED FIRST BY RAPIDLY CHANGING EXPERIMENTAL TYPES AND LATER BY ATTEMPTS TO SECURE ORNAMENTATION

operation, but also allowed any number of the lights on the circuit to be extinguished without affecting the current traversing the remaining lights, so that any lights which were burning (if only a fraction of the capacity of the dynamo) were maintained at the same standard brilliancy or were operated under standard conditions. This regulating system was a very valuable adjunct and undoubtedly gave the Thomson-Houston system its great prominence in its early arc operations.

There were other unique features which contributed in a measure to the same result of enabling the series arc system to meet the conditions for great expansion. This expansion began to take place in the early eighties, when cities and towns, municipalities everywhere, as well as some of the largest stores, railway stations and other buildings, adopted the open carbon arc as a means of illumination. The pioneer work of the time had, in fact, laid the foundation for a very great business, of which the Brush and Thomson-Houston companies obtained by far the largest share.

It was frequently the case in the early days that the arc lamps were hung and operated without any protection around the arc, especially in the open spaces. As we may say now, the lamps had bare arcs. It became customary, however, to surround them with glass globes, thus conducing to the steadiness of the arc in the wind and also preventing sparks and trouble caused by hot carbon particles falling from the arc in stores. The glass globes themselves oftentimes were made with ground surfaces or of opal glass for the better diffusion of the light. The development of the arc lamp and arc-lamp illumination remained in about this form, with minor improvements naturally, until new demands arose. One of these, in particular, was the desire to apply the arc lamp upon the then expanding constant-potential circuits at 110 volts. In some cases two arcs in series were connected across the mains, but this method had its limitations.

There came into existence, however, what was called the "enclosed arc," an arc the carbons of which were surrounded at the location of the arc by a small thin-glass opalescent enclosing globe with a gas cap or cover on the top, through an opening in which the upper or positive electrode was fed. By so enclosing the arc with a limited supply of air the oxygen within the small glass enclosure was soon consumed and the rate of combustion of the carbon was very greatly diminished, so that the life of a pair of electrodes was extended a number of times as compared with burning in the open. At the same time, the ends of the carbons at the arc burned square across, and the arc itself could be elongated so as to have a drop of, say, 75 volts to 80 volts between the carbons. Considerable application was made of this type of enclosed lamp, and, in fact, some series circuits were established with enclosed arc lamps, besides those run in parallel from 110-volt circuits.

The economy of the production of light in this manner was nowhere equal to that of the open arc, but the cost of trimming the lamps was greatly reduced because fewer visits were necessary. The method was afterward extended to alternating-current arc-lamp operation, the enclosed alternating-current arc being the next step. This method was applied to alternating-current circuits and can hardly be regarded as having been a step in advance, for the light production was at such a low economy as to be scarcely better than the carbon-filament incandescent lamp then used. These various types of carbon-arc lamps were brought into service, one after the other, and commercial examples of each of them were found in operation for about ten or twelve years after the first introduction of arc lighting.

The General Electric Company, which was formed in 1892 by the consolidation of the Edison General Company, whose special business was the supply of machinery and appliances for incandescent lighting by carbon-filament lamps, and the Thomson-Houston Company, had besides its own business acquired that of the Brush Electric Company. These two companies had supplied and installed by far the greater number of the arc lamps in use, and there arose an opportunity for continuing development in all the phases of electric lighting, as well as the other industries, such as electric railways, electric power and electric service generally. It may be said that the engineers and the business men who were gathered into the consolidation had contributed in the largest way to the extension of the different types of electric lighting.

Flame Arc Enters the Field

Then came the period when the development of the flame arc gave a new impetus to the business of electric arc lighting. The advantage may be briefly characterized as follows: In the carbon-arc lamp used up to that time in its several forms the major source of the light was the highly heated ends of the carbon electrodes themselves at the arc, while the flame, though countributing to the lighting effect, did not do so in very large measure. With the flame arc, however, the current in passing from one electrode to the other raised enough vapor to produce a highly luminous flame, and the electrodes became entirely secondary and negligible as a source of light, while the flame became the important source. The flame arc depended upon the volatilization of material, generally of a character to condense and form smoke, and some of the early developments of this type of arc lamp consisted in providing for the condensation and escape of the smoke from the arc without detriment to light emission.

There was soon developed what is now known as the direct-current "magnetite arc," consisting of an arc between electrodes one or both containing largely magnetic oxide of iron, with other admixtures to improve the economy of light production and the steadiness of the light. As an example of such admixtures titanium oxide and titanium carbide may be mentioned. These flaming arcs, or luminous-flame arcs, came to be substituted for the carbon arcs largely because of the economy of light production, together with a longer burning of the arc, the electrodes wasting away so slowly as not to require any attention for many days. At the same time, the mechanism of the arc lamp itself was modified in order to insure the best possible regulation as to feeding and separation of the electrodes to form the arc.

The arc flame itself in these later types of arc was much longer than the flame at the separation of the original carbons in the carbon arc, and the arc itself was more sensitive to drafts of air, or even to the character of gas surrounding it, so that it was necessary to provide a much more effective inclosure of the arc than was formerly the case. Since the electrodes in burning were not converted into invisible gas, as in the case of the carbons in the carbon arc, there has always remained a necessity for taking care of the smoke or fumes.

Along with these changes in the arc and the arc flame itself, the details of which must necessarily be omitted here, came into existence other methods of supplying the current for working them. Since the large stations were generating alternating current almost exclusively, the distribution being made at comparatively high voltages through transformers, there was need of transformers for supplying series arc lights instead of the arc dynamos formerly used. This led to the development of the constant-current transformer, which originally took the name of the "tub system," and this particular type of transformer, coupled with the mercury-arc rectifier developed in connection with it, supplied a rectified direct current to series arc lamps of the magnetite type and soon reached a very extended application throughout the country, especially in street lighting.

These improvements and developments were substantially the outcome of the laboratories of the General Electric Company and the engineers working therein. The most striking evidences of this development are to be found in the arc lamps used in what is known as "white-way lighting." There will, without question, be other important developments in the future, but the major part of the work may, perhaps, be said to have been accomplished. The open carbon arc still survives in searchlamps, especially those of large capacity. It is likely to remain as the lighting source in the many applications such as searchlamps and lighthouses that demand a concentrated, fixed source of relatively small size and high intensity which can be manipulated by reflectors or lenses. The special form of arc lighting known as the mercury arc, giving a greenish illumination, finds its own applications, especially as a source of ultra-violet rays for sterilization and other purposes.

In conclusion, it may be asserted that the arc lamp in its various forms has been characterized by a quality of light which approached closely to a white light. It has not been possible to run any form of incandescent lamp at such a high temperature as to give the characteristic of a white light or to produce a spectrum which represents very nearly that of solar radiation. Approximations to this result have been produced only by absorbing a considerable quantity of superabundant rays, such as red and orange, by tinting the inclosures of incandescent lamps. It is also recognized that a pure white tends to afford a superior visual contrast, assisting visual clarity, as compared with any light which has a distinct color or tint.

In this brief review of the developments in arc lighting, especially in the United States, limitation of space has prevented reference to the work of many of the early contributors to the art, names familiar to those who were at the beginning, such as Wallace Farmer, Weston, Wood, Hochhausen, Sperry and others, and later to Stanley, who started the Westinghouse company in this field.

Nor has there been any space to refer even briefly to the developments abroad, such as those of Crompton, Siemens and Halske and numerous others engaged in the development and utilization of electric arc lighting.

The truth is that no brief account can be more than a bare outline. It would require a considerable work devoted to the subject to present an accurate and competent history. It has been only possible to touch lightly those matters which had a profound effect upon the growth and successive modification of the arc in lighting.

Electrical Development the Key to Prosperity

A Glance at the Early Days When Faith Triumphed Over Ridicule—Great Objectives Which Led On to Progressive Development

By Arthur S. Huey

Vice-President H. M. Byllesby & Company, Chicago

LOOKING back over thirty-eight years of work in the electrical industry, the thought uppermost in my mind is the enormous amount of energy expended in inducing the public to use electricity. A child of today might well suppose that this wonderful force was eagerly seized upon by the people. This was not the fact. One generation has but little conception of the problems, trials, doubts and efforts of that preceding it, and the effort which has been entailed in convincing men and women of the values and advantages of the various applications of electric service is past calculation. How to overcome the sales resistance is one of the great problems of the industry.

First Minneapolis Installation

It was through the novelty or advertising value of electric lighting that we first got a foothold in Minneapolis. A clothing store put in a small generator and a few lamps. The brilliant new-fangled lights drew the crowds, but the majority of the sightseers were skeptics. Many were unreserved in their ridicule. Offhand the average citizen could give you many reasons why electricity could never succeed.

However, I suppose that the clothing merchant—E. H. Steele it was—did a larger business because the crowds came to see his electric lighting system. At any rate, other stores took up the innovation, more to show that they were up to date than through any conviction of the illuminating value of electricity. In due time a central station was built to serve the first handful of customers to whom, somehow or other, we had sold the new idea.

The ridicule aimed at electricity as a source of lighting, however, was mild compared with the shafts aimed at the claims advanced for this new force as a means of traction or motive power. I must confess that there were some grounds for the arguments of the unbelievers. We had to sell the electrical idea and electric service largely on vision and faith. We frankly didn't know so very much about it ourselves, but we knew enough to *feel* most intensely that infinite possibilities were latent in this new force. We didn't know much about the sizes of wire required to carry a given load, but we were confident that if we could only get people to use the service and to pay for it, all technical obstacles would somehow be surmounted.

In those days it seemed that only a limited few saw a future in electricity. The rest of the crowd merely exhibited an inclination to laugh and "be shown." I am sure today that the future uses of electricity are not even dreamed of by the average person. There is no doubt that eventually transmission lines will extend continuously from coast to coast. Electricity will be the universal agent of power and lighting for virtually all purposes in all well-established sections of the country, and as it becomes more plentiful it will grow cheaper. It is destined to be the greatest conservator of natural resources, the greatest saver of human drudgery and animal toil and the key to vast areas now unpeopled and unproductive.

The value of the work which electricity will do for the people is so great that questions of who shall build and nominally own the generating plants and transmission lines are comparatively unimportant details. The main thing is to get the job done as rapidly as possible. Save every possible ton of coal and every possible gallon of oil. Get rid of the waste, grime and confusion of steam-operated railroad trains. Bring cheap power to the factory in the small town, energy for pumping water to make the desert bloom and to replace the human labor in mine, forest and on the farms. Those are the objectives.

During the first forty years of electricity this public utility has helped to increase the size of our cities and to add vastly to the welfare and comfort of urban existence. The next cycle will probably build up the small communities and the rural districts. The same force which has made possible city crowding and congestion will unmake a condition already grown intolerable.

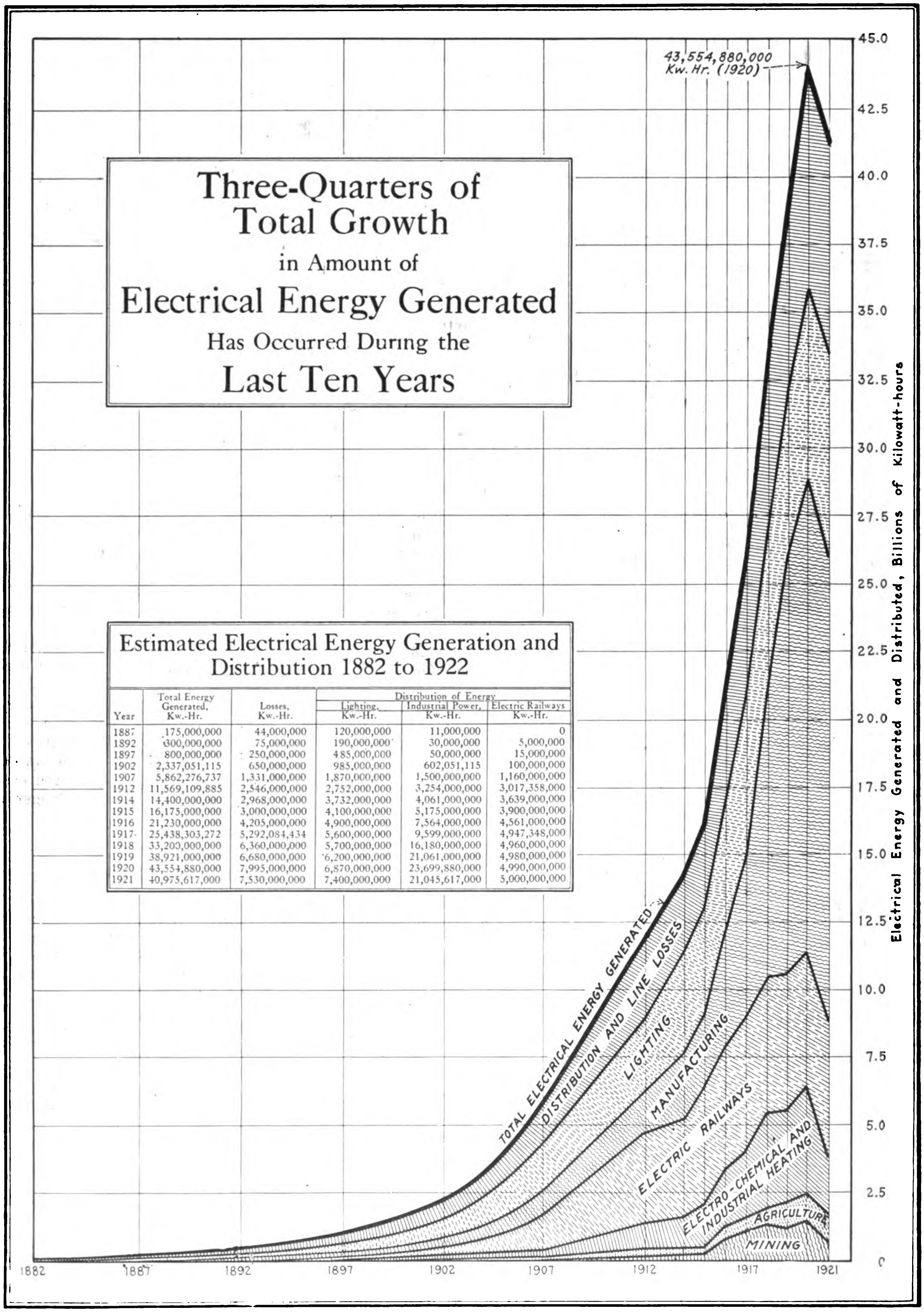
More than fifty years ago the great flour mills of Minneapolis were built there because of the water power of the Saint Anthony Falls in the Mississippi River. The wheat fields were close by; railroad transportation of the finished product was cheap; coal and power were expensive. This was before the age of electricity. Today great central stations—both steam and water-power—and transmission systems have made the cost of power and the means of producing it no longer a controlling factor.

Finance and Protection

Just as we fought hard to get people to use electricity in the early days, we who earn our living in this industry must fight for the development which we know will mean inestimable things for the prosperity of our country and the welfare of its citizens. Controversies over government, state or municipal ownership mean but costly delay. What is necessary in physical construction will call for such astounding amounts of capital that the method of development will solve itself. Only by the investment of the savings of great numbers of citizens can the development outlined be possible.

While governmental bodies debate and theorists talk or write the needs of mankind persist. Energetic men will build to satisfy those needs, just as they have in the past. Already our utility systems are becoming owned by vast numbers of the plain people. These direct investors and owners will continue to multiply. When America has reached a measurable period of electrical development the people will own the power plants and distributing systems in a manner which will serve as a perpetual bulwark against the "cohesive force of public plunder."

Three-Quarters of Total Growth in Amount of Electrical Energy Generated Has Occurred During the Last Ten Years



Estimated Electrical Energy Generation and Distribution 1882 to 1922

Year	Total Energy Generated, Kw.-Hr.	Losses, Kw.-Hr.	Distribution of Energy: Lighting, Kw.-Hr.	Industrial Power, Kw.-Hr.	Electric Railways Kw.-Hr.
1887	175,000,000	44,000,000	120,000,000	11,000,000	0
1892	300,000,000	75,000,000	190,000,000	30,000,000	5,000,000
1897	800,000,000	250,000,000	485,000,000	50,000,000	15,000,000
1902	2,337,051,115	650,000,000	985,000,000	602,051,115	100,000,000
1907	5,862,276,737	1,331,000,000	1,870,000,000	1,500,000,000	1,160,000,000
1912	11,569,109,885	2,546,000,000	2,752,000,000	3,254,000,000	3,017,358,000
1914	14,400,000,000	2,968,000,000	3,732,000,000	4,061,000,000	3,639,000,000
1915	16,175,000,000	3,000,000,000	4,100,000,000	5,175,000,000	3,900,000,000
1916	21,230,000,000	4,205,000,000	4,900,000,000	7,564,000,000	4,561,000,000
1917	25,438,303,272	5,292,084,434	5,600,000,000	9,599,000,000	4,947,348,000
1918	33,200,000,000	6,360,000,000	5,700,000,000	16,180,000,000	4,960,000,000
1919	38,921,000,000	6,680,000,000	6,200,000,000	21,061,000,000	4,980,000,000
1920	43,554,880,000	7,995,000,000	6,870,000,000	23,699,880,000	4,990,000,000
1921	40,975,617,000	7,530,000,000	7,400,000,000	21,045,617,000	5,000,000,000

The Edison System in Europe Forty Years Ago

By Etienne de Fodor
Budapest, Hungary

Reminiscences of One of the Pioneers Who Introduced Edison System Into Europe Forty-one Years Ago—Recalls Work that Laid the Foundation of Present-Day Service

THE year 1881 was full of important electrical developments which were the immediate precursors of the birth of electric light and power supply. Until that year the only electric illuminant known was an unsteady, flickering arc between two carbon electrodes, which were regulated by complicated and unreliable clock mechanisms. The Siemens construction dominated Germany and England, the Gramme design France, and the Brush lamp America. The idea then was to concentrate as much power and light as possible in one lamp, to imitate the sun or a bright full moon. For that reason extremely high towers were erected in the attempt to illuminate entire city areas with a few high-power arc lamps, an individual power house rated at from 15 hp. to 20 hp. being installed for each. A high-speed rotating-cylinder steam engine of the Brotherhood type, running at about 750 r.p.m., was usually directly connected to the generator.

SEEKING TO SUBDIVIDE THE LIGHT

More and more, however, the desire was felt to subdivide the source of light and to provide one generator for a number of lamps. To have a circuit of six to eight lamps was then the highest European ambition. Brush in America ignored this limitation and by 1881 already operated as many as forty arc lamps in series. This required currents of high voltage, and he was the first to build dynamos of 2,000-volt tension, transmitting light over a distance of 6 miles. The year 1881 therefore saw also the birth of high-voltage transmission.

The Russian Jablochkoff was the first to succeed in the building of a small arc lamp, obviating at the same time any regulating mechanism. He used two small carbon rods, placed in close parallel to each other and separated by a sort of plaster of paris. A small piece of conductive and volatile material, called "Colombine," started the arc. The Avenue de l'Opéra in Paris was illuminated by several series of these Jablochkoff "candles" during 1881. Their unsteady light, varying from dark purple to brilliant white, and the frequently occurring break of the arc in one candle, causing the failure of the entire series, did not warrant the general adoption of the system.

The ambitions of Edison in America to develop an incandescent lamp became known in Europe as early as 1880, but were ridiculed even by serious-minded scientists, who found out that many such attempts had been made in the past by Maxim, Swan, Sawyer, Fox and others, with no practical results. But Edison's untiring efforts were finally rewarded by success, and in 1881 Bergmann in New York City carried a full stock of electric incandescent fixtures to compete with the gas fishtail burner then used everywhere. Illustrations of these very first electric fixtures may be found in the 1881 volume of the *Scientific American.*

While Europe was still arguing about arc lamps a book by Sawyer appeared in New York, on the electric illumination of homes, including even metering devices.

All achievements of an electric nature were to be exhibited and the competition between the arc and the filament was to be settled at an international fair, the like of which the world had never seen before. At the end of 1881 the "International Electrical Exposition at Paris" was to be opened. This was announced in October, 1880, and invitations were sent out broadcast. Edison's ambition was aroused, and he was among the first to send a staff of men to Paris. These men, of whom the author was one, began the installation of his incandescent lamps at the fair grounds in the Avenue des Champs Elysées. Copper wires of low conductivity, covered with a layer of guttapercha and protected with a zinc-oxide impregnated layer of cotton, were offered in the European markets. Their high ohmic loss proved to be prohibitive. Edison therefore asked his friend Wallace of the Ansonia Copper Company in Connecticut to produce some electrolytic copper wires for this exposition. Much of the success of his lamps was due to this "Ansonia wire." The wires themselves were held in place by staples, cleats and wooden moldings. The slow progress made by the Parisian carpenters forced the Edison staff to take the making of the moldings into their own hands. All the joints in the wires were insulated with friction tape, invented in the Edison laboratories and used ever since the world over. Short circuits did not entail any danger for the Edison staff, as they brought with them another detail, of greatest importance then and of greatest importance today—the fuse plug, another development of Edison's laboratories. Already in those early days the advantage of using two plugs at each branch point was realized. The Edison staff comprised but a few men, but with Edison's slogan "Hard work and little sleep" we accomplished the large task in schedule time. Of the many exhibits no doubt Edison's "home-lighting plant" attracted the widest attention. It proved that his system of light distribution which in the meanwhile was used in the first central station—on Pearl Street in New York City—was no dream, but a technical possibility and a financial success. This deadened all ridicule, which soon gave way to envy.

The exposition itself was an immense success, crowded day and night by an international throng. It was the meeting place of all the electrical men of those days, such as Siemens, Deprez, Bell, Gramme, Hughes, Pacinotti, Planté, Thomson, von Alteneck, Becquerel, d'Arsonval, Crookes, Preece, Ferraris, Jablochkoff and others. An international congress of electricians was held at the exposition, the most important result of which was the establishment of the electrical units, the ohm, the volt, the ampere, the coulomb and the farad. These units, too, have reached their forty-first birthday.

With the distribution system the era of large generators also began. Edison exhibited a dynamo for 1,200 16-cp. lamps, consuming about 200 hp. The huge size of this dynamo will be appreciated when it is mentioned that all of the electric devices exhibited did not require more than about 20 hp. Edison had to build his own generator as no existing machine was large enough for his purposes. His machine with drum armature was quickly announced as an imitation of Siemens' dynamo, but upon closer investigation it was found to differ from it materially. The German machine was built with a very small amount of iron and with high armature resistance, resulting in about 50 per cent efficiency. Edison's dynamo had much iron, only 0.0039 ohm. armature resistance, a solid copper bar winding with 146 bars, 43 in. long and of 0.2 sq.in. cross-section. The commutator, with its seventy-three mica-insulated segments, was a great mechanical accomplishment, the original construction being used today with negligible changes in the mechanical design. His 200-hp. dynamo showed 90 per cent efficiency. The lamination of the iron to prevent eddy currents also originated in Edison's laboratories. Great surprise was caused by Edison's suggestion to regulate the voltage of his machine with a resistor in the field circuit.

PLANS FOR PEARL STREET STATION EXHIBITED IN 1881

The plans of the Pearl Street station were exhibited and aroused never-ending comments. The question of transporting the generated current, whether in wires overhead or in cables underground, was a great problem in those days. On account of the high cost it was considered out of the question to use cables. Guttapercha and caoutchouc were the only known insulators which could be considered. Edison finally decided for the underground system and used two semi-circular copper bars, placed against each other, their flat sides facing, insulated by a strip of pressboard. This circular combination was placed in wrought-iron pipes filled out with a specially invented compound. These conductors were made in 20-ft. lengths, joined in a square metal boxes.

The second question of importance was that of necessary copper cross-section. Until then only the so-called "tree system" was known, starting with a heavy conductor at the station and diminishing the cross-section as the line progressed, like the branches of a tree. Aside from the enormous voltage drop of such a system, its cost of copper for a larger station was considered insurmountable. Edison, who tried the "tree" system at his Menlo laboratory, discarded it and put in its place the network system with feeders. The cost of the copper for the Pearl Street station would have amounted to $201,000 for the "tree system," while his feeder network required only $25,000, the price of copper being 25 cents a pound. On Aug. 4, 1922, it was just forty years since Edison applied for a patent on the feeder system. Two years later he applied for the protection of his "three-wire system," cutting the copper cost dcwn 60 per cent.

A large impetus was given to the new electric light by the famous French architect C. Garnier, who insisted upon changing the gas illumination of the Parisian Opera House to electric light. Several exhibitors at the fair were therefore invited to install their systems in the Opera House. To Wedremann fell the vestibules, to Brush the large stairway, to Jasper the refreshment rooms, to Jablochkoff the inner salon, to Swan the chandeliers of the large hall, to Maxim the two small foyers, and to Edison the large foyer. On the outside of the Opera House were erected small sheds containing the generating plants of these firms. The Edison shed had two 30-hp. locomobiles, driving each a belted dynamo. The first tests showed a very brilliant but also very flickering illumination from the arc systems, in comparison with which the mellow light of our lamp bulbs almost vanished. Fortunately the architect decided to eliminate the arcs entirely, restricting the tests to the glow lamps. This decision of Garnier was actually the launching of the victorious progress of the incandescent light. The great evening of the final test came, and everything was in entire readiness. Two stokers and an Irish machinist by the name of Green were stationed at the locomobiles. "Mat" Force, an American, and the author held watch over the dynamos. A buzzer signaling set was in operation between our shed and the main foyer. Voltmeters or ammeters were not in use at that time. The voltage was merely estimated according to the brightness of a lamp.

As soon as the test started signals came from the foyer for "more pressure" and "still more pressure." The locomobiles began to groan, belts began to slip, the commutators sparked badly, and the copper-wire brushes, with their soldered ends, threatened to melt. Wet waste was laid on the machine bearings to keep them cool. And still the signals came for "more pressure." The steel springs pressing the brushes onto the commutator began to lose their temper and softened. We had to "waste-cool" them too. Each of those waste applications was accompanied by severe electric shocks. Finally we had to hold the brushes by hand against the commutators to insure proper collection. "More pressure for a few more minutes" the buzzer announced. Making almost superhuman efforts, our little force held out to the last second. My fingers were roasted, and our bodies ached, but we had won the battle. Garnier was delighted with our lights, and Edison's system had established its practicability.

Soon after the success in Paris Edison was called upon to electrify the illumination of the large railroad station in Strassburg, and the work was finished on Christmas, 1881. This was the first European use of incandescent lamps on a large scale.

It was no easy task to meet the severe competition which the electric light found in gas illumination, and a bitter fight was waged between the gas and electric companies. When Auer von Welsbach introduced the incandescent gas light the battle for electric light seemed almost lost. Just in the nick of time, however, the tide was turned by the introduction of a practical and energy-saving metallic-filament lamp.

We therefore returned to the old idea of the metallic filament, tried long before the advent of the Edison lamp. It may not be generally known that Edison applied as early as 1879 for a patent on a metallic-filament lamp covering several metals of high melting point, such as platinum, iridium and tungsten. He actually built 25-cp. platinum lamps, burning in a vacuum, with a wire 30 in. long, consuming only 1 watt per candle. These lamps were, however, so sensitive against any rise in voltage that it was found necessary to use an iron resistor in series with them. This made the lamps rather unhandy to use, and Edison gave up the idea of the metal filament and turned his full attention again to the carbon-filament lamp. Nevertheless, we may celebrate also the forty-first birthday of the metallic-filament lamps.

Electric traction dates back also to 1881, being successfully installed in that year on a 1½-mile stretch near Berlin. Passengers were transported on scheduled trains at a speed of 12 miles per hour. In the same year Sir William Thomson and Marcel Deprez, the pioneers of the electric motor, published their papers on the technical feasibility of long-distance transmission of electric power.

It is also of great interest to mention that the French engineer Faure announced in 1881 his invention of the improved storage battery. Up to that year the storage battery, invented in 1860 by Planté, was used only in laboratories. In July, 1881, the first Faure storage-battery operated bus made its appearance in the streets of Paris. Sir William Thomson suggested in the same year the transmission of power from Niagara Falls for 300 miles at a direct-current voltage of 80,000. At the receiving station 40,000 storage-battery cells were to be charged in one series and discharged in groups of fifty in series.

It has thus been shown that many fundamental achievements date from 1881, and many are the men whose names gained luster at that time. So many new ideas appeared in that year that it is difficult in some cases to distinguish between the property of different inventors. But let us also remember the unnamed co-workers of those days whose untiring work and perseverance were essential to the success achieved by the famous inventors.

Public Relations Then and Now

Good Will of Customers Has Been Sought Since the Early Days of Electric Light and Power—Service in Its Broad Sense

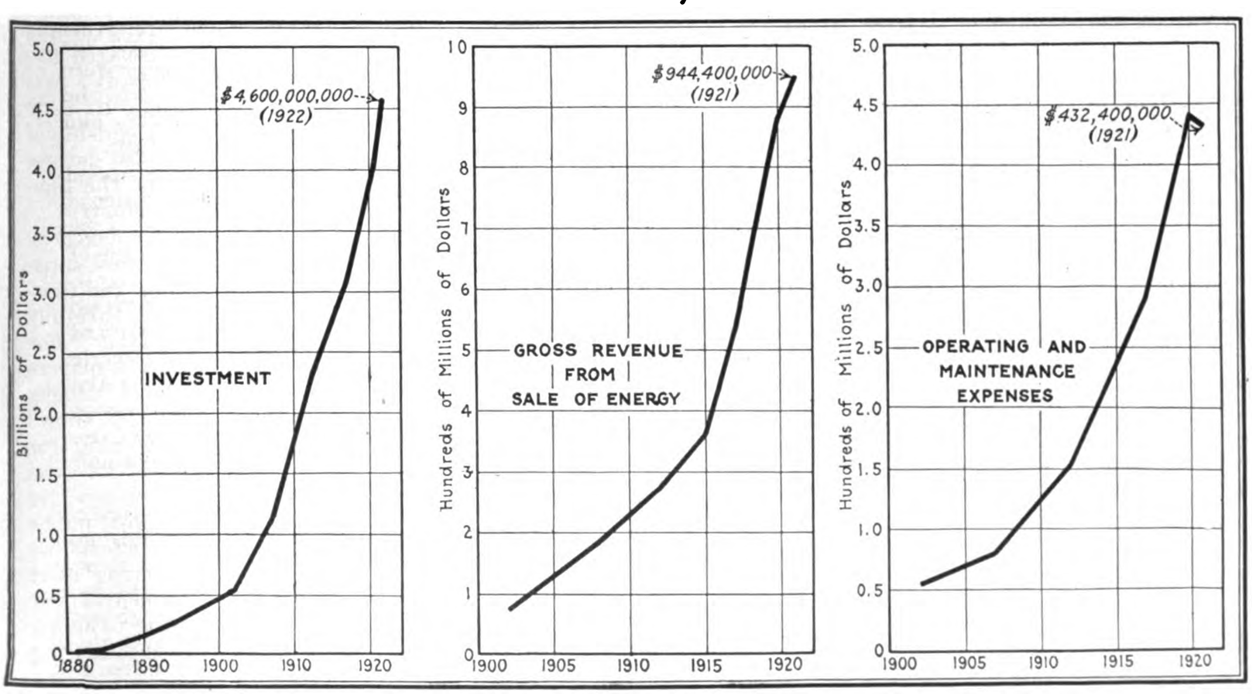
By William H. Atkins
General Superintendent
Edison Illuminating Company of Boston

THE fortieth anniversary of the establishment of the Pearl Street station in New York offers an opportunity for those long associated with central-station development to look back to the old days and to compare them with the new. At the request of the editors of the *Electrical World* some of the activities carried on here in Boston with the hope of making our customers our friends will be commented upon, in the belief that similar efforts were made by the central-station industry in general.

Obtaining the good will of the public has been one important factor in the central-station business through the long history of its development. The main business of the electric utilities is to supply electric service to the consumer, but if a company did no more than simply to supply service it would render a poor account of its stewardship. Even in the early days of the industry service had a far broader meaning than the delivery of electrical energy twenty-four hours a day with good voltage regulation and freedom from interruption. I am sure that even if the central-station men of the earlier days did not put into words their conception of service as we know it today, they none the less laid the foundations of future success upon a willingness to do much more for the customer than was agreed to in his contract.

Personal acquaintance with customers was a matter of course in the early days. For some time we knew

The Central-Station Industry in the Aggregate Has Never Reported a Decreased Yearly Revenue



them all, practically speaking. At that time it did not cost three or four thousand dollars to write a letter to each of our patrons. From the start, however, electrical energy supply was run as a business, and while some things were done (such as free wiring for a few months in 1886) which modern practices would instantly throw out of consideration, the need of making real profits was never lost from sight. Back in 1887 our rate was 1¼ cents per lamp-hour, equivalent to 25 cents per kilowatt-hour. Until 1892 the annual output was unrecorded.

In those days competition was keen, and there were many isolated plants in the territory we served. The Boston Electric Light Company was our chief competitor. To get business it was often necessary to offer discounts which ranged from 10 to 60 per cent, and stores and factories were our principal customers. We had no public relations problem as such in those days, our task being to maintain service and keep our customers satisfied. As the use of electricity increases, the tendency can be seen for the public relations problem to merge into that of customer relations.

Permits to open streets and lay conduits were to be had for the simple asking in those days. At one time we learned that a group of men were planning to establish a competitive plant in the Back Bay residential district. The situation was promptly met by a visit to City Hall, where our representative received licenses granting the company the right to excavate streets and lay conduits in a large area of the district in question. Conduit and tube equipment which had been purchased for downtown service were at once laid in the Back Bay. The proposed plant as a competitor never materialized. Relations with city officials were upon a friendly, man-to-man basis, and formalities were few and far between.

In 1901 the Suburban Electric Light & Power Company was acquired and in 1902 the Edison company* purchased the Boston Electric Light Company. Two years before that the retail price of electricity had been reduced 1 cent per lamp-hour to 18 cents per kilowatt-hour, and in 1903 the purchase of electric companies at Milton, Dedham, Natick, Framingham and Canton really started the growth of the Edison system into the suburban territory, which has resulted in striking reductions in the price of service and remarkable improvements in its quality throughout a great area still but partially developed from the commercial electrical standpoint. This period of consolidation of companies was also marked by a standardization of rates. Motor business started with the coming of the direct-current electric elevator and of small shop electrifications.

Merchandise Has Helped Public Relations

For many years past the Boston company has merchandised appliances. We exhibited appliances at Head Place as far back as 1889, showing flatirons, fans and other devices. The business friendship between the company and the public has been strengthened year by year through the opportunities which have been given to customers and others to visit displays of the latest electrical conveniences at our offices and to purchase them on liberal terms. There is no question that the commercial departments of the company have had a powerful influence for good in the development of sound public relations. As our suburban stores have been established the same efforts to practice courtesy and good will have been put into effect.

It is obviously no longer possible for the executives of the company to be personally acquainted with any large percentage of our customers. As the system has grown a lot of hard work has been done to keep the company from becoming a huge, impersonal organization looked upon by both employees and the public as a mere machine for the supply of electric service. Within the company a bureau devoted to the welfare of employees was established some time ago and has proved very successful. From the day the applicant for employment enters the office to the day when he receives his diamond service pin representing thirty-five years of faithful work under the Edison banner, a personal interest is taken in his individual progress and welfare. The Edison Employees' Loyalty Committee, composed of men below the rank of division head, functions without advice or instructions except as to policy matters, seeking to dispel the idea that this company is merely a business structure run for profit alone without regard for the varied interests of individuals and communities.

In Personal Touch with Customers

Recently a number of district managers were appointed with authority to do everything possible in their respective towns to help the customer and the public at large in any dealings they may have with any department of the company. In other words, in the territory far removed from the central office of our company the customer and the public may deal with the company in a close personal way just as they would were they doing business with the main office. These district managers associate themselves with every public activity in the town in which they are stationed.

This procedure has developed to the extent where the district manager is a close personal friend to most of our customers in the city or town which he lives, and this assignment of ten employees to devote practically their entire time to improving and strengthening the relations of the company in our more isolated territories indicates a determination on the company's part that, regardless of the size of its organization, its daily endeavor shall be to gain the good will and friendship of the public it serves. One man in our office also devotes his entire time to improving the relations of the company with other branches of the electrical industry.

As far back as 1907 all our customers were asked by a personal letter from our president if they were satisfied with the service. Criticisms were invited and thoroughly investigated, all suggestions being carefully studied with a view to their practical application. For many years our publicity matter in the local newspapers has been brief but interesting, one subject usually being discussed at a time. In the "Friendly Glow" advertisements, a series which has been running for two years, the company is telling the story of its aims and business fundamentals, always inviting constructive —yes, and destructive—criticisms from the great public which it is serving. As a result of these efforts we believe that the individual customer is becoming more and more friendly with the men and women of our organization, and that he is gradually coming to appreciate some of the larger problems that we encounter in our business.

*The Boston Edison Company was organized Dec. 26, 1885, and the first station, consisting of a 90-hp. engine driving two Edison generators capable of supplying 800 incandescent lamps, began operation Feb. 20, 1886. The number of customers in 1887 was 260, and the generating equipment had a total rating of 1,320 kw. Today there are about 2,300 men and women in this organization, which serves more than 600 square miles in eastern Massachusetts, supplies nearly 160,000 customers and has a generating station capacity of about 175,000 kw., besides interconnections with adjoining systems.

The Evolution of the "Code"

A Record of the Origin and Gradual Development of the National Electrical Code and Some Influences Which Have Assisted in Its Progress

By C. M. Goddard
Secretary New England Insurance Exchange

THE evolution of the electrical code dates back practically to the year that saw the opening of the Pearl Street station in New York, the first central station established. Electric light had been used in a small way, a very small way, but so largely was this use a matter of experiment that no need for any standard rules governing the installation of wiring had been felt. Fuse blocks, switch bases and other mountings were made of wood, and in each case the man who put in the wiring exercised in large measure his own ingenuity in working out the method of installing the wires and fittings.

This the men of that day were in a good position to do, for they were picked men, selected by the lure of the new mystery of electricity from the ranks of the handy craftsmen whom we call "jacks-of-all-trades." It was these ingenious minds that had been dabbling with bell wiring and playing with batteries. They were fascinated with the new idea of electric light and began to experiment with it whenever opportunity offered, and they displayed a high degree of versatility in working out the many new mechanical problems involved.

INFLUENCED BY EARLY FIRE HAZARDS

The first use of electricity for interior illumination on any large scale came with the introduction of arc lights among the textile mills of New England, and the operation of these novel lighting systems was immediately followed by a number of fires. People were very much surprised. This was in 1881, and there were sixty-five installations of electric lighting in factories insured by the Manufacturers' Mutual Insurance Companies of New England. Within a period of six months this company suffered twenty-three fire losses due to electricity, and the insurance interests naturally became very much alarmed over the hazardous nature of electric light.

The insurance men at once got in touch with the leading electrical authorities and began a series of experiments which repeated in so far as possible the condition of those fires and out of it developed new methods of installation which would give safety. Dr. Charles F. Brush, Prof. Elihu Thomson, Thomas A. Edison, Edward Weston and others assisted in these investigations and the first set of rules to govern the installation of electric wiring was the result. These rules were originally intended to be applicable only to the textile mills and not for general use, but other rules more general in character followed, and rule making came to be the order of the day. Municipal boards made rules, commercial bodies and manufacturing companies made rules, and an organization of salesmen was actually formed for the purpose of drawing up regulations for wiring.

Naturally the electrical interests were very much disturbed by these conflicting influences. What was demanded by one group was prohibited by another. Sometimes requirements would specify the use of supplies not in the general market, some interested person having framed this particular set of rules for local use near the point of manufacture. But the fact that there were no means of enforcing these rules saved the situation, and those who worked at the electrician's trade used their best judgment and went ahead.

All this evidenced clear recognition of the need for rules and a trend toward the development of a practical code of wiring that would make electric light safe. The use of the arc light, of course, increased and spread. Then series incandescent lamps became available in 1882, which gave new impulse to the demand. I remember it well, for my own experience dates back to the early eighties, when I first saw electric lighting in an office in New York City supplied with energy from a small plant in the basement of the Equitable Building.

Incandescent lamps in series of four or seven were lighted from circuits run in duplicate, so that when the lamps went out the trouble could be taken care of by throwing the switch and lighting the other side of the chandelier. And this was an almost daily necessity. I became very much interested in the new industry and went into contract work in Plainfield, maintaining the city fire-alarm system and wiring buildings for light. Here in 1886-87 the first alternating-current plant was built by the Westinghouse company as a show plant to demonstrate the new system of lighting.

The first printed resolution ever sent out by any insurance company governing the use of electric lighting was issued on Oct. 19, 1881, by the New York Board of Fire Underwriters. It read:

> Resolved, That the committee on police and origin of fires is hereby directed to notify the owners and occupants of all buildings in which uncovered electric light wires or in which arc lights with open bottoms or without globes are found that the wires must be covered and the lamps altered to conform to the rules of this board within ten days from date of notice and request that the lights shall not be used until the alterations are made; and in case the alterations are not made within said time, the committee is hereby directed to notify the members of the board of said failure, and the companies insuring said property are hereby recommended to give notice to the owners and occupants of such buildings that unless the request is complied with and the alterations made within a reasonable time the insurance on said property will be canceled.

FIRST CO-OPERATION WITH UNDERWRITERS

It was the very next day when the Manufacturers' Mutual Company in Boston sent out its first warning, which it followed the next year with its first set of rules, and the New York board also adopted rules a few months later, which in turn were established by the National Board of Fire Underwriters. Then in 1885 came the first act of definite official co-operation between organizations of insurance men and the electrical industry to construct a code. Two insurance men went that year to the convention of the National Electric Light Association in Baltimore and discussed rules for wiring, but nothing came of it until the following year, when a joint conference was held and a set of brief though comprehensive regulations was formulated. Again in 1890 the more complete rules were developed by the underwriters of Philadelphia, Boston and the Pacific Coast and another joint conference committee was appointed by the insurance men and the N. E. L. A. It adopted a new code that had been prepared and published by the National-Electro-Insurance Bureau. But no effort was made to influence the general acceptance of these rules, and different companies and different communities continued to use their own.

It was really not until 1892 that any real attempt at standardization was undertaken. In that year an invitation was sent out by the New England Insurance Exchange inviting the electrical inspectors of the various industrial organizations of the country to a meeting in New York City, where, taking the N. E. L. A. code as a basis, a revision was made and the body formed itself into an organization known as the Underwriters' National Electric Association. A further meeting was held a few months later which represented practically the whole of the United States and a large part of Canada. The revised rules were issued in printed form, and a permanent body was established consisting of electricians in the employ of the insurance interests whose duties were the care of the rules, the making of tests and the giving of information and advice to members of the association.

The rules themselves had, of course, undergone many changes both as to the extent of their application and the assurance with which they were fashioned. I have a copy of the first printed rules issued in this country, dated Oct. 19, 1881. They are not overdefinite. For instance, four of them read:

Wires to be thoroughly insulated and doubly coated with some approved material.

All wires to be securely fastened by some approved non-conducting fastening.

When it becomes necessary to carry wires through partitions and floors they must be secured against contact with metal or other conducting substance in a manner approved by the inspector of the board.

The conducting framework of chandeliers must be insulated and covered the same as wires.

There can be little wonder that there was some lack of uniformity in the interpretation of these rules. Progress was made step by step, often pioneering boldly by demanding some refinement in construction which could not be supplied by current materials. For example, at one time a demand was made for non-combustible hanger boards for arc lights, but there was no such thing available. It was desirable, however, and it came, for porcelain and fiber were provided in time. The wireman used his best common sense in working out new ways of wiring.

I well remember one job where I ran a pair of primary wires carrying 1,000 volts around the framework of a door concealed in a piece of molding that was part of the door trim, which I had removed and hollowed out. Repeatedly we would run through a partition beside a gas pipe, if there was room enough in the hole to pull the wires through.

The underwriters in their code making used their own good sense in trying to follow along and suggest new ways to improve the element of safety and reduce the risk. But the code of 1892 was a great improvement over the one I have just quoted from as is shown by the copy of a letter I have from the Edison Electric Illuminating Company of New York which reads as follows:

THE EDISON ELECTRIC ILLUMINATING COMPANY
OF NEW YORK.

March 30, 1892.

R. R. BOWKER, First Vice-President.

DEAR SIR: Pursuant to your request we have gone over the proofs of the wiring rules proposed by the National Association of Underwriters and beg to submit herewith our notes and criticisms.

These rules in general are far in advance of any heretofore proposed—so far as we are aware—either here or abroad. They treat very broadly the various electrical systems in use and will undoubtedly tend to raise the standard of electrical work in general.

Respectfully submitted,
J. VAN VLEET,
Chief Electrician and Consulting Engineer.
ARTHUR WILLIAMS,
General Inspector.

By 1894, in less than two years from the first general meeting, these insurance company rules for the regulation of electric wiring had been adopted by nearly every company in the country and uniformity had been secured. In the meantime a bureau for the testing of devices and materials and for the dissemination of information had been established in Chicago in charge of a member of the electrical committee, and the publication of quarterly bulletins was begun giving brief accounts of fires in all parts of the country reported to be of electric origin and the results of tests at the laboratory.

EVERYBODY VOTED AT EARLY MEETINGS

These early meetings which were held for the discussion of wiring methods were all held on the mob-rule plan; that is, they were free to any one who was interested. Electric light men, contractors or wiremen had the freedom of the floor and could vote, for it was felt that it was a job for the application of common sense primarily and a diversity of viewpoint would tend to bring balance to the judgment of the meeting. Naturally, however, the insurance men, the insurance background and the insurance interest predominated, and in 1895 it was decided to broadcast a general invitation for suggestions for the improvement of the rules. Many were sent in. Then a call was sent out for a conference to represent the following bodies: American Institute of Electrical Engineers, National Electric Light Association, American Street Railway Association, American Society of Mechanical Engineers, American Institute of Architects, National Board of Fire Underwriters, Underwriters' National Electric Association, Factory Mutual Fire Insurance Companies, International Fire Chiefs' Association, American Bell Telephone Company, Western Union Telegraph Company, Postal Telegraph Company, General Electric Company and Westinghouse Electric & Manufacturing Company.

From this meeting the National Conference on Standard Electrical Rules was organized. A code committee was appointed to amend and recodify the standard electrical rules. After many meetings and the embodying of many suggestions, it completed its work and the resultant rules received the approval of the N. E. L. A. at its annual convention in June, 1897.

Through these fifteen years, of course, the electrical industry grew and expanded with tremendous speed. Multiple incandescent lights, electric motors for industrial power and the various applications of electric heat followed one another. Constant progress in the popular use of electricity brought continually new extensions of the wiring system and laid new demands upon it. The code grew from a few simple rules printed on a single page until today it makes a sizable book. The history of the code is virtually the history of the industry in so far as its scope is concerned. Many changes have come as knowledge has broadened. The matter of grounding secondary circuits as an example has seen a complete reversal. In the early days the rules read that all circuits "must test free from grounds," while the present rule requires grounding of practically all ordinary low-tension systems. There have been numerous other interesting trends.

CODE OF TREMENDOUS BENEFIT

That the influence of the code has been of tremendous benefit to the electrical industry goes without saying. It has maintained a degree of safety which would not have been realized without some such regulatory guidance. It has tended toward standardization of many methods and materials which have speeded the advance of the art. It has served as a safe anchor to keep the head of the fast-drifting industry to the wind. One of the great problems has been and still is to secure intelligent and progressive interpretation, administration and enforcement of the code by all the numerous inspection departments, both insurance and municipal, for the code has never been mandatory upon the inspector.

It is not generally understood that to the various boards of underwriters throughout the country very great latitude in the matter of detail methods is of necessity given, independent of interference from the fire insurance companies themselves. They are composed of men connected with the insurance business in the localities which they supervise and are supposedly much more familiar with the needs of the locality than the distant company officials. Therefore, although the companies in the national board have the undoubted moral right to demand absolute compliance with the code, yet business policy makes this method impracticable, and the more effective though slower influence of moral suasion has been adopted. The code is provided for their guidance, but it must be remembered that the management of the local board is seldom in the hands of electrical men. They must rely on their electrical inspector for advice. He is supposed to know it all; at any rate he knows more than any one else on the board. That is why he is employed and his interpretation of the code is usually accepted.

In addition to this we have the influence of municipal regulation, which is a local law unto itself. Every city electrician can usually procure the incorporation of his own ideas into an ordinance and need yield these ideas to no one. It is profitless for the local underwriters to compete and contend with the city regulations, so as a rule they fall in with them, this being the only practical course to pursue, although they do not as a rule actively require those things demanded by the city but not specified by the code. This, of course, introduces new inequalities in the standard of construction.

In the matter of enforcement the same obstacles present themselves. Suppose an inspector finds work not in accordance with the code and requests a correction but the owner refuses to remedy the defects. If the violation is not a vital one, the board finds that if the rate is advanced non-co-operating companies stand ready to take the risk at the old rate. Vital defects are under control because the central station will not cut in the installation if it is unsafe, but for the enforcement of the other requirements of the code moral suasion must again be resorted to lest member companies who are supporting the board suffer too much loss of business. At the same time, however, every effort is made to secure the rigid observance of the code, not only as a measure of safety, but as an act of simple justice to the electrical contractor who by building in accordance with the code loses jobs if competitive work is passed at less than code standards.

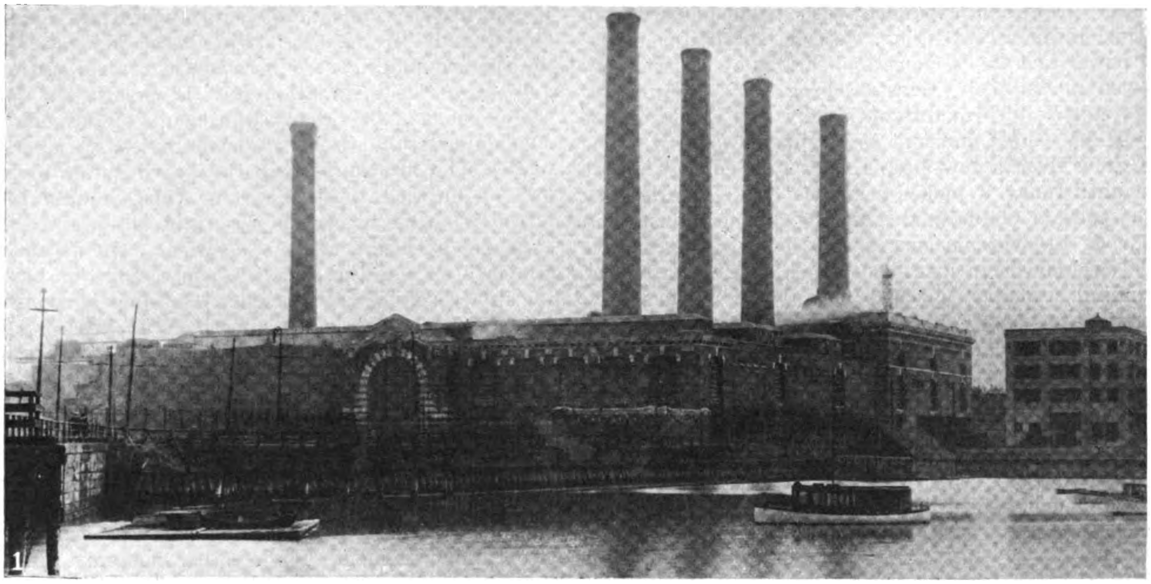
But in spite of all these difficulties steady progress has been made and continues to be made. After its establishment as a national electrical code in 1896 the code was in the hands of a committee composed of insurance inspectors representing the boards of underwriters of different districts until 1910, when the work was taken over by the National Fire Protection Association and delegated to a committee now consisting of twenty-nine members representing not only the insurance interests but also all of the allied interests having membership in the association.

NOW AN AMERICAN STANDARD

The most recent step which has been taken in the evolution of the code is among the most interesting, for within the year it has been officially indorsed by the American Engineering Standards Committee, which is impartially representative of the following bodies: American Electric Railway Association, American Institute of Architects, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Railway Association (Engineering Division), American Society of Civil Engineers, American Society of Mechanical Engineers, American Society for Testing Materials, Association of American Steel Manufacturers, Electrical Manufacturers' Council (representing Electrical Manufacturers' Club, Electric Power Club and Associated Manufacturers of Electrical Supplies), the electric light and power group (Association of Edison Illuminating Companies and National Electric Light Association), the fire protection group (Associated Factory Mutual Fire Insurance Companies, National Board of Fire Underwriters, National Fire Protection Association and Underwriters' Laboratories), the gas group (American Gas Association, Compressed Gas Manufacturers' Association and International Acetylene Association), the safety group (National Safety Council and National Bureau of Casualty and Surety Underwriters), Society of Automotive Engineers, and the United States Departments of Agriculture, Commerce, the Interior, the Navy and War.

As a result, the code becomes truly an American standard, sponsored by the committee, and as such it gains a very definite standing questionable in public opinion.

So the code is today a reflection of the status of the industry, just as it has evolved with the industry step by step from the first groping effort until today. It has more than once been accused of restricting free progress. It is naturally and inevitably a restraining influence on hazardous experiment, but its purpose is clear-cut to protect the electrical industry from the incalculably greater costs of fire and the loss of public confidence that would most surely follow.



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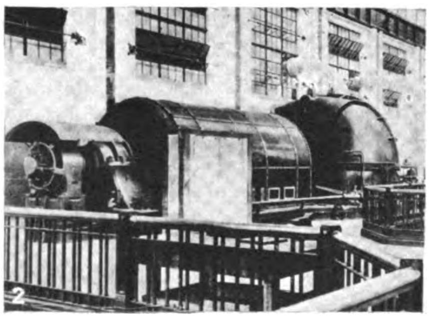

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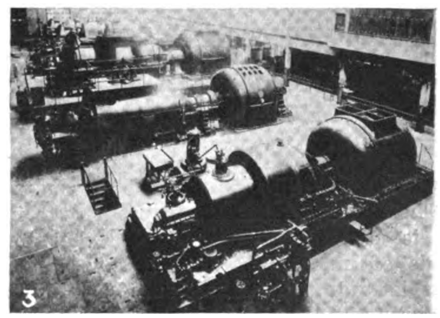
Four Other Pioneer Edison Companies



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FOLLOWING closely on the heels of the old Pearl Street station of the Edison Electric Illuminating Company of New York, four other similar systems were founded that have grown to remarkable proportions. They were established in Boston, Brooklyn, Chicago and Philadelphia, the first starting in December, 1885, the second in March, 1887, and the third in 1888. In many respects these plants were similar, containing Armington & Sims high-speed engines to drive the old Edison bipolars.

In the early nineties triple and quadruple expansion marine engines directly connected to generators were substituted by most of them. As the territories demanding service expanded the Edison systems were supplemented by alternating-current distribution and the companies went through the mechanical and electrical development which is familiar to most of us.

Last year these four companies had a total output of more than 3,500,000,000 kw.-hr. No. 1 shows L Street Station, Boston; No. 2 a turbo-generator in the new Calumet station, Chicago; No. 3, remodeled Gold Street station, Brooklyn, and No. 4, new Delaware station, Philadelphia, with its surrounding load district.

4

Development of an Alternating-Current System

Incidents in the History of The United Electric Light & Power Company, Which Started Alternating-Current Service in New York Thirty-five Years Ago

By Frank W. Smith
Vice-President and General Manager The United Electric Light & Power Company, New York City

> THE crowded history of electric service from its crude beginnings down to the present time covers so short a period that the older officials and employees of every company that has been in existence for thirty or forty years can personally recall its successive stages of development and look back on a series of significant happenings, including many amusing incidents. Among such recollections possibly none are more interesting than those which cluster around the growth of The United Electric Light & Power Company of New York, which was so closely associated with the first commercial electric service system in this country. The history of this company is bound up with the history of the development of alternating current, and its experiences parallel closely those of other companies which early adopted that system.
>
> Starting in 1887 with no precedents on which to base its operating practices and development policies, the United company, then called the Safety Electric Light & Power Company, entered the early period of its alternating-current operation with some trepidation. At first the board of directors was even skeptical of making the alternating-current system a commercial success. However, with improvements in operating methods and changes in the design of generators, switching and protective equipment, distribution methods and metering apparatus, the company surmounted the various obstacles which arose and has brought its system to its present high stage of development, now shared by other progressive companies. In its details the history of electric service development is more absorbing than that of the automobile, since it started with a less understood form of energy and yet has progressed to an extent excelled by no other activity. The accompanying article, of course, does not purport to give a detailed account of the technical progress of alternating-current service in New York, but to touch in anecdotal fashion on outstanding events.—*Editors.*

BEFORE the introduction of the alternating-current system in New York the United States Illuminating Company and the Brush Electric Illuminating Company were doing a considerable series-arc lighting business, and the first-named company had already introduced the incandescent system. Just prior to the introduction of alternating current the total gross revenue of the United States Illuminating Company for series-arc and multiple direct-current incandescent lighting service, including plant rental—at that time part of the business consisted of the rental of dynamo machines and lamp equipment — amounted to approximately $340,000 per year. A step forward came when, in 1887, the United company was incorporated under the name of the Safety Electric Light & Power Company for the express purpose of developing the alternating-current system. Two years later it changed its name to the present corporate title, The United Electric Light & Power Company. The alternating-current system was brought to the attention of the company by the Westinghouse Electric & Manufacturing Company, provision being made whereby the operating company would acquire this system under a license agreement. It is amusing to quote from a report submitted by the then president of the operating company to the board of directors setting forth at length the details of the Westinghouse proposition. At one point the report read: "The machine has been run from time to time, but from results obtained I am not able at the moment to say just how far we shall be able to adopt this system, for the reason that it has not yet had a fair opportunity to be tested for efficiency. The converters, however, do seem to hold the current."

George Westinghouse, the pioneer in the commercial development and application of the alternating-current system, had by this time satisfied himself "as to the great merit of the system and its tremendous possibilities, realizing that the alternating-current system was the solution of the problem of economically transmitting energy long distances, if it could carry large quantities in the form of high voltage and low amperage — the transformer supplying the means for locally readjusting the voltage to the requirements."

At this time the Edison system was making great progress and afforded the greatest source of competition, as evidenced by a quotation from the records of a meeting of the board of the company in 1888, as follows: "As you are doubtless aware, it is by this method (alternating current) of supplying incandescent lights that we expect to hold our customers in the districts now threatened by an early and bitter competition with the Edison system." Nevertheless, the direct-current interests in those days did not consider the alternating-current system very seriously. As an instance of this a paper read in 1888 before the Association of Edison Illuminating Companies deserves citation. In it the alternating-current system was alluded to as a failure because: "They cannot make it safe. They cannot make it reliable. They cannot make it run twelve 16-cp. lamps per horsepower. They cannot make its lamps even. They cannot make its lamps last a reasonable time. They cannot make it run motors. They cannot make it sell by meter." It must be said that at that time a number of these indictments were "true counts" against the alternating-current system. Great opposition to alternating current naturally developed. Assertions were made as late as 1889 that the system was dangerous and deadly and that its use should not be permitted commercially.

In spite of the opposition the alternating-current system was pushed with great energy and skill by the Westinghouse and Thomson-Houston companies and by the United company. All of the distribution was by overhead lines, and the operation of this system was an exciting and even a nerve-racking occupation.

A PICTURE OF MR. EDISON AND SOME FRIENDS TAKEN DURING THE DEDICATION OF THE PLAQUE ERECTED ON THE SITE OF THE PEARL STREET STATION

The first alternating-current machines for local commercial service were purchased from the Westinghouse company in 1889 and were the so-called "1,500 and 3,000 lighters." Rotating surface-wound armatures designed for 1,000 volts and 133 cycles, single-phase, were employed, being driven from a steam engine by belting. The armature windings were retained in place by numerous bands, which would frequently come loose, allowing the armature to shed its windings in small pieces over the whole neighborhood.

Parallel operation of these old alternators was practiced occasionally, but it was a dangerous proceeding, not because the machines could not be operated in parallel, but because the methods of synchronizing and paralleling were crude.

The defects of the surface-wound type of armature of the first alternator led to the development of the so-called toothed type of armature, in which there was a single large tooth per pole. This permitted the substitution of machine winding for hand winding and allowed the use of 2,000 volts and even 3,000 volts between terminals.

In 1895 the Twenty-ninth Street station was equipped with the reconstructed "World Fair" machine, completed by the Westinghouse company in 1893. The engines were of the double-acting steeple compound type; the generators, which were 60-cycle, polyphase machines, marked the transitions from 133 cycles to 60 cycles, which has been retained as the standard frequency. Each alternator in the first machines consisted of two armatures and fields side by side, with the armatures displaced half a pole pitch. Each armature was wound for single-phase, but two could be used together to furnish polyphase energy. Two of these units with a rating of 1,500 kw. occupied the same floor space as one of the present 22,000-kw. turbo-generators in the Sherman Creek station. Later the capacity of the station was increased by the addition of three 500-kw. Westinghouse generators of more modern type, which were belt-driven by Corliss compound engines.

It is interesting to note that the first large turbo-generator contracted for in this country was available about 1898. This was a 1,500-kw., six-pole, 1,200-r.p.m. machine directly coupled to a Westinghouse-Parsons turbine. It was built for the United company, but was finally installed at Hartford, Conn.

The first commercial parallel operation of alternating-current direct-connected generators was successfully begun in the Twenty-ninth Street station in March, 1896. When it became necessary again to obtain additional generating capacity, motor-generator sets were installed at this station, which was supplied from the Waterside station of the New York Edison Company's 25-cycle system.

With the abandonment of the Twenty-ninth Street station in 1907, brought about by condemnation proceedings instituted by the city of New York, it became imperative to effect immediate plans for the generation of 60-cycle energy. As a temporary expedient 60-cycle generators were purchased and placed on the same shaft with the 25-cycle generators of the Edison service at the Waterside station. The motor-generator sets already mentioned were removed to the substations of the company. Two of these motor-generator sets are still in operation for emergency purposes. This arrangement made it possible to take care of the immediate requirements of the 60-cycle system with relatively small investment by using the steam equipment in the Waterside station.

Although storms played havoc with the early overhead lines and city authorities insisted on removing the overhead circuits, the operating companies viewed the use of underground circuits with great concern, because cable for this work was more or less unknown, the operation of underground high-tension circuits had been untried, and the total gross business was not sufficient to offset the subway rental demanded. Grave doubt existed as to whether an underground system could be successfully employed. Furthermore, the company questioned the right of the city authorities to compel the use of underground construction. The operating company was persistent in its demands that it be allowed to demonstrate by trial under actual service conditions the adaptability of the subway system before it was compelled to abandon or remove the overhead system. Nevertheless, in 1890 drastic steps were taken by the city authorities to remove the poles and overhead wires, the Commissioner of Public Works with a large force of men undertaking their demolition.

By 1895 135 miles of subway ducts were under rental and in use by the operating company, of which a considerable part was for the alternating-current system. At that time the company service did not extend north of Fifty-ninth Street and the gross revenue amounted to slightly less than $500,000 per year. A year later the extension of service beyond Fifty-ninth Street was commenced, and gradually it worked its way north to the Harlem Ship Canal. The company now operates more than 2,000 miles of cable of various kinds and sizes throughout Manhattan.

In the early days virtually every installation was a primary point, with individual converters for each customer rated at ten, twenty, forty and up to eighty lamps. During the days of overhead circuits the converters were mounted on poles or on the sides of buildings, whereas after the introduction of underground service they were placed in the basement.

Early service installations consisted of a Shallenberger meter, a single-throw, open-knife switch on the primary side of the surface, and a snap switch on the secondary or customer's side. This meter, which was developed in 1888 and operated on the induction principle, afforded such a simple and satisfactory method of metering that it enabled the alternating-current system to compete seriously with the direct-current system in the field of incandescent lighting. Energy was then sold on the ampere-hour basis. Soon after the watt-hour became the commercial unit of energy the Thomson and Shallenberger watt-hour meters appeared.

Series-arc lamps were originally furnished for illumination. Later multiple-series direct-current lamps were used, and still later the alternating-current type were installed. An early feature of the introduction of incandescent lighting service was free wiring, including complete installation of wiring fixtures and lamps without cost to the consumer. This practice was considered necessary at that time to introduce the company's service in competition with that of the Edison company, but it was later abandoned and never resumed.

For some time after the alternating-current system had been fairly well established for incandescent service and to some extent for power service the system was still incomplete because of the fact that no satisfactory arc lamp was in existence. Finally, however, a system was developed by William Stanley in which the Westinghouse company took an interest, spending considerable money for its development. Broad, flat carbons were used, and the lamps were operated in series in groups supplying the various customers from a common transformer in the basement of one of the premises. With the development of the inclosed multiple-circuit arc lamp the alternating-current system was able to compete in a more general way with the direct-current system.

Between 1907 and 1913 the Waterside station supplied all of the primary service for the United company. At the end of this period the Sherman Creek station of the United company was completed. This station, which was described in the *Electrical World* at the time, is now completely equipped with eight units and has a capacity of 151,000 kw. During the year 1921 it generated nearly 500,000,000 kw.-hr. and supplied consumers as far as 30 miles away. The generating voltage was originally 7,500, but a change has recently been made—13,200 volts, 60-cycle, three-phase, now being the standard. From the generating station the current passes through three-conductor feeders to the substations, where it is transformed to 2,500 volts, two-phase, for distribution to central distributing points throughout the city. These centers of distribution are determined by the connected load in the district and are shifted from time to time as conditions require. From these points primary distributing mains radiate, conveying energy to individual service transformer banks which further reduce the voltage to 110, single-phase, for lighting and 220, two-phase, for power.

The company now operates seven substations throughout its territory. Its Ninety-seventh Street substation, which is the latest addition to the system, is supplied by three-phase feeders instead of two-phase, but the lighting service is still single-phase and the power service two-phase as heretofore. This change in feeder service to the substation is a part of a general program which is intended to apply to the entire system when conditions permit of a greater load upon the existing generating transmission and distribution facilities.

Manhattan Island is divided into seventy separate sections, each of which is supplied by a separate 2,500-volt distributing feeder. Each area is controlled by a separate feeder, although the sections are interconnected by means of switches at strategic points, placed either in subway manholes or at the transformer banks. It is thus possible in the event of trouble to interconnect adjacent territories, confining troubles and interruptions of any duration to very small areas.

At the present time there are about 250 switching points throughout the city, making it possible to transfer a section from one feeder to another. In the larger and more important installations double service facilities are provided by independent feeders. Automatic switches are used in the more important installations.

The growth of business in New York is indicated by the fact that the Sherman Creek station is now supplemented by the Hell Gate station (described in the *Electrical World* of April 29, 1922), finished this year at an expense of $18,000,000.

Scoffings of Scientific Men

How Many Prominent Authorities in Europe Viewed Edison's Claims About His Incandescent Lamp System

NEITHER Mr. Edison nor any one else can over-ride the well-known laws of nature, and when he is made to say that the same wire which brings you light will also bring you power and heat there is no difficulty in seeing that more is promised than can possibly be performed. The talk about cooking food by heat derived from electricity is absurd.—*John T. Sprague, London.*

Much nonsense has been talked in relation to this subject. Some inventors have claimed the power to "infinitely divide" the electric current, not knowing or forgetting that such a statement is incompatible with the well-proved law of conservation of energy.—*Dr. Paget Higgs, London.*

Knowing something of the intricacy of the practical problem, I should certainly prefer having it in Mr. Edison's hands to having it in mine.—*John Tyndall, England.*

I think that any system of electric lighting depending on incandescence will utterly fail from an economic point of view and will be the more uneconomic the more the light is subdivided.—*Prof. Sylvanus P. Thompson, London.*

The subdivision of the light is an ignis fatuus.—*Sir William H. Preece.*

The subdivision of the electric light is impossible of attainment, and the disintegration of carbon when made incandescent rules it out of consideration for small burners.—*Fontaine, Paris.*

Development of Rates for Electric Service

Rate Systems Have Changed and Are Changing Because They Attempt to Reconcile Many Conflicting Economic and Human Elements in a Simple Formula

By E. W. Lloyd

General Contract Agent Commonwealth Edison Company

ABOUT thirty-five years ago the central-station industry depended very largely for the majority of its meter readings on the old Edison chemical meter, and electricity was generally charged for on the lamp-hour basis. The 50-watt carbon lamp burning for one hour was a standard. The electric motor was just beginning to be used, and in many instances the electricity consumed by motors was determined by taking ampere and voltage readings. An experienced man would then determine the number of hours a day the motor was used under average load conditions, and from these calculations the kilowatt-hours were determined.

Some Historical Papers

During this period the rates for electricity approximated 20 cents per kilowatt-hour for light and 10 cents for power. Electricity was charged for in blocks or steps, and in some cities at flat rates with discounts for quantity. This condition of affairs led to innumerable hot discussions on the cost of electricity supply at the early conventions of the National Electric Light Association, and it was not until 1892 that a very definite step forward was taken. Then Dr. John Hopkinson, the English engineer, presented as his presidential address to the Junior Engineers' Society of England a paper on the "Cost of Electricity Supply." This paper was a classic at the time and is still counted among the famous rate papers of the industry. In it he brought forward distinctly the different factors which have to do with the determining of rate charges in many large supply systems today. He recognized that rate charges should be divided into two distinct parts, one a demand charge covering the fixed charges to the customer, taking care of the investment factor of the cost, and the other an energy charge covering the cost of manufacturing the electricity and delivering it to the consumer.

In 1896 Arthur Wright, president of the Municipal Electrical Association of England, read a paper on cost of electricity supply before the convention of Borough Electrical Engineers at Brighton, England. In this paper he advocated a system of charging which has since become known as the Wright demand system and applies to that method on which a maximum price per unit is charged for a certain amount of energy and one or more reduced prices per unit are charged for the balance, on the block principle, in accordance with a schedule based upon the use of the maximum demand.

In May, 1900, Henry L. Doherty read a paper before the National Electric Light Association at Chicago entitled "Equitable, Uniform and Competitive Rates." This paper first established what has since become known as the Doherty or three-charge rate, which consists of a customer charge (a charge per customer or per meter) plus a demand charge plus an energy charge.

Electricity charges today are practically based on the foregoing rate systems and a few other methods, such as straight-line meter rate, which is equivalent to a flat price per kilowatt-hour; the step meter rate, which indicates that a certain specified price per unit is charged for the entire consumption, the rate depending on the particular step within which the total consumption falls, and the block meter rate, in which a certain specified price per unit is charged for all or any part of a block of such units and reduced prices per unit are charged for all or any part of succeeding blocks of such units, each such reduced price per unit applying only to a particular block or portion thereof.

The term "flat demand rate" applies to a charge for electricity based upon the customer's installation of energy-consuming devices or on the measured maximum demand. This is usually so much per watt or per kilowatt per month or per year.

Commonly Used Forms

The most commonly used of these various systems today are the block rate, the Hopkinson method and the Wright demand method.

There was no well-defined effort to encourage those in the central-station business to make more uniform the different methods of charging for electricity until 1910, when a paper presented by S. E. Doane on "High-Efficiency Lamps, Their Effect on the Cost of Light to the Central Station," encouraged the then president of the association, W. W. Freeman, to appoint a committee on rate research. The first report of this committee. of which John F. Gilchrist, Chicago, was chairman. appears in the *Proceedings* of the National Electric Light Association's New York convention, 1911. This committee has reported annually since that time, and the vast amount of data collected and made available to central-station companies by it has resulted in a very distinct movement toward uniformity of rate systems and expression.

In the report of this committee in 1912, at which time the writer was chairman, the conclusion was arrived at that there existed a "great necessity for adopting, as rapidly as possible, uniform methods of charging for central-station service. It is not alone sufficient," the report said, "that some general policy of rate making be recognized by the several companies, but it is very desirable that the actual forms in which the rates are placed before the public should be as nearly alike as possible."

Rates Becoming More Uniform

As a result of further recommendations of this committee, the weekly *Rate Research* bulletins have been issued by the National Electric Light Association ever since, and they are highly valued by every one connected with the business and interested in rate matters. This committee was also responsible for the production of the National Electric Light Association "Rate Book," which is republished annually, with corrections quarterly. In this publication are enumerated in detail the rates for cities having a population of 20,000 or more. An examination of its contents indicates the great good which has been accomplished by the work of the rate research committee in making the rate system throughout the country more uniform.

It is to be hoped that the slow progress made during the past twenty years in bringing into effect greater uniformity in rate systems will be accelerated. It seems possible that rate systems of the future could be confined to the following well-defined methods without very much difficulty: Block meter rates, flat demand rates, Wright demand rates, Hopkinson demand rates and three-charge or Doherty rates.

These methods have had sufficient trial to stabilize them, and it does not now seem necessary to add to them. In developing a rate system for any company it is extremely desirable to consider the relation of rates to different classes of service, so that in applying the various rates of the company to different quantities and hours' use of electricity there will be no conspicuous steps or jumps where the quantity and demand approximate the same at certain points in the scale. Many companies, for example, use two systems of rates, one applying to residential and small commercial lighting service and another applying to larger commercial uses. In such instances it would seem desirable that the rate steps should run into one another gradually where the smaller schedule leaves off and the larger schedule begins.

Discount Logical for Off-Peak Service

A logical modification of a rate system in common use is a discount applied in one way or another in cases where the customer uses energy off the central-station company's peak. Such modifications tend to improve the average load factor in systems which may have normally a poor load factor, and frequently they have resulted in reducing cost supply. There are undoubtedly cases where off-peak rates could not apply, but these modifications are mentioned as possible examples of accomplishing the ultimate aim of central-station companies to produce energy at the lowest possible cost. Load factor has a large influence on this situation.

In building up the electricity supply business class rates are often used until such time as sufficient experience shall have been had with the time use and conditions of demand in industries depending in a large measure for their profitable existence on favorable rates. The development of artificial ice making, the electrochemical industries, carborundum, graphite, electric steel, enameling and the heat treating of metals are examples. Ultimately such rates are merged in a general rate system, but their use, when fairly applied, is justified because of the ultimate advantage in the improvement of the load factor of a system.

One-Rate System Ideal

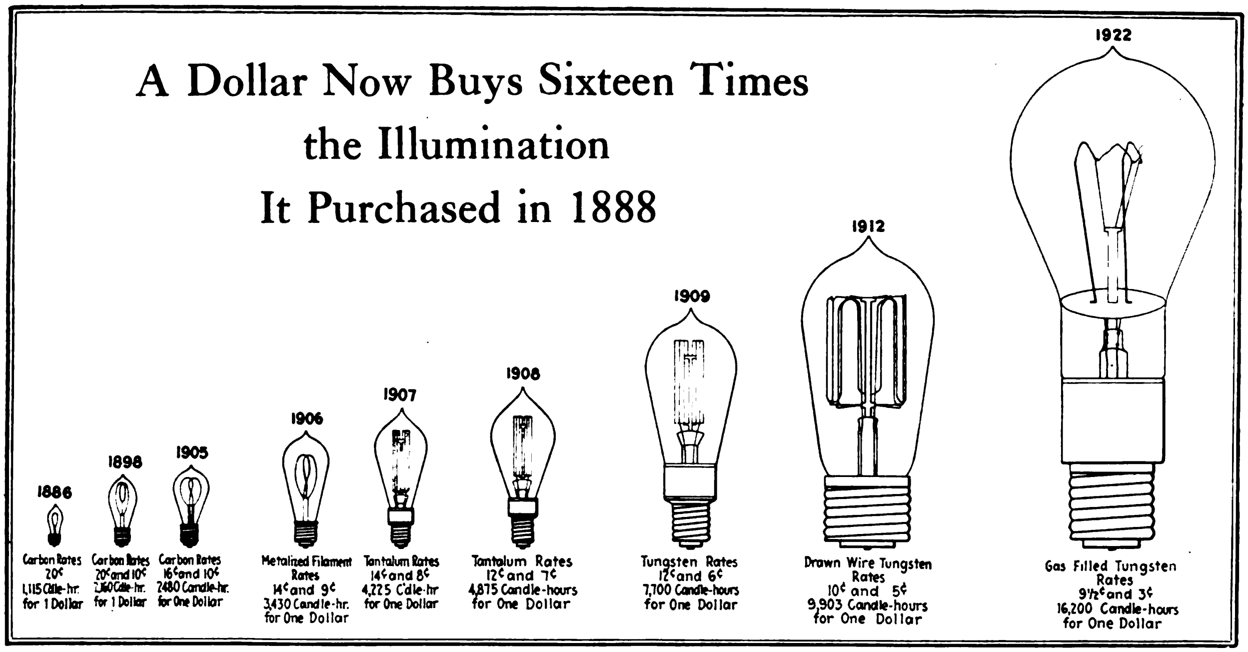
Another factor to be considered is diversity, and diversity of use by individual customers has a great deal to do with the load factor of the system, so that high individual load factors of customers plus diversity factor finally result in high system load factors, a happy combination which makes for low cost. Unquestionably, the ideal to be attained is that of a one-rate system for a company. The public is mystified to a great extent by almost any rate system now in existence for measuring electricity, and any move forward either in uniformity of expression, uniformity of system or the reduction to one rate system with reasonable modifications to take care of the exigencies of the business will go a long way toward removing the difficulties now experienced.

As we look into the future it would seem inevitable that rate methods will be constantly modified to the end that the lowest costs may be obtained. Through the constant study of new methods of use in industry and elsewhere our intelligence as a nation in realizing the necessity for the economy obtainable by time of use—in other words, the betterment of diversity and load factors —will bring about a situation where the most economical point of generation will be reached. As this study proceeds simplification will undoubtedly follow. Any complications in rates today are the results of our attempts to build up a business which is still young and the future of which is unknown.

To encompass the desired results the experience of the past must be utilized to the full and further laborious experimentation and analysis will be required. Yet every indication points to a successful solution of the rate problems confronting the industry. Not the least element in the situation is the necessity for full publicity about rates and an educational campaign to acquaint the public and the industry with the basic elements in the rate problem.

Milestones in the Early Development of Electricity

1745—Electric charge isolated; Leyden jar—Von Kleist.
1800—Primary battery—Volta.
1803—Storage battery—Ritter.
1805—Electroplating—Brugnatelli.
1810—Carbon arc—Davy.
1815—Electric furnace—Pepys.
1819—Electricity from magnetism—Oersted.
1821—Electromagnetic rotation—Faraday.
1823—Thermo-electricity—Seebeck.
1825—Electromagnet—Sturgeon.
1831—Magnetism from electricity—Faraday.
1832—Permanent magnet generator—Pixii.
1832—Rotary magnet motor—Sturgeon.
1832—Electromagnetic telegraph—Morse.
1834—Electric boat—Jacobi.
1835—Electric car—Davenport.
1840—Incandescent lamp—Grove.
1844—Arc lamp—Foucault.
1856—Shuttle-wound armature — Siemens.
1863—First commercial alternator—Nollet.
1860—Lead storage battery—Planté.
1860—Telephone—Reis.
1870—Ring armature—Gramme.
1873—Stanley generator; Thomson generator.
1873—Drum armature—Rowland.
1875—Arc lamp and generator—Brush.
1876—Jablochkoff candle.
1876—Commercial telephone—Bell.
1879—Carbonized-paper filament lamp —Edison.
1882—Commercial generating station, Pearl Street; three-wire system —Edison.
1884—Alternating-current system acquired by Westinghouse.
1884—Transformer—Stanley.
1886—First regularly operated alternating-current generating station, Greensburg, Pa.
1886—Electric welding—Thomson.
1887—Richmond street railway—Sprague.
1888—Shallenberger meter and induction motors of Tesla and Ferraris.
1890—Polyphase transmission in Colorado.
1890—Electric automobile.
1891—Automatic telephone in Chicago —Strowger.
1895—Niagara Falls, 25-cycle generators; stationary armatures and revolving fields.
1895—X-rays—Roentgen.
1895—Radio—Popoff.
1896—Radio system—Marconi.
1900—1,500-kw. steam turbo-generator in Hartford.
1903—First all-turbine central station at Fisk Street, Chicago.
1906—Radio telephone—Collins.
1906—New York Central Railroad electrification.
1907—Tungsten-filament lamp — Langmuir.
1907—New York, New Haven & Hartford electrification.
1913—Gas-filled lamp—Langmuir.



Development of Electric Lamps

The Growth in the Use of the Incandescent Lamp Has Stimulated the Use of Electricity for Power Purposes

By J. R. Colville
Engineering Department, National Lamp Works

ELECTRIC lighting, in an experimental way, was an accomplishment of more than a hundred years ago. Nearly sixty years, however, after the introduction of the electric arc (1810) it still remained for some one to develop a practical lighting unit which could be universally applied to all lighting purposes, both commercial and domestic. The year 1875 marks the beginning of the development of such a unit, and with the introduction of Edison's first incandescent lamp in 1879 the electrical industry was really started. With our present knowledge of the many accomplishments in electric lighting during the past forty years, a reference* taken from Mr. Edison's personal notes made in the early days is of particular interest as an indication of the vision of the man. It was his object "to effect exact imitation of all done by gas, so as to replace lighting by gas with lighting by electricity; to improve the illumination to such an extent as to meet all requirements of natural, artificial and commercial conditions."

It would be impossible here even to mention all of the problems that were solved and the obstacles that were overcome in bringing the incandescent lamp to its present state of development.

Some idea of the growth of the electric lighting industry can be gained from the fact that during the year of the introduction of the carbonized bamboo-filament lamp 25,000 were made and sold. In recent years the annual consumption of incandescent lamps in this country has passed beyond the two-hundred-million mark.

This popularity has not been due alone to the fact that light has become increasingly easier to obtain as improvements in lamp quality are recorded, nor to the constantly decreasing cost of electrical energy, but to the fact that the real value of good lighting has been gaining ever greater recognition. The higher efficiency of the modern incandescent lamp has of necessity brought about an increase in the brightness of the lamp filament which has made it very important to guard against the harmful effects of glare. With the several types of diffusing bulbs and accessories now available. light can be used in abundance without the discomforting effects of brightness. As an indication of the increasing use of light in the many fields in which the incandescent lamp is found today, the chart at the top of this page gives conditions for the period 1888 to 1922.

*John W. Lieb, Brooklyn N. E. L. A. *Bulletin*, May, 1915.

LUMENS PER WATT INCREASE

It would be only natural to suppose that with the many improvements in lamp efficiency, and with the increased efficiency with which electrical energy can be generated and distributed, the cost of light today must be only a fraction of what it was forty years ago. In 1885 the 16-cp. carbon lamp was sold for $1. The cost of energy was in the neighborhood of 20 cents per kilowatt-hour. Based on these figures, the consumer of that day received only 98 lumen-hours for one cent.

Between the years 1885 and 1906 the cost of energy decreased from 20 cents to about 11 cents per kilowatt-hour; the price of the 16-cp. carbon lamp decreased from $1 to 20 cents, and the efficiency of the lamp improved from 2.5 lumens to about 4 lumens per watt. The result of these developments was a decrease in the cost of light such that in 1906 it was possible to get 302 lumen-hours for 1 cent.

After the introduction of the "Gem" lamp (5 lumens per watt) and a further decrease in cost of energy, this figure was raised to 385 lumen-hours just before the tungsten-filament lamp came into the market. The tantalum lamp was so quickly superseded by the more efficient tungsten-filament lamp that no data are given for it.

During the period following the introduction of the tungsten-filament lamp until the war period decreases in the cost of lamps and energy and increases in lamp efficiency all contributed to further phenomenal reductions in the cost of electric light. By the end of 1916, with an average energy cost of about 8 cents per kilowatt-hour, a price of 27 cents for the 40-watt "Mazda" lamp and a lamp efficiency of 9.5 lumens per watt, the consumer got 1,098 lumen-hours for 1 cent. This was more than eleven times as much as in 1885.

Now, in 1922, the cost of light is again on the downward trend. Although the average cost of energy is still at 1920-21 levels, some increase in lamp efficiency, combined with decreases in lamp cost, make it possible for the consumer to obtain about 1,138 lumen-hours for 1 cent, which makes the cost of light with the 40-watt "Mazda" lamp less than at any other time in the history of incandescent lamps.

Great Advances Made in Meters

Starting in 1872 with Magnetically Regulated Clock Meter, Development Has Proceeded Along More than 190 Lines—Greatest Development in Last Twenty-five Years

By P. H. Bartlett

Engineer Meter and Instrument Department, Philadelphia Electric Company

"'MEASURE for measure' has ever been the underlying principle of the trade of the world. Where values cannot be measured we demand averages based upon long experience. Where it is possible to measure goods delivered the ingenuity of man is untiring until some means is found adapted to the uses of all the traders of the world. It is only so far as we can draw from nature's limitless supply of necessaries and blessings 'without money and without price' that we fail to find in these days a meter check upon our consumption. As long as people live in civilized communities water and artificial light will represent somebody's labor, and as they come to be more and more generally used they must be more and more accurately measured."

The foregoing excerpts from a paper on "Electricity Meters" written by W. J. Jenks in 1888 express in a few words the reasons for a development which has kept pace with, and exceeded perhaps in some respects, the advances made in many of the other branches of the industry. The demand for an accurate method of measuring electricity was contemporaneous with its availability as a marketable commodity, and this demand presented the problem of measuring a commodity invisible and without mass. It has been said that more than 190 different electrical, electrochemical and electromechanical lines of approach have been utilized in the attempt to create an electricity-measuring device which would be accurate and also rugged and inexpensive. The millions of electricity meters in use at this time are silent witnesses as to how well this work has been accomplished over a comparatively short term of years.

Progression in the earlier development of electricity meters followed, generally, three distinct operating principles. These were (1) the application of electricity to vary the speed of otherwise uniformly driven clockwork or actually to impart motion to a clock mechanism, (2) the chemical effects of electricity upon various liquids, either in altering the weight of previously standardized electrodes or (3) through devices translating chemical action into mechanical work.

All of the above operating principles have given place to the motor type of meter wherein the electromagnetic force of the current is translated into rotating motion suitably limited and made to drive a registering mechanism. While these are the fundamental lines along which invention has proceeded, many other principles have, of course, been utilized with more or less unsuccessful results.

FIRST METER HAD CLOCK MECHANISM

The first electricity meter in which electromagnetic action was utilized in connection with a clock mechanism was the integrating meter for which a patent was issued to Samuel Gardiner in 1872. This meter was composed of a spring-driven clockwork with a train of dial gears which were locked in place except when an electromagnet in series with the line was energized, releasing the stop. This allowed the gears to rotate and the meter to register. The meter, therefore, indicated the duration of current flow rather than the quantity, but as the early electrical installations were not subdivided into branch circuits and all the lamps were used at the same time, the quantity used could be calculated from the meter readings, provided that the number of lamps and the energy taken per lamp were also known.

An alternating-current variation of this meter was patented by J. B. Fuller in 1878, consisting of a polarized armature vibrating under the influence of an electromagnet in such a manner that the vibrations were recorded upon a suitable dial. Devices similar to these were patented by William E. Sawyer in 1878 and J. Finney in 1880, but they did not develop them commercially.

These meters probably filled the needs of the period, as the commercial utilization of electricity was still very limited, although rapidly growing. This growth, combined with improvements in utilization devices and transmission, soon created a keener demand for meters, however, and from 1880 to 1885 such men as Hudson Maxim, S. De Mott, H. M. Byllesby, R. P. Diehl and Edward Weston in America, Jules Canderay in Switzerland and C. V. Boys and S. Ferranti in England were busy developing clockwork devices for the measuring of electricity.

The majority of these devices operated by electromagnetically oscillating a pendulum or balance wheel geared to a spring-driven clock movement to which was connected a train of registering gears, or else the rate of oscillation of a pendulum was electromagnetically altered. This was usually accompanied by solenoid control and resulted in a corresponding alteration in the speed of the clock mechanism. Variation in this scheme, as in the Aron meter (1887), consisted of comparing the speeds of two pendulums, one oscillating at a constant predetermined speed, the other having the period of vibration accelerated through the agency of an electromagnet in series with the line. Vibrations from the more rapidly moving pendulum were translated into rotary motion through differential gearing and transmitted to a ratchet and pawl mechanism, advancing a dial train. In another of the same general form, which was perfected by S. De Mott in 1885, the length of the pendulum, and consequently its vibration period, was decreased according to the rate of current flow in a series electromagnet.

Chemical Meter Was First Commercial Success

In 1881 Thomas A. Edison produced the Edison chemical meter for direct current, this being the first meter which was commercially successful on a large scale. This meter consisted of an electrolytic cell containing copper electrodes in a copper-sulphate solution, and the principle of operation depended on Faraday's law of electrolytic deposition. Metal was removed from one plate (anode) and deposited on the other (cathode) in amounts proportional to the rate and duration of the flow of current. The meter was, therefore, strictly speaking, an ampere-hour meter, and the quantity of electricity used was determined for each month or billing period by replacing the electrodes and determining the change in weight of the electrodes removed.

Prior to the perfecting of this meter Edison had invented three others, of the electrochemical type, which he called "Webermeters." One was arranged as a tilting beam in which, owing to the decomposition of metal, the heavier end sank, closing an electrical contact and righting the tube. This motion was transmitted to a train of gears. In another meter water was decomposed under a bell jar, the resultant gases causing the jar to become buoyant. On rising in the liquid in which it was floated it closed a contact which advanced a dial train through an electromagnet. From 1881 Edison took out several patents on electrochemical meters in which decomposition of water was made to alter the weight of the container and the consequent loss of balance was translated into mechanical work by oscillating and rotating members. In 1883 he changed the composition of the electrodes and also the electrolyte of the Edison chemical meter from copper and copper sulphate to zinc and zinc sulphate, and this was the final form in which many thousands were manufactured and used. Other inventors who designed meters depending upon electrolyte or electrochemical action were J. Green, Elihu Thomson, Johnston and Vanderpoel in America and S. Ferranti in England. The Bastian meter, which decomposed water, the amount of current flow being determined by the amount of liquid left undecomposed, was also of this period and was also commercially successful, but not to the same extent as the Edison meter.

All of the types enumerated up to this time were ampere-hour meters, and, further, the majority of them, particularly the chemical type, were suitable only for direct current. From 1886 on the development of alternating-current machines and systems had progressed to the point where this form of energy began to come into commercial use, and the development of the alternating-current meter naturally followed.

In 1888 the forerunner of our modern types of alternating-current meters, the rotating induction meter, was invented by O. B. Shallenberger. This meter consisted of a metal disk rotating in a magnetic field, produced by a cell in series with the line, combined with that of a fixed short-circuited secondary. The speed was kept proportional to the rate of current flow by means of an air-vane or fan damping system.

Edison in 1881 had invented a motor meter of the commutator type, without iron, for use on direct current, and George Forbes in London in 1886 developed a novel meter in which a delicate fan was rotated by the currents of air arising from a heated conductor directly underneath it, the heating, and consequently the air currents, being proportional to the rate of current flow. This last was applicable to either direct or alternating currents. The use of the Edison motor meter was not encouraged by its inventor, and the Forbes meter was not a commercial success on account of its delicacy and extreme sensitivity to disturbing outside influences.

In 1889 the Thomson recording wattmeter, with which nearly all electrical men are familiar, was patented by Elihu Thomson. This meter is a motor type with a wound armature connected across the line and with series fields carrying the line current. The current in the armature is kept in proper direction to insure continuous forward rotation by means of a commutator and brushes. The speed is controlled by eddy or Foucault currents generated in a disk rotated by the shaft of the meter between the poles of permanent magnets. This meter was the first true wattmeter and was for a long time used on both direct and alternating current, but the later rapid development of the induction-type watt-hour meter for alternating currents and in a less expensive form soon limited the Thomson meter to the direct-current field, where it is today, in its later modifications and improvements, one of the leading types of modern meters.

Improvements in the induction ampere-hour meter of Shallenberger, made over a period of years and by many engineers of different manufacturing companies and consisting of the utilization of a shunt and series coil, producing a rotating magnetic field, the substitution of damper magnets for the air vanes and the use of a single disk for the double purpose of driving and damping, converted this meter into a true watt-hour meter. These and other improvements and refinements in design and manufacture have gradually resulted in the production of a highly accurate, lighter and less expensive meter with a greatly improved appearance over the early models.

The improvements both in direct-current and in induction meters are due to the work of such men, among others, as Shallenberger, W. Stanley, Thomas Duncan and M. M. Slattery in America, H. Aron in Germany and S. Ferranti, Faure and Forbes in England.

Different Principle Applied

In 1886 F. Borel and E. Paccand, in Switzerland, developed a new rotating meter using a different principle from any so far utilized. This was based on the fact that a current-carrying fork will rotate if suspended above a bar electromagnet in such a manner that one branch is pivoted and the other is free to rotate around it, the current being conducted to this latter branch through a mercury bath. Edison in 1887 experimented with this meter, but S. Ferranti in England patented in 1886 what was undoubtedly the forerunner of the mercury type of meter as known today. It consists of a disk immersed in mercury and caused to rotate by passing current through it while the disk is subject to the influence of a magnetic field. Ferranti made several later improvements to the meter, and in 1904 the Sangamo company placed on the market a line of meters based on the same principles, a method still employed, although refinements in design and modern manufacturing and testing methods have greatly improved the product.

SOME UNUSUAL TYPES DEVELOPED

Many of the early inventors resorted to most complicated measures to obtain their results. Among the most interesting of these are the St. George Fox meter of England (1883), in which the flow of water through an orifice was controlled by a valve operated by a solenoid in series with the line; the Patterson meter in 1886, which utilized a spot of reflected light from a galvanometer mirror to a uniformly moving strip of sensitized paper (which was probably the forerunner of our modern graphic meters), and the Hansen meter of 1889, in which an hour-glass containing sand was employed, the flow being solenoid-regulated proportionately to the rate of current flow.

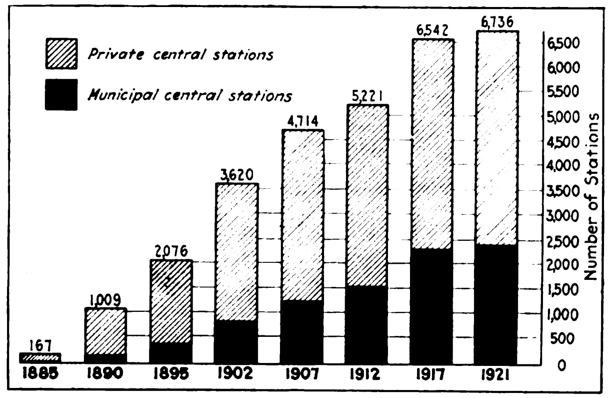
In the time which has elapsed since the earlier meters were made there have naturally been many types produced for special purposes, such as the two-rate, prepayment and so forth, and the development of the polyphase naturally followed the single-phase meter. All of these have, however, been merely modifications in construction of the standard designs. While the development noted has occurred over a period of fifty years and while the fundamental principles on which this development centered were evolved thirty to forty years ago, the refinements in design and detail by which electricity meters have reached their present state of perfection have taken place only in the last twenty-five years. The present types of alternating-current meters, for instance, have been in production for only seven or eight years, and standardization among the manufacturers and improvements in detail of construction are still proceeding.

Further improvements may no doubt be anticipated until the claim already made—that it is questionable if there is today any commercial measuring device which equals from the viewpoint of accuracy the modern electricity meters—will be unquestioned.

Growth of the Electrical Industry Must Continue

IT IS probable that no primary industry in the country can present such an array of figures of growth as are to be found in the accompanying diagrams and others in this issue concerning the electric light and power industry. The infant among industries has grown until at the present time it is second in invested capital among manufacturing industries.

The energy generated has almost quadrupled during the past ten years, owing very largely to the growth in the use of electrical energy for industrial power purposes. From 1882 to 1902 the energy distributed by central stations was used mainly for lighting, but since that date the industrial load and the electric railway

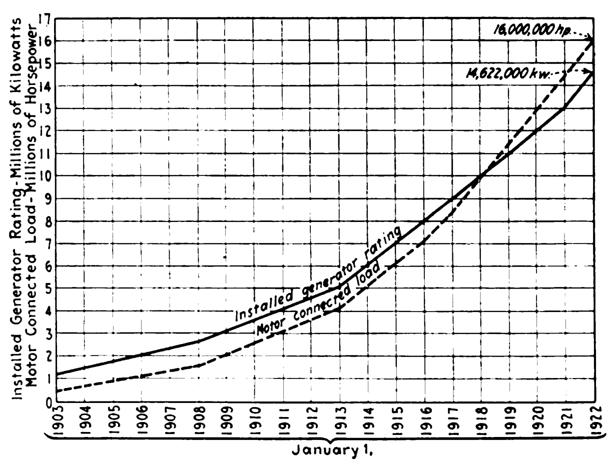


PRIVATELY OWNED CENTRAL STATIONS HAVE ALWAYS OUTNUMBERED MUNICIPAL PLANTS

energy consumption have rapidly grown until in 1921 the energy consumed for lighting was only about 23 per cent of the total sold to all classes of customers. In 1920 more than twenty-three billion kilowatt-hours of electrical energy were sold to industrial power customers alone, which is more than the total amount of energy generated by all the central stations for all purposes during 1917. Almost every month of the present year has witnessed record central-station operations, and it is probable that when the totals are available at the end of the year the fifty-billion kilowatt-hour output mark will be found to have been passed.

The capital invested in the electric light and power industry was only about $5,000,000 in 1885, or three years after the establishment of the first central station. At the end of 1921 this figure had increased to $4,600,000,000, and it will probably total about $5,000,000,000 by the end of the present year. The gross revenue last year reached $933,000,000 and without doubt will pass the billion-dollar mark in 1922.

With all this wonderful growth behind the industry the field is far from crowded. Only about one-third of



GROWTH IN TOTAL INSTALLED GENERATOR RATING HAS AVERAGED ABOUT 10 PER CENT PER YEAR

the people of the country are enjoying the luxuries of electric light and electric labor-saving devices in their homes, and more than one-third of the people of the country are living in districts not reached by central-station service. Less than two-thirds of the primary horsepower of the manufacturing plants of the country is electrical, and only about 58 per cent of electric motor rating is at present being run by central-station energy.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

What Benefits Can Be Expected from Laminated-Frame Arc-Welding Generators?

To the Editors of the Electrical World:

The majority of phenomena met with in electrical engineering practice result from magnetic fluxes interlinking with electric circuits and varying more or less rapidly in intensity, direction or both. For example, in the oscillating current circuits of radio telegraphy the term "rapidly" may mean several hundred thousand cycles per second. In industrial apparatus 100 cycles per second is a relatively high frequency, and, compared with variations occurring in direct-current circuits as results of changes in load resistances, switching apparatus on or off, etc., 25 cycles per second is a high frequency.

The fact that the expression "rapidly changing flux" is a relative term is not given due consideration in the design of certain types of machines, considerable expense being incurred to meet conditions which are not actually encountered. Thus, in the publications of some manufacturers of arc-welding generators we are informed that laminated frames permit a very rapid change in the amount of "magnetism" or "flux density," and this in turn makes it possible for the electric current to adjust itself almost instantly to any demand. The idea which it is intended to convey probably is that a rapid change of flux permits a rapid change of terminal voltage so that a substantially constant current can be maintained when the resistance of the arc circuit varies rapidly. Therefore, the statement obviously applies to the so-called "variable-voltage" or "constant-current" generators only.

In these types of generators the terminal voltage varies to a greater or less extent in opposite sense to the current in the arc circuit, the object being to overcome the inherent instability of the arc. In general there are two ways in which this voltage regulation is accomplished. One method is to use the main current in some way or other to modify the magnetic field so that the terminal voltage will decrease as the current increases and vice versa. The other is to use variations in the resistance of the arc to accomplish the same purpose. A combination of both may also be employed. The object of laminating the frame is then to avoid the well-known damping effect of eddy currents which would flow in a solid frame when the flux changes and thus cause sluggishness in response to variations in the external circuit.

In most arc-welding generators on the market the former method of voltage regulation is used, the demagnetization in a great many being effected by a differential series field. With this arrangement there is obviously no tendency for the flux to change until the main current changes, and it follows that whatever tends to retard current changes in the arc circuit will also cause the flux to become more sluggish in response to changes. That is to say, in this respect a reactor in the arc circuit has the same damping effect as eddy currents in a solid frame, and it seems evident that when a reactor of appreciable size is used, because of its capacity to store energy, lamination of the frame is an entirely needless precaution.

That the benefit gained by laminating the frame is in many instances greatly overestimated is shown by the following paragraphs taken from a catalog:

"As an aid to obtaining quick response to circuit conditions the complete magnet structure of both generator and converter is laminated."

"In the generator, as regulation is obtained by distortion of flux in the interpolar space surrounding the armature, under immediate response to the armature current variations, and as the flux in the poles and field ring remains substantially undisturbed, no damping action results from currents circulating in the field windings or solid masses of iron in the magnet structure; therefore a pronounced freedom from lag exists during the welding operation."

It seems self-evident that when the magnetic conditions are such that no damping action results from currents circulating in the solid masses there is no need of laminating the frame.

To derive any substantial benefit from a laminated frame certain conditions are obviously essential. If the magnetic field depends on the arc current there should be no external devices tending materially to retard current changes in the arc circuit. All other possible closed circuits, such as may be formed by the rivets and laminations in the poles, must be avoided. The generator-field circuits must be designed to have very large time constants.

If designers of such generators would give a little more explicit explanation as to what extent beneficial results can be reasonably expected from a laminated frame, it would be of great interest to users of such machines as well as engineers in general.

K. L. HANSEN,
Electrical Engineer.
Milwaukee, Wis.

Differential Protection

To the Editors of the Electrical World:

The Merz-Price balanced protective gear, which is most commonly used in England to isolate electrical equipment when faults occur within the apparatus, has some defects which cause delay or uncertainty in operation. The current transformers which are inserted in each phase winding do not give protection in the case of a fault developing between different turns of one phase. Eventually a short circuit to another phase or to earth takes place, and the circuit is opened, but by the time this happens much damage may have occurred.

Difficulties also arise owing to the differences in the magnetic characteristics of the transformers, but these can be eliminated by a modified system in which the two ends of a phase winding are passed through the core of a single transformer. The first difficulty still remains unsolved, and protection is incomplete. However, a method has been advanced which removes the dangerous effects of both sources of trouble. It involves the use of potential transformers or reactance coils across each phase and current transformers in the leads connecting the midpoint of the generator with mid-point tappings on the reactances. The device has not yet been tried on large machines, but has given satisfactory results in the laboratory tests.

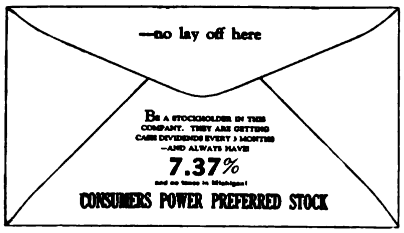
Liverpool, England. MARK MEREDITH.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Every Envelope Aids Stock Sales

ON THE back of each envelope mailed by the Consumers' Power Company of Jackson, Mich., attention is called to the advantage



COMPANY MAIL ADVERTISES PREFERRED STOCK

of the company's preferred stock as an investment. Thousands of these envelopes sent out keep the customer ownership idea constantly in mind.

Denver Company's Trouble Department Eliminates Delay

THE Denver (Col.) Gas & Electric Light Company by a system of trouble dispatching has developed a highly efficient method of handling trouble calls in that city. This has been accomplished through a service department which has been so organized as to eliminate as far as possible any lost motion or delay between the time a customer calls in to report trouble with his service and the arrival of a repair man on the customer's premises.

All trouble or complaint calls are referred by the telephone operator to the service department in the main office, and the employee answering the call inquires fully regarding the nature of the trouble so as to be able to refer the call at once to the proper department.

Electric complaint and trouble orders are classed under two general heads, namely, electric trouble and appliance trouble. Electric trouble orders are referred to the trouble department and appliance trouble orders to the appliance repair and adjusting department, the latter being an adjunct to the new-business department.

The trouble department personnel consists of both inside and outside troublemen, all of whom report to a trouble dispatcher whose office is at the company's warehouse in the wholesale district of the city. Inside troublemen report at the warehouse only when going on duty and subsequently report by telephone from stations located in the district within which they operate.

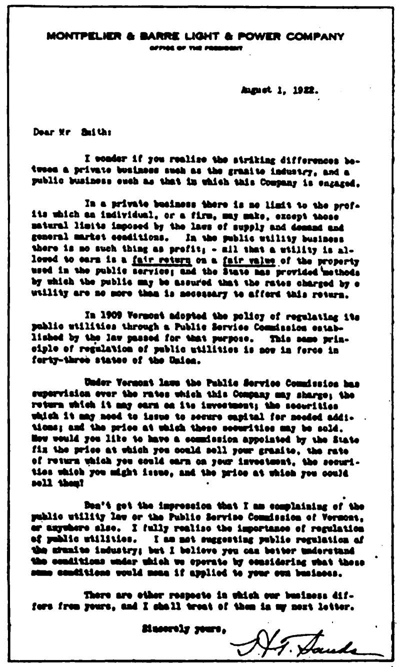
The city of Denver covers an area of approximately 58 square miles, and at present it is divided into four general districts. Police stations and gas or electric substations are used by the inside troublemen in making telephone reports, and when all outstanding orders are executed one of these places is used by the troubleman as his headquarters awaiting further orders.

The inside troublemen at present rectify or clear trouble within the customer's premises only and do not attempt to do any pole work. It is hoped that at some time in the future these men can be trained to take care of line as well as inside trouble. The outside troublemen report and make their headquarters at the warehouse and are sent on only such calls as appear to require a lineman.

The present personnel of the trouble department consists of four outside troublemen, six inside troublemen and two trouble dispatchers. The working hours of these men are so arranged that during the afternoon two men work within a district ordinarily covered by one man during the morning hours. The working schedule of the outside troublemen is so arranged that two men are on duty during the afternoon and evening. With this arrangement the company is able to give very satisfactory service without great expense. The period of the individual outage has been materially reduced, and customers appreciate that the company is trying to render service as near 100 per cent as possible.

Explaining the Public Utility to Another Industry

THE president of the Montpelier & Barre (Vt.) Light & Power Company, H. T. Sands, is a firm believer in the policy of telling the utility story to the public. Not long ago the Montpelier company sought



MONTPELIER & BARRE LIGHT & POWER COMPANY
OFFICE OF THE PRESIDENT

August 1, 1922.

Dear Mr Smith:

I wonder if you realize the striking differences between a private business such as the granite industry, and a public business such as that in which this Company is engaged.

In a private business there is no limit to the profits which an individual, or a firm, may make, except those natural limits imposed by the laws of supply and demand and general market conditions. In the public utility business there is no such thing as profit; - all that a utility is allowed to earn is a fair return on a fair value of the property used in the public service; and the State has provided methods by which the public may be assured that the rates charged by a utility are no more than is necessary to afford this return.

In 1909 Vermont adopted the policy of regulating its public utilities through a Public Service Commission established by the law passed for that purpose. This same principle of regulation of public utilities is now in force in forty-three states of the Union.

Under Vermont laws the Public Service Commission has supervision over the rates which this Company may charge; the return which it may earn on its investment; the securities which it may need to issue to secure capital for needed additions; and the price at which these securities may be sold. How would you like to have a commission appointed by the State fix the price at which you could sell your granite, the rate of return which you could earn on your investment, the securities which you might issue, and the price at which you could sell them?

Don't get the impression that I am complaining of the public utility law or the Public Service Commission of Vermont, or anywhere else. I fully realize the importance of regulation of public utilities. I am not suggesting public regulation of the granite industry; but I believe you can better understand the conditions under which we operate by considering what these same conditions would mean if applied to your own business.

There are other respects in which our business differs from yours, and I shall treat of them in my next letter.

Sincerely yours,

H. T. Sands

ONE OF A SERIES OF LETTERS TO POWER CUSTOMERS

to increase its power rates because of increased costs of operation, but this was disallowed by the state commission following extended hearings in which representatives of the granite industry appeared in opposition to the company. Instead of concluding that nothing further could be done, Mr. Sands decided to go straight to the granite industry and tell it the story of fundamental economics upon which the company is obliged to function, with the idea of then presenting its needs to the commission and seeking a rate readjustment on the basis of a better understanding on the part of the dominant industry of the locality.

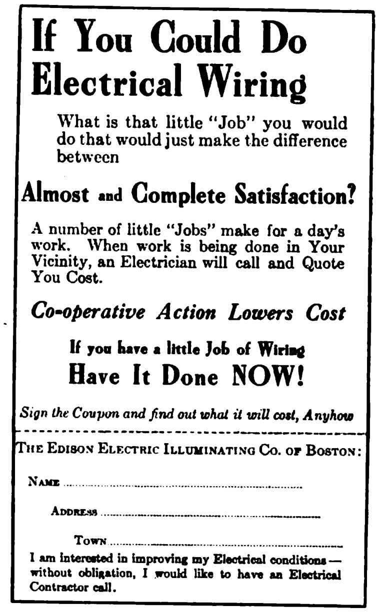
A series of letters, one of which is reproduced here, was therefore prepared and sent to about 110 leading concerns. While the granite industry has since been greatly disturbed by labor troubles, much interest in the company's presentation has been noted. A better understanding of the company's position now exists in the territory, and the comparisons between the public utility and the private business with which the letters largely occupy themselves have brought home to thinking business men the vital necessity of maintaining a prosperous electric utility for their service and for the service of the general public.

Advertising Electric Service Along the Highway

IN A GORGE below the highway the hydro-electric plant of the Central Connecticut Power & Light Company at Leesville, Conn., can be seen through an opening in the trees, as in one of the accompanying illustrations, and to inform passersby about the station and the company's service the rustic sign is in use. This sign is double-faced and calls attention to the communities served by the company besides carrying the well-known slogan of the Society for Electrical Development. On the wooded hillside behind the station a second effective sign is installed, featuring the two main divisions of electrical supply from the system. L. P. Perry is general manager of the company.

Aiding Customers to Install Convenience Outlets

MANY persons go without needed outlets in their homes bcause they do not know what they will cost and hesitate to call in a contractor



If You Could Do Electrical Wiring

What is that little "Job" you would do that would just make the difference between

Almost and Complete Satisfaction?

A number of little "Jobs" make for a day's work. When work is being done in Your Vicinity, an Electrician will call and Quote You Cost.

Co-operative Action Lowers Cost

If you have a little Job of Wiring
Have It Done NOW!

Sign the Coupon and find out what it will cost, Anyhow

THE EDISON ELECTRIC ILLUMINATING CO. OF BOSTON:

NAME ....

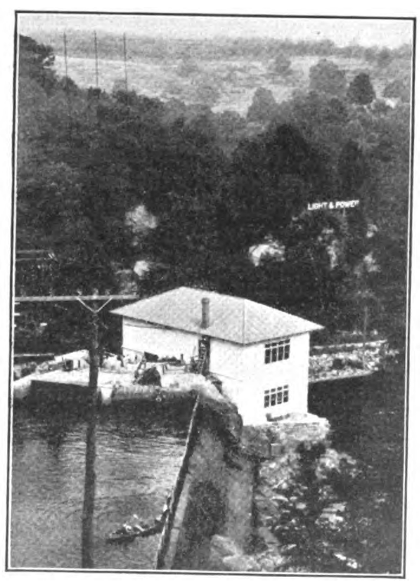
ADDRESS ....

TOWN ....

I am interested in improving my Electrical conditions—without obligation, I would like to have an Electrical Contractor call.

POST CARD INVITING REQUESTS FOR ESTIMATES ON WIRING JOBS

for an estimate on a small job. To make it easy for its customers to find out without obligation what the installation of convenience outlets or extensions to their wiring will cost, the Edison Electric Illuminating Company of Boston has sent out the card shown here inviting requests for estimates.



RUSTIC SIGN CALLS ATTENTION TO HYDRO PLANT LOCATED IN GORGE

This is an interesting and valuable form of service to customers and should result in greater residential consumption of energy and a consequent increase in revenue for the Boston Edison company.

What Other Companies Are Doing

Lexington, Ky.—Another indication of the volume of new business which is being secured by central-station companies is seen in the merchandise sales of the Kentucky Utilities Company, which for the week ended July 29 amounted to $12,374. Included in this amount were fixture contracts for four residences at Glasgow and for a new hotel at Middlesboro, Ky. Twenty-four fans, thirty-six irons, two washing machines, one electric range, four electric signs, two transformers and two pumps were sold.

Dayton, Ohio. — The Dayton Power & Light Company has for some time kept a record of the service of its meter readers, showing the number of meters read and the number of errors made. Lee Wehkamp during the year 1921 read 65,949 meters and made only eleven errors. This is the best record that has ever been made in that organization. The record for the year 1922 to date is held by Chas. O'Brien, who read 5,762 meters during the month of April with only one error. The Dayton Power & Light Company maintains a premium-penalty plan of meter reading which has worked out very satisfactorily.

Chicago, Ill.—An analysis of the 13,000 stockholders of the Public Service Company of Northern Illinois shows that 35.6 per cent of the total stockholders are women and that they own 28.58 per cent of the total stock. Comparing this with the 61.72 per cent of stockholders who are men and who own 56.64 per cent of the stock, it is readily seen that a good proportion of the owners of the company are women. Stocks owned by trustees, estates and joint owners are only 2.58 per cent of the total number of owners. One out of every eleven men, women and children of the town of Worth, Ill., owns some stock. Although this town has a population of only 250, it appears that the public ownership idea of utilities is well established in the minds of the residen's.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press from All Parts of the World

Hydro-Electric Development and Steam Equipment

Heat Losses from Bare and Covered Wrought-Iron Pipe at Temperatures up to 800 *Deg. F.*—R. H. HEILMAN.—Heat losses from pipes under high-temperature conditions are of importance. This paper presents the finding of an experimental investigation conducted in the Mellon Institute of Industrial Research of the University of Pittsburgh. Losses from bare pipes have been measured for temperatures up to and including 800 deg. F. and have been carefully studied for pipes of various diameters. Empirical formulas are presented whereby the loss from insulated pipes of any diameter may be readily calculated.—*Mechanical Engineering*, July, 1922.

Vibration and Critical Speeds of Rotors.—C. RODGERS. — The critical speed of rotors can be calculated with sufficient accuracy for practical purposes, and as a rule the running at speeds not in the neighborhood of that indicated by the calculation is free from vibration. But cases occasionally arise where troubles from vibration occur at speeds above or below the calculated critical speed. The author discusses the various subsidiary causes which might lead to unsatisfactory running at other than the usual calculated critical speed. The basis of the article is a physical one, but the treatment is largely mathematical. The author confines himself to a single-part rotor, rigid as regards bending and mounted on an elastic shaft running in rigid bearings. Some effects of non-rigidity of the rotor and bearings and of alterations in the thickness of the oil film in the bearings are considered.—*Philosophical Magazine*, July, 1922.

Heat Balance and Electrical Equipment in the Gennevilliers Station.—R. H. ANDREWS.—In connection with the electrical equipment and heat balance of this station the following features are of particular interest: Cooling of the generators is performed by air moving in a closed circuit with provision for use of this waste heat in the first stage of feed-water heating; a high-tension switch house, equivalent to an American outdoor switchyard, is inclosed in a remarkably light reinforced-concrete structure, and all auxiliaries except the boiler-feed pumps are electrically driven from station buses fed by the main bus. In this plant the feed water is successively heated by generator-cooling air and the oil coolers, steam bled from the seventh and eighth stages of turbines, exhaust steam from boiler-feed pumps and steel-tube economizers. The stage bleeding and the use of air preheaters in the boilers are outstanding features of this large French station.—*Power*, Aug. 15, 1922.

Generation, Control and Switching

Considerations Relating to the Design of Oil Circuit Breakers.—D. R. DAVIES. —The generation of explosive pressures is investigated and approximate data are given in this article, which is the third of a series. Constants, together with the explosive limits, are also determined for a given analysis of gas. The explosive pressure produced in a breaker is considered under three headings—(a) the pressure produced in the tank simultaneously with the sudden formation of a comparatively large volume of gas in a confined space, (b) the pressure in the chamber due to the gas from the arc rising, and (c) the pressure due to the ignition of the explosive mixture present above the oil level.—*Electrician*, July 28, 1922.

Switching of Direct and Alternating Currents in Inductive Circuits.—R. RÜDENBERG.—The author discusses in the first part of this paper, using mathematical and graphical methods, the opening of direct-current circuits with the aid of resistance switches and with arc switches. The time relations between current and voltage are derived, and the switching energy is calculated. All mathematical conclusions are illustrated with oscillograms from actual tests. The second part deals with alternating-current air and oil switches and covers investigations similar to those with direct current. The second installment particularly should prove of interest to designers of high-voltage switches. — *Bulletin of Association Suisse des Electriciens*, June and July, 1922.

Transmission, Substations and Distribution

Economical Transmission Line Construction.—ERNEST V. PANNELL.—The author shows the influence of different types of conductor material on the layout of a 130-kv. transmission line carrying 60,000 kw. over a distance of 150 miles. Copper, aluminum and aluminum-steel conductors are compared, each being strung on the most appropriate span length, and the estimated construction cost is tabulated in each case. The general conclusion is in favor of the use of aluminum-steel cables.—*Journal of the Institute of Electrical Engineers of Japan*, June, 1922.

Substation Layout of an Ohio Railway.—R. P. MEILY.—The installation of three automatic railway substations which operate in conjunction with two manually operated stations has recently been completed by the Columbus, Delaware & Marion Electric Company in Ohio. A transmission line parallel to the railway supplies both power and railway loads at 15,200 volts, three-phase, 60 cycles. The equipment of the different automatic substations is identical and consists of a 500-kw. synchronous converter and a three-panel automatic switchboard on which is mounted all the metering and switching equipment except the alternating-current oil circuit breaker. Some of the details of design and construction of these stations are given.—*Electric Railway Journal*, July 29, 1922.

Ionization Point of Cables. — M. HÖCHSTADTER.—The significance of the Clark and Shanklin ionization point with high-tension cables is investigated, and recent results of research, both European and American, are employed in discussing the nature and magnitude of the dielectric losses in the type of material used for impregnating paper cables. The effects of voltage-frequency temperature and physical state on the losses are considered, and it is demonstrated that well below the transition region dielectric losses consist of hysteresis losses, while above this region they are in the nature of current losses.—*Electrician*, Aug. 18, 1922.

Units, Measurements and Instruments

Electrostatic High-Voltage Indicator. —A. PALM.—In the middle of a long tube of insulating material is suspended a light metallic needle, which by means of a delicate helical spring points about 15 deg. off the main axis of the tube. At the upper end of the tube a metallic cap is attached and at the bottom another one. The former is connected to the line, the latter being grounded. If the line is alive, a potential drop will exist along the tube from full voltage to zero. As the length of the needle covers a considerable portion of this voltage gradient, its two ends will be electrostatically attracted toward the axis of the tube, with the result that if the line is alive the needle will align itself with the tube. To protect the delicate needle, the middle part of the tube with the needle is surrounded by a glass cylinder. For a voltage of, for example, 60,000 the tube is made 83 cm. long. The instrument is made for 6,000 volts to 80,000 volts. —*Elektrotechnische Zeitschrift*, July 17, 1922.

Low Power Factors: Their Prevention and Their Remedy.—The problem of low power factor is on many alternating-current systems becoming most acute. In England the growing importance of power factor is evident from the formulation of acts stipulating that any charges for energy may be based upon and vary with (a) the consumer's load factor, (b) the power factor of his load, (c) the total consumption of energy during any stated period, or (d) the hours at which the supply of energy is required. With regard to special metering arrangement or tariffs for checking bad power factor the various practices throughout England are stated.—*Electrical Times*, July 22, 1922.

Illumination

Scientific Methods and Architectural Requirements for the Lighting of Public Buildings.—E. H. RAYNER, J. W. T. WALSH and H. BUCKLEY.—The experiments described, arising out of a request for information on the lighting of public buildings in England, aimed at the provision of an average illumination of about 4 foot-candles. Data were obtained by a variety of different methods, semi-indirect lighting being generally employed. The particular problem under investigation was the lighting of very large rooms that were to be used by a large clerical staff. The results show that estimates of resultant illumination with a given consumption of energy can be foretold with sufficient accuracy, though some latitude in this respect must be allowed. Experiments on the natural lighting of picture galleries were also carried out for the purpose of avoiding the inconvenient reflections of light in the glass of pictures. The method suggested, while occasioning some loss of daylight, seems to effect a material improvement in this respect.—*Illuminating Engineer* (London), Vol. XV, No. 4.

Fundamentals of Projection.—L. C. PORTER.—The purpose of this bulletin on projection is to set forth the elemental theory of various projection devices now in use. It covers the phenomena of reflection and refraction, the use of parabolic reflectors, spherical mirrors and other reflecting devices, and considers the spherical and chromatic aberration of lenses.—*Bulletin L. D. 138 of Edison Lamp Works, General Electric Company.*

Motors and Control

Performance Calculation of an Induction Motor.—S. AOKI.—For calculating the performance of an induction motor the author introduces a modifying coefficient (1 + exciting admittance × primary impedance). This method is shown in detail. A method is also shown for properly determining the calculating constants from the test data. The application of the modifying coefficient to the solution of other electrical engineering problems, such as voltage regulation and other characteristics of transformers, transmission lines, etc., is discussed.—*Journal of the Institute of Electrical Engineers of Japan*, July, 1922.

Location and Identification of Motors.—A serial motor number, a building location number and a building column number form the basis of an effective scheme of motor identification and location records employed in the extensive plant of the Crane Company, Chicago. The serial motor number is painted in white on the motor frame as soon as it is received from the plant. The building location numbers include two letters and a numeral so chosen that the complete number tells the location of the building on the property and the floor of the building under consideration. The building column numbers include one or more letters and a number. By thus combining the motor number and building location number a complete motor identification is made. For example, C2-F 124 indicates the location of motor No. 124 as being in building C2 on the first floor. The system employed is quite complete and helps maintain safety, reliability and continuity of service. — *Industrial Engineer*, July, 1922.

Heat Applications and Material Handling

Technology of the Carbon-Electrode Industry. — CHARLES L. MANTELL. — Grinding, mixing, molding and extrusion are the important steps in production as carried out in modern electrode plants, and they receive critical attention in this article. Special reference is made to effects produced by various types of equipment. To obtain greatest density and highest tensile strength in the finished electrode, it is necessary for the pulverized material to be graded properly; that is, to be composed of a mixture of large and small particles in a definite proportion rather than of uniformly sized particles. The factors affecting the quality of the finished carbons are reviewed. Inspection and grading of electrodes is also covered.—*Chemical and Metallurgical Engineering*, Aug. 9, 1922.

The Electric Furnace for the Foundry.—C. W. FRANCIS.—The 3-ton furnace is best adapted for foundry use in making the average run of jobbing steel castings. In cases where larger capacity is needed it is better to install two units of 3 tons each instead of one 6-ton unit. The question of the use of acid or basic operation is a vital one, and the choice of one or the other is dependent on a large number of factors. For alloy-steel castings it is almost imperative to use basic refractories, while the acid furnace is particularly adapted to light work in the foundry where clean and hot metal is essential.—*Iron Age*, July 27, 1922.

Electrophysics, Electrochemistry and Batteries

Prevention of Corrosion of Metals by Water in a Closed System.—PERRY WEST.—Some of the latest developments in commercial apparatus for eliminating dissolved oxygen are described with the purpose of preventing corrosion. There are two methods by which this is done, and each of these is explained. The first is the deoxidizing method, in which hot water is allowed to pass into a deactivating tank, where it is brought into contact with thin sheets of specially prepared metal. The water exerts its corrosive activity on the comparatively cheap and easily replaced metal rather than on the piping system. The second is the deaërating process which removes the free dissolved gases from the water by heating, by vacuum or by a combination of both, while the water is sprayed over baffles in a deactivator. The latter process removes nitrogen, carbon dioxide, etc., as well as oxygen. The prevention of corrosion by the removal of free oxygen applies to brass as well as to iron and steel.—*Journal of Industrial and Engineering Chemistry*, July, 1922.

Traction

Choice of a System for Electric Traction on Main-Line Railways.—L. THORMANN.—Basing his findings on ten years' European experience of single-phase traction, the author analyzes the continuous-power system to determine if it has done what was expected of it and in what points other systems might perhaps be advantageous. Technical rather than economical matters are chiefly considered, though in some cases the two are inseparable. The author claims that under no circumstances can the continuous-power system be pronounced superior to the single-phase system. From a purely technical standpoint both systems can satisfy fairly well the requirements of main-line traffic. On the other hand, with continuous current the cost will be considerably higher in consequence of the less favorable conditions of distribution.—*Engineering*, July 7, 14 and 21, 1922.

Swedish Railways Increase Use of Diesel Engines.—In sparsely populated districts and in countries where the railway mileage per inhabitant is high there must necessarily be a keen demand for light passenger equipment. This is being met in Sweden by the use of motor cars with Diesel engines and electric transmission to the driving wheels. The success of small cars of this type has led to the introduction of cars with capacities of 160 hp. and 250 hp.—*Electric Railway Journal*, Aug. 5, 1922.

Telegraphy, Telephony, Radio and Signals

Radio Stations in Ecuador.—The extreme height of the Andes, reaching nearly 20,000 ft. in the Chimborazo Mountain, makes it practically impossible to build and to maintain telegraph lines between the main cities of Ecuador. It is chiefly for this reason that three of the most important cities —Guayaquil, Quito and Esmeraldas— have each been equipped with a 5-kw. radio station for public use. French 1,000-cycle generators, driven by gasoline motors, with 300-ft. umbrella-type antenna, are in use at these posts. The government of Ecuador is also making experiments with radio-telephonic communication between these stations. —*Radioélectricité*, July, 1922.

A Critical Résumé of Radio Science. —A. PRESS.—This résumé treats of the influence of Lodge's work, Kelvin's formula in radio work, difficulties of the stationary-wave antenna theory, the law of effective radiation characteristic, and proper requirements for dummy antenna representation. — *Electrician*, July 14, 1922.

New Books

Reviews of the Latest Contributions to Technical, Industrial and Commercial Literature of Particular Interest to Members of the Electrical Industry

World Metric Standardization: Urgent Issue

Compiled by Aubrey Drury in collaboration with other members of the World Metric Standardization Council. San Francisco: World Metric Standardization Council. 513 pages. $5.

The organization known as the World Metric Standardization Council is purely voluntary and the members are persons who urge the adoption of the metric system in the United States.

The book recently published by this council contains an enormous amount of data and arguments in favor of the use of the metric system.

Various chapters contain reports of many scientific, commercial and independent associations and individuals, which set forth cogent reasons for the universal adoption of the metric system. One very important chapter treats of the probable cost in and to the United States of change from the present system to the metric. To those who already use the metric measure this book will supply a world of proof as to why they should continue to use it. Those whose minds are open on the subject it will do much to convince that the metric system is superior to any other. With those whose opinions are fixed by previous study against the metric system it will have little avail. In any event, it is principally for the ones who have not taken a definite position in favor of or against the metric system.

Elements of Radio Telephony

By William C. Ballard, Jr. New York: McGraw-Hill Book Company. 132 pages.

The title "Elements of Radio Telephony" does not convey a very definite idea of the method of presentation, but the preface of this book leads one to assume that the presentation is such as to be easily understood by the man of limited technical attainment. This proves to be the case.

The author has tried to stimulate the interest of this group in the physical phenomena involved and their applications by a brief, simplified discussion of what happens when messages are transmitted by radio. It is unfortunate that more space was not given to certain of the topics, even though this would have necessitated the omission of others.

The graphical comparison of wire and radio telephone systems—Chapter I—makes clear that there is no great difference in the way they function, except for the fact that one uses guided waves and the other free waves.

In Chapter II mention is made of the fact that spark and arc systems are not suitable for radio telephony. The possibility of using high-frequency alternators is pointed out but is not discussed to any extent. The book is largely devoted to an explanation of the use of vacuum tubes as oscillators, modulators, receivers and amplifiers.

The discussion of space charge and grid control, while brief, is very good.

The treatment of the subject, on the whole, is quite satisfactory.

H. M. TURNER.

Principles of Electrical Engineering

By W. H. Timbie and Vannevar Bush. New York: John Wiley & Sons. 498 pages, 244 illustrations.

This introductory text for students of college grade, which presumes a knowledge of physics and calculus, presents with technical exactness and at the same time in understandable form the basic principles of electrical engineering. The book is a radical departure from other introductory texts in three respects: (1) The electron theory is used to arrive at quantitative results, the authors arguing that the electron theory is essential to co-ordinate electrical phenomena; (2) electrolytic conduction, thermionic emission, conduction through gases, the dielectric circuit and certain high-frequency phenomena are treated in a detailed and rigorous manner; (3) electrical machines receive a minimum amount of space and no types are treated in detail. Five hundred problems are included which make a very valuable addition to the book. The chief criticism that suggests itself is that too great reliance is placed on mathematical developments of principles, visualizations and physical conceptions being minimized, so that the book is rather abstract for an introductory engineering text. The authors do not use the unit-pole theory in their treatment of the magnetic circuit at all, holding it to be too artificial. Another criticism that might be made is that there is little co-ordination between the chapters, which take the form of assembled units, each dealing with its own topic, rather than that of sections of a whole. The relative weight given the different principles is open to objection also; for example, the direct-current electric circuit and the growth and decay of transient currents are treated in detail, but no appreciable space is devoted to the alternating-current electric circuit of normal frequency containing the usual properties. Nevertheless the book, which is splendidly arranged and printed, is a welcome contribution to electrical literature.

L. W. W. MORROW.

Electricity: Science in the Service of Man

By Sidney G. Starling. New York: Longmans Green. 245 pages, illustrated.

The editor of this year book anone of the best, to co-ordinate and interpret the developments in electricity and magnetism and set the story before the public in an instructive and acceptable manner. The whole may be characterized as done from the standpoint of the physicist, and in dealing with the later advances it is limited by the difficulty that so much of all which dates from Maxwell, Kelvin, Kohlrausch and Rowland down to Steinmetz is quite mathematical. But Dr. Starling has a fine gift of comprehensive explanation and shapes his story admirably in demonstrating "that reaction between pure and applied science which is vital to the life of both." Each chapter of the book is complete in itself, so that while there is first of all an excellent historical summary, the individual topics, under their respective heads, deal with the evolution of the subject from the beginning of its separate identity as a novel field of investigation and engineering. All that is best as well as latest is here summed up in a way to meet approval and serve usefully, even with students of a more exacting class than the general reader.

T. C. MARTIN.

Mexican Year Book, 1920-1921

By Robert Glass Cleland, Ph.D. Los Angeles: Mexican Year Book Publishing Company. 524 pages.

The editor of this year book announces that his purpose is to meet the demand for unbiased and systematized information concerning Mexico, prepared to suit American needs and having no official Mexican patronage. The subject is considered under seven heads: History and Geography; Politics and Government; Travel and Transportation; Commerce and Manufacturing; Natural Resources, Public Finances, Currency and Banking; Labor Conditions and Educational Systems.

Books Received

The Properties of Electrically Conducting Systems. By Charles A. Kraus. New York: The Chemical Catalog Company, Inc. 408 pages, illustrated.

Publicity Methods for Engineers. The proceedings of the first national conference on public information. Chicago: American Association of Engineers. 186 pages, illustrated.

Standard Lighting. Information of practical value to the purchaser and installer of lighting equipment. New York: H. C. Cushing, Jr. 208 pages, illustrated.

Corso Teorico-Pratico Elettrotecnia. Volume II. By Luigi Lombardi. Milan: Dottor Francesco Vallardi. 458 pages, illustrated.

Testing of Transformers and Alternating-Current Machines. By Charles F. Smith. London: Sir Isaac Pitman & Sons, Ltd. 88 pages, illustrated.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Soft-Coal Crisis Past

Transportation and Not Mining Labor Is Now the Main Factor in Fuel Situation

WITH the resumption of work in the soft-coal mines of the nation production has shot upward almost as suddenly as it plunged downward five months ago. Between 9,100,000 and 9,300,000 tons are reported as having been mined in the week ended Sept. 2. The main factor in insuring an adequate supply of fuel to utilities and industries is now one of transportation rather than mining labor. The first response of the railroads for coal cars was adequate, but whether they can maintain the present rate of coal movement when the surplus of cars caused by the strike has been exhausted remains to be seen.

Many of the states are taking action in the direction of apportioning the supply of fuel to their citizens and preventing profiteering. Governor Miller of New York has appointed William H. Woodin, president of the American Car & Foundry Company, as fuel administrator. He will have sweeping powers under the emergency legislation passed by the State Legislature at a special session. The Ohio Legislature is to meet in special session on Monday to take similar action, and the executives of other Eastern and Middle Western states are taking steps to control the situation in their communities. The State Fuel Administrator of Massachusetts has informed Fuel Distributor Spencer that his state will require no further supplies of emergency coal. Urgent requests from some of the Southeastern States are reported.

Senate Still Deliberates

The United States Senate is still debating the bill to create the national office of Coal Distributor and to authorize the Interstate Commerce Commission to refuse cars to coal profiteers. A bill introduced into the Senate by Senator Reed of Missouri would compel mine operators and brokers engaged in interstate commerce to report to the Secretary of Commerce every fifteen days the price at which they are selling coal.

Secretary Hoover, asserting that the chief sufferers from the strike were powerless to end it and had no voice in its settlement, declared his conviction that a plan must be found "under which the public may have a rightful voice in aid of justice and in its own protection."

The agreement in the anthracite strike proposed by the Pennsylvania Senators has been accepted by the operators and is almost certain to be accepted by the miners.

The railroad strike remains unsettled, its sensational feature being the sweeping temporary injunction procured by Attorney-General Daugherty against union propaganda. This, it is thought, is likely to be modified when application to make it permanent is heard.

Planning for 70,000-Ton Ships with Electric Drive

Chairman Lasker of the United States Shipping Board has made a statement to the press in which he asserts that an American company with a capital of $30,000,000 is being organized to build in this country monster ships to engage in the transatlantic passenger business. The plans, he says, call for ships 1,000 ft. long and surpassing in tonnage the largest ship afloat, the White Star liner Majestic, by more than 13,000 gross tons. They will have accommodations for 3,000 passengers. According to Mr. Lasker's statement, these vessels will be propelled by electric motors, with power supplied either by turbines or Diesel engines.

Indiana & Michigan Electric Company Sold

Controlling interest in the Indiana & Michigan Electric Company of South Bend, Ind., has been sold by Homer C. Henry, K. Chapin and Lowell Chapin of Chicago to the American Gas & Electric Company, which operates in six states. The sale figure is reported to be close to $10,000,000. The three thousand small stockholders in the company will be fully protected and their interests even strengthened, according to an announcement from F. A. Bryan, president of the Indiana & Michigan Electric Company. The company will retain the same officers with two additional vice-presidents—Thomas English of Muncie, Ind., vice-president and general manager of the Indiana General Service Company, and George Tidd, vice-president of the American Gas & Electric Company.

Recently the Indiana & Michigan acquired the Benton Harbor & St. Joe Railroad & Light Company, and it now operates in South Bend, Mishawaka, Elkhart and Ligonier, Ind.; Buchanan, Berrien Springs, St. Joseph, Benton Harbor, Niles, Three Oaks and New Buffalo, Mich., and smaller communities.

For Wider Retail Channels

The California Co-operative Campaign Will Recognize Distributors Other Than Contractor-Dealers

FURTHER electrification of the home and the broadening of the channels of distribution were outlined as the tentative program to be carried out by the California Electrical Co-operative Campaign at the meeting of the advisory council of that organization held in San Francisco on Aug. 25. Particular activity in pushing the convenience outlet and emphasis upon the adequate wiring of the home for ranges and heaters were suggested as the best method of increasing the scope of the merchandising field and of providing the proper outlet for the surplus power which will be made available through the extensive development now under way in the state.

In presenting the solution of the contractor-dealer problem as the major work of the campaign for the year the chairman, Earl Fisher, offered the following principles for discussion and adoption by the advisory council: "No small division of the industry can expect to control or direct in any manner whatsoever the channels of distribution nor to bear the burden of educating the public or the men within the industry. Those benefiting from the educational work now being carried on and to be carried on must pay a just pro-rata share of the expense; in other words, the campaign should build up a greater source of revenue by enlarging its contributors, with the distinct understanding that those contributing meet the campaign's requirements as to policies and ethics. This will permit both the establishment of a broad constructive program which will recognize the legitimate distributors of electrical appliances and the financing of an educational program among all electrical contractors, which will be financed to a very great extent by retail distributors of merchandise not now bearing their portion of the expense."

Favored by Contractor-Dealers

This principle of recognizing a broader channel of distribution for electrical appliances was acted upon by the California State Association of Electrical Contractors and Dealers at their Santa Cruz convention when they adopted a resolution calling the problem to the attention of the co-operative-campaign members and urging that body to take action looking toward a solution of present difficulties. It was the consensus of opinion at that meeting that the trend of the times in the widening of merchandising channels could not be disregarded and that the new conditions should be frankly recognized by the electrical dealers.

Final action on the program thus outlined, which opens the way for the welcoming of retail establishments other than those purely electrical into the co-operative campaign upon their acceptance of its principles, has been referred to the constituent bodies represented upon the advisory council.

New Hydro-Electric Project for Southern California

Following the signing of a contract to supply the Southern Sierras Power Company of Riverside with 30,000,000 kw.-hr. annually for distribution in the Imperial Valley, the San Gorgonio Power Company has announced that work will begin in the near future on a hydro-electric project to cost $2,500,000, on the south slope of Mount San Gorgonio, near Riverside. The project consists of a series of three plants to be built on property purchased from the Consolidated Reservoir & Power Company two years ago. The contract which has been signed extends over a period of thirty years.

The San Gorgonio Power Company was organized a year ago with a capital stock of $1,000,000. It is headed by the following group of power men: R. R. Scarborough, president; W. T. McAllister, M. S. Hazen, A. W. Hazen and J. A. Lamour, directors.

Seattle and Tacoma Refuse Power Company's Offer

The offer of the Puget Sound Power & Light Company to furnish the cities of Tacoma and Seattle with an interconnected service for their lighting plants for a consideration to be agreed upon has been refused by both cities, and interchange of energy will be accomplished over a line owned and operated jointly by the two municipalities. The offer by the power company was made after both cities had awarded contracts for the work and purchased materials and supplies. It was intended as a substitute for the proposed construction.

President A. W. Leonard informed the city councilmen that his company now owned and operated four lines between the two cities capable of accommodating any interchange of power desired. Mr. Leonard offered the city of Seattle the use of these lines at a saving of 25 per cent less than the cost of interest and maintenance charges on its proposed investment of $75,000, the same offer being made to Tacoma. J. D. Ross, superintendent of the Seattle light department, told the Council that the proposed line was a necessity and urged that it be not abandoned. Under the interconnection agreement of the two cities Seattle will be able to sell its surplus hydro-electric power to Tacoma in the winter months and will be able to purchase power from Tacoma during the summer.

N.E.L.A. Divisions and Other Bodies Meet

Good Fellowship of Telephone Companies Marks the Bedford Springs Convention of Pennsylvania Association—New England Men at New London—Electrical Leagues Confer

THE fifteenth annual convention of the Pennsylvania Electric Association (Eastern Geographic Division of the National Electric Light Association) was held at Bedford Springs, Pa., on Thursday, Friday and Saturday of this week. A feature of the convention was the spirit of co-operation and good fellowship that was displayed by the telephone companies of Pennsylvania, which not only provided the necessary speakers to make a symposium on inductive interference most interesting and instructive but in addition had present every one of the fifteen division superintendents.

Following the custom of geographic sections, the work of the convention was split up into four divisions, technical, commercial, accounting and public relations. The association now has more than 2,000 individual members in addition to almost every privately owned electric light and power company in the state. Forty-two committees are actively at work on definite programs for association work.

PRESIDENT CANTLIN'S ADDRESS

In his presidential address A. H. S. Cantlin of Allentown called attention to the change that has taken place in the electric light and power business since it has been publicly regulated, and suggested that possibly other industries, such, for instance, as the coal industry, would find it advantageous to be under some sort of public regulation also. As indicative of the trust reposed in regulated business, President Cantlin told of the appointment by the State Fuel Commission of a public utility advisory committee composed of four members of each of the four associations, through which committee all matters pertaining to coal priorities are handled. To the members at large President Cantlin delivered this recommendation: "Make your rates and service and treatment of the public such that not only shall we ourselves be satisfied but the public also. Don't wait to be forced by the regulating body."

PRIZE PAPERS PRESENTED

During the week three prize papers were read as follows: "More Business Through Better Lighting," by G. Bertram Regar of the Philadelphia Electric Company; "Ways and Means of Overcoming Inductive Interference," by J. C. Damon of the West Penn Power Company, and "Inspection of Lines and Equipment as a Means of Preventing Breakdowns," by L. W. Heller of the Duquesne Light Company. The public policy meeting which is always a feature of the conventions of the Pennsylvania Electric Association was held on Thursday night. The speakers included Walter H. Johnson of Philadelphia, W. D. B. Ainey, chairman of the Pennsylvania Public Service Commission, and M. H. Aylesworth, executive manager of the National Electric Light Association.

New England Men Convene

The annual convention of the New England Geographical Division of the National Electric Light Association opened at the Hotel Griswold, New London, Conn., on Wednesday last, under the presidency of Charles L. Edgar of Boston. On Thursday the technical committees of the association held a round-table discussion of their year's work. A report of the convention will appear in next week's *Electrical World*.

Electrical Leagues Emphasize Local Co-operation

It is the judgment of the first national gathering of electrical leagues that co-operative activity by the electrical men of an individual city offers the greatest opportunity for immediate business development and that upon the central-station company in each town rests the responsibility of leadership.

Representatives of electrical leagues operating in cities from coast to coast gathered on Tuesday of this week at Association Island, Henderson Harbor, N. Y., at the invitation of the Society for Electrical Development. Boston, New York, Albany, Philadelphia, Syracuse, Rochester, Buffalo, Cleveland, Pittsburgh, Cincinnati, Toledo, Warren (Ohio), Dayton, Chicago, St. Louis, Denver, Salt Lake City, Boise, San Francisco and Los Angeles all sent one or more delegates from local electric leagues, clubs or development associations.

There were also men from fifteen other cities interested in organization co-operative activities, making an attendance in all of 125, including members of the Joint Committee for Business Development, manufacturers, jobbers, the electrical press and others eager to assist in the further organization of more and better local co-operation.

Camp Co-operation was formally opened with the traditional island ceremony under the big elm, taking the names of the original conference when the society was organized in 1913. W. E. Robertson of Buffalo related the history of the island as an influence for co-operation in the electrical industries. F. M. Feiker of the McGraw-Hill Publishing Company, E. W. Lloyd, E. W. Rockafellow and W. L. Goodwin discussed present conditions in the electrical business and the place of the local leagues in developing further progress. Then followed a session in which men from the leagues sketched the experiences of the local organizations and the plans of the movement for business development which the joint committee and the society are leading. It was the purpose of the concluding sessions to pick out of these plans and experiences the fundamental principles involved and crystallize from them definite guidance for league activities, making plain the vital function which they must fill in the further commercial expansion of the industry.

Central Division Jobbers Meet at Chicago

Subjects ranging from house organs and trade associations to the effect of radio on the industry at the expiration of the Marsh patents were discussed at a two-day session of the Central Division of the Electrical Supply Jobbers' Association held in Chicago on Sept. 6 and 7. V. G. Eastman, sales manager of the Erner & Hopkins Company, spoke on the value of house organs for building up good will. He felt that a house organ issued by any company would return a value in increasing sales proportional to the effort put into it. He considered that the primary reason for failure where it occurred was the absence of a supervised mailing list and of control by a constructive editorial policy.

George A. Hughes, speaking on the effect on the industry when the Marsh radio patents expire in February, declared that he felt nothing was going to happen. Undoubtedly the number of manufacturers would increase, but since the present market was purely a competitive one, Mr. Hughes thought that this increase in manufacturers must be dealt with along economical lines. Manufacturers of "quality" products, he felt, need have no qualms as to what the future may have in store.

Alex Dow Addresses National Safety Council

"The aim of safety work is the reduction of preventable accidents and illness that results in injury to the human body in order that something may be added to the sum total of human happiness," said Alex Dow, president of the Detroit Edison Company, in beginning his speech at the joint luncheon of the Public Utility and Electric Railway Sections of the National Safety Council at Detroit last week. He asserted that there was no room for discussion of aims but that there was a wide field for the discussion of methods, warning his hearers that the fixation of methods in the form of law or codes may hinder rather than advance safety work.

Mr. Dow expressed his lack of patience with the man who balances life and limb against expense accounts and declared that industry must carry its own accident bill. In any movement there are errors of judgment, and the benefit of the doubt must be given in favor of human life and welfare. As a remedy for the prevalence of carelessness in industial establishments he advocated a heavy charge to cover the cost of compensation to those injured in accidents and a minimum of state interference in the form of codes and inspection. The hope in the future for safety work, he declared, lies with the children.

Arthur W. Brady of the Indiana Union Traction Company declared that the street railways of the country come into more intimate contact with the public and therefore are more interested in safety work than any other industry. As one of the hopeful elements in the situation he pointed to the 20 per cent decrease in the number of fatal accidents in the street-railway field in the years 1920 and 1921.

In the separate session of the Railway and Utility Sections reports showed that the electric railway membership of the National Safety Council had increased during the year from 109 to 113 and that of the Public Utility Section from 120 to 142. The committees in making their reports called attention to the small portion of the total number of utility and railway companies represented in the National Safety Council.

Two Edison Pioneers Revisit Pearl Street

On Monday of this week, at exactly 3 p.m., just forty years to the hour from the time when John W. Lieb pulled the switch which started Edison lighting service, Francis Jehl and Frank A. Wardlaw, two Edison pioneers, celebrated the birthday of the central-station industry by making a pilgrimage to 255 and 257 Pearl Street and hanging beneath the bronze tablet which marks that historic spot a wreath of laurel.

Earlier in the day Mr. Wardlaw and Mr. Jehl had sent to Mr. Edison the following telegram:

"Two loyal Edison pioneers still on the job will pilgrimage to the old Pearl Street station at 3 o'clock to-day, its fortieth birthday, to place a laurel wreath on the building consecrated by your marvelous genius. Congratulations and deep affection to you."

"How different it was then from what it is to-day!" said Mr. Wardlaw to a New York *Herald* reporter who witnessed the simple ceremony. "We were all half crazy with excitement as the hour for throwing the switch approached. Out in the street there were a lot of people, many of whom had come down here expecting to have a good laugh when the thing proved a fizzle. Mr. Edison had us all set our watches alike in order that none of us would miss being on hand when the current went on. We all left our jobs—few of us had any specialized work in those days; you might be working around the dynamos one day and digging trenches the next. Some of us remained at the station, but a lot of us went down to the offices of J. P. Morgan at the corner of Broad and Wall Streets, where there were several lamps. And then the light came on and there was more excitement than ever."

Timber on Dammed Rivers

Federal Engineers Insist on Provisions for Floating Timber That Hamper Water-Power Financing

THE application of the Clarion River Power Company for a license for one of its three prospective developments on the Clarion River has precipitated renewed discussion of just how far the government should go in protecting the interests of a few to the possible detriment of the many.

The Clarion River taps a region in which there is some low-grade timber. Most of this is second growth, and it is probable that the time will come when the river could be used to advantage to float that timber to market. During the past fifteen years there has been no navigation on the river. The Corps of Engineers' district engineer has recommended that a provision be inserted in the license requiring the power company to construct a sluiceway to permit the passing of forest products over the dam whenever the Secretary of War may decide that the interests of navigation demand it. The district engineer indicates that the sluiceway should be 50 ft. wide and have a slope of one on ten. He puts the maximum cost of such sluiceway or other facility for handling floating forest products at $150,000, which would add a capital cost of $30 per horsepower on the average power developed by the dam. It is contended that this is too heavy a burden to place on the power user and that the prospective commerce in no way justifies so heavy an expenditure.

A Question Constantly Met

This question is met in almost every case where the commission is called upon to issue a license. The officials of the Corps of Engineers and of the Forest Service look at the situation from an angle entirely different from that of those who must obtain the capital to develop the power. In the opinion of those interested in water-power development, the importance attached to potential commerce on some streams is so exaggerated as to be ridiculous.

In the same way the Forest Service, where it has jurisdiction, wants all licenses to provide for the construction of logways and the use of reservoirs for the storage and transportation of logs, if the Secretary of Agriculture should deem it necessary. Such provisions are sometimes very burdensome. In one case in the Sierra Mountains the stream has such a steep slope and such a rough channel as to preclude its use for the transportation of logs. The applicant proposed to store almost the entire run-off and to divert most of the water through long tunnels to plants with heads of 2,000 ft. or more. The loss of a cubic foot of water for sluicing logs would mean the loss of an unusually large amount of power. To insist on providing for log transportation in this particular case seems entirely justifiable, in the opinion of those who wish to develop power sites.

Weeks Complains of Lack of Power Board Personnel

The handicap imposed on the Federal Power Commission by its being prevented from employing its own personnel was emphasized very recently in a letter sent by the Secretary of War to the Federated American Engineering Societies in support of the efforts of that body to obtain the necessary legislation to remedy the situation. An extract from Secretary Weeks' letter follows:

"The commission has had placed upon it the greatest task with respect to water powers the government has ever had at a time when the utilization of water power is more necessary than ever before. The act made a definite pronouncement of a national policy in water-power development. It created a commission to carry out that policy, but it gave it no means to do so. The commission has been obliged to depend exclusively upon such assignments from the several departments as these departments were willing to spare. The departments have had their own forces out to a point where they are unable to perform either in Washington or in the field the work required of the commission under the act; and even if they had the numbers and the funds to pay them they do not have employees with the training or experience required for the performance of certain of the duties of the commission. As a necessary consequence the commission has been forced to omit altogether action upon important matters which the act requires of it. Furthermore, with no personnel of its own and with no control over the personnel of the departments engaged upon its work, except for the small number directly assigned to its Washington office, it is not possible to organize the work on an effective basis or to make the most economical use of the personnel actually engaged on the commission's work or of the funds actually expended for such purposes."

In its first annual report the commission said:

"What is seriously needed in the interest of adequate administration of the act is a small organization of trained and experienced men capable of meeting intelligently the important and perplexing engineering and economic problems which are constantly arising and upon the correct solution of which will depend the value of the legislation and, in no small degree, the future of the electric power industry."

Nothing has happened since to alter the situation.

New Orleans Ordinances Are Adopted

The three enabling ordinances introduced two or three weeks ago by Commissioner Maloney of the Department of Public Utilities, New Orleans, looking to the reorganization of the New Orleans Railway & Light Company were adopted on Sept. 3 by the Commission Council of New Orleans. Mayor McShane cast the only dissenting vote. The ordinances were adopted as originally introduced, carrying the option clause under which the city is privileged to acquire the public utilities by purchase at any time, together with other points of agreement formulated between the city and the company.

Hydro-Electric Enterprise in Alabama

Permission for a hydro-electric power development of great magnitude in Alabama is being sought from the Federal Power Commission by the Alabama Power Company. Plans call for the construction of four dams on the Tallapoosa River to provide a total potential capacity of approximately 140,000 hp., or more than the primary power eventually to be developed at Muscle Shoals.

According to a statement by Thomas W. Martin, president of the company, the power from the Mitchell Dam now under construction on the Coosa River will be entirely absorbed a year or two after completion, and for that reason development will begin on the Tallapoosa River.

The four dams on the Tallapoosa, with their total rated output of 140,000 hp., will give 20,000 hp. more than the Mitchell Dam, which is to give 120,000 hp., and 30,000 hp. more than the dam at Lock 12, which gives 110,000 hp. With the completion of the four dams on the Tallapoosa the company's installed power in Alabama will be 435,000 hp. This includes 50,000 steam horsepower at the Gorgas plant and 15,000 steam power at Gadsden.

The Tallapoosa River is a non-navigable stream, but application was made to the federal authorities because of the river's relation to navigation on the Alabama River. The Alabama Power Company is already regularly serving other states than Alabama in times of necessity.

Federal Departmental Reorganization Not Abandoned

Word comes from Washington that there has not been the slightest surrender on the part of the administration of its intention to bring about practical reorganization of the executive departments of the federal government. A tentative report was laid before the President several months ago.

Were the report to be sent to Congress without the indorsement of certain of the department heads, it is recognized that the possibility of obtaining the necessary legislation would be lessened. Moreover, the legislative situation since the report was submitted to the President has been such as to preclude action on reorganization. In addition, if the report were made public in its tentative form and before unanimous indorsement by department heads had been obtained, there is a feeling that it would invoke non-constructive criticism and arouse agitation which delay may avoid.

Sweden to Erect Great Radio Station Near Gothenburg

A contract for a new wireless station in Sweden, which will insure direct communication between that country and the United States, has been awarded by the Swedish government to the Radio Corporation of America, according to a recent announcement from the headquarters of the Radio Corporation in New York. The entire plant will cost more than $2,000,000 and will be one of tremendous power. The American firm won the contract in competition with French, British and German concerns.

Sweden now has one station, that at Karlborg, but it has been found unreliable for transoceanic work. The new station, which will be two and one-half times as powerful as the old, will be situated in the vicinity of Gothenburg, on the west coast of Sweden, and the contract with the Radio Corporation of America calls for the installation of two 200-kw. Alexanderson alternator equipments, which, when associated with the multiple-tuned antenna, will each deliver to the antenna a current of 600 amp. The receiving equipment will consist of two complete and independent modern sets, composed of tuners and the necessary amplifying apparatus, and will be used in conjunction with receiving aerials devised for the reduction of static disturbances.

British Engineers Form Joint Council for World Peace

Following the receipt of a message from M. Mowat of London, secretary of the British Institution of Mechanical Engineers, Charles F. Rand. chairman of the Engineering Foundation, announced a few days ago that the leading engineering societies of England had formed the Engineering Joint Council, which will work with the engineers of the United States and of Canada and other British possessions to bring about concerted action for world peace and the advancement of engineering ideals "for the good of mankind."

Coincident with Mr. Rand's statement, Dean Mortimer E. Cooley of the University of Michigan announced that the Federated American Engineering Societies, of which he is president, had appointed a committee on affiliation with engineering societies outside of the United States. The chairman is Gardner S. Williams of Ann Arbor.

The question of the affiliation of the Engineering Institute of Canada and the Engineering Society of Czechoslovakia was, Dean Cooley said, to be taken up at a meeting of the executive board of the American Engineering Council to be held in Boston on Friday and Saturday.

Numerous other international matters were to be considered at the Boston meeting, including the International Congress at Rio de Janeiro, the Pan-Pacific Conference and a projected trip of American engineers to China.

N. E. L. A. Southeastern Division Selects Speakers

Speakers who will address the convention of the Southeastern Division of the National Electric Light Association, which will be held in Atlanta Sept. 12 to 15, inclusive, have been announced by Charles A. Collier, secretary of the association. They include: Frank W. Smith, president N.E.L.A. M. H. Aylesworth, executive secretary N.E.L.A.; H. A. Lane, chairman Joint Committee of Business Development; P. S. Arkwright, president Georgia Railway & Power Company; T. W. Martin, president Alabama Power Company; W. J. Meyers of the United Electric Light & Power Company; C. Murphey Candler, chairman Public Service Commission of Georgia; H. M. Addinsell of Harris, Forbes & Company, New York; C. G. Adsit, executive engineer Georgia Railway & Power Company; C. W. Stone, manager lighting department, General Electric Company, and F. G. Vaughn of the meter department, General Electric Company.

Among the features of the meeting will be a trip to the Tallulah Falls power development projects of the Georgia company.

California's Attitude on the Boulder Dam Project

An informal statement of the attitude of southern California upon the regulation and control of the proposed forty-five-million-dollar Boulder Canyon Dam was made recently at a conference held in San Diego by the southern branch of the California League of Municipalities. The policy indorsed by the conference embraced the following points:

1. Provision should be made for organization of a permanent commission for regulation and control of the project, giving the commission ample authority and means to function.

2. "Beneficial use" should be the measure and limit of rights to be acquired (that is, appropriation of water could be made only where it would economically serve such purposes as agriculture, river control, domestic uses, mining, manufacturing, etc.).

3. Priority of appropriation shall govern, regardless of state lines, except as modified by the provisions of equitable division. In times of possible scarcity, pending the completion of conservation or regulation works, the supply should be prorated while awaiting appropriations.

4. The commission in control should maintain an office centrally located in the basin to be served by the project.

In regard to possible demands from other states for water or power from the project it was agreed that southern California representatives should "go as far as possible toward satisfying those demands without jeopardizing the interests of California."

Britons to Have Big Electrical Exhibition in 1924

The British Electrical and Allied Manufacturers' Association is making plans for the "electrical and allied engineering section" at the huge British Empire Exhibition to be held in 1924. The space at the disposal of this section is about 220,000 sq.ft., which is rented at the rate of £1 per sq.ft., with a discount of 12½ per cent on large spaces. Collective exhibits of domestic appliances are contemplated, and possibly of heavy equipment as well, in view of the expense to smaller manufacturers of maintaining their exhibits for more than six months, this being the period of the show.

The world power conference already referred to in the *Electrical World* (April 22, page 795, and July 1, page 37) will be held in connection with this exhibition under the auspices of the British Electrical and Allied Manufacturers' Association and other bodies.

Twin State Company Starts to Build Hydro Plant

A new hydro-electric generating station to deliver about 1,400,000 kw.-hr. annually from the Great Works River at South Berwick, Me., has been begun for the Berwick & Salmon Falls Electric Company, a subsidiary of the Twin State Gas & Electric Company of Dover, N. H. The project includes a dam 28 ft. high and 185 ft. long, with a highway bridge directly above and a reinforced-concrete station to house two generating units of 425-kw. and 200-kw. rating. A pondage of about 40 acres will be created above the dam, and the generating station will be built under one end of the highway bridge. The plant will be of the automatic type, and it is estimated that it will save the Twin State company about 33⅓ per cent of the energy which it is obliged to purchase from outside sources. R. M. McGillivray is manager of the Dover division of the company.

All War Loans to Utilities Repaid Save Two

A statement of the present status of all loans made to public utility corporations under the war finance act has been prepared by the War Finance Corporation at the request of the *Electrical World*. It is as follows:

Appalachian Power Company, New York	$1,000,000	Paid in full
Aurora, Elgin & Chicago Railroad Company, Cleveland	219,000	....
Brooklyn (N. Y.) Rapid Transit Company	16,566,900	Paid $22,200
Central Power & Light Company, St. Louis	60,000	Paid in full
Charleston (S. C.) Consolidated Railway & Lighting Company	350,000	Paid $13,006
Columbus (Ohio) Railway, Power & Light Company	642,000	Paid in full
Commonwealth Power, Railway & Light Company, Portland, Me.	4,800,000	Paid in full
Interborough Rapid Transit Company, New York	11,937,500	Paid in full
New Orleans Railway & Light Company	1,000,000	Paid in full
United Railways Company of St. Louis	3,222,000	Paid in full

Utility Commissioners Postpone Convention

The National Association of Railway and Utility Commissioners announces that its annual convention, originally set for Sept. 26, has been postponed because of the coal strike. The meeting will be held on Nov. 14 in Detroit. James B. Walker, secretary, explains that so many commissioners have been appointed fuel administrators that it has been decided their duties during September will not permit of their attending.

Two "round-table" conferences, on rural extensions of electric light and power service and state and federal regulation in connection with depreciation, are scheduled as part of the association's program.

Brief News Notes

Niagara Falls Company Gives Use of Land to City.—Free perpetual use of 58 acres of land belonging to the Niagara Falls Power Company has been offered to the City of Buffalo for park purposes provided that the city is able to acquire the rest of the land needed to carry out the plan favored by the promoters of the new park.

Customer Ownership in Central Illinois Company.—The growth of the customer-ownership movement is reflected in a striking way by the record of the Central Illinois Public Service Company. During the last two years the stockholders in this company have increased from 249 to 2,947, or more than 1,000 per cent.

Growth of Electric Service in Birmingham, England.—The great increase in the use of electricity in Birmingham, England, due to its ever-increasing employment in industrial processes, is strikingly shown by the fact, recently published, that whereas in 1900 only 3,000,000 kw.-hr. were sold, at present the total consumption is 111,000,000 kw.-hr. a year.

Lighting Mexico's Caves.—Plans for a hydro-electric plant in the State of Morelos for the purpose of lighting the famous caves of Cacahumilpa have been submitted to the government by Richard H. Ludlow, representing an American company. The hydro-electric plant will also supply the towns and industries of that region with light and power, according to its promoters.

Colorado River Commission Meeting Again Postponed.—The scheduled meeting of the Colorado River Commission at Santa Fé, N. M., which has been twice postponed, will not be held until after the November elections, owing to the necessity of Secretary of Commerce Hoover remaining in Washington until the fuel and railroad crisis is past. Nov. 15 has been tentatively selected as the date.

France Loses Money by State Ownership of Utilities.—Nearly 300 members of the French Chamber of Deputies are reported to have signed a bill in favor of transferring the telephone system of the nation to private hands. On three public services owned by the state—the postal, telegraph and telephone systems—there is a loss of about six hundred million francs annually, according to the *Wall Street Journal*.

Extensions in West Texas.—When the extensions of the power transmission lines which are now being constructed by the West Texas Utilities Company at Abilene are finished its system will be in position to supply electric power and light to towns and industries within a radius of more than 100 miles and the lines will have a total length of more than 250 miles. Work is now in progress extending the power lines to Haskell, Tuscola and Albany. Extensions to Sylvester and Cisco are finished.

Earnings of Alabama Power Company.—Gross and net earnings of the Alabama Power Company for the past month and year show improvement over the preceding month and year. July gross was $438,000, an increase over July, 1921, of $82,000. July net after taxes was $232,000, an increase of $51,000 over last July. Twelve months gross was $4,913,000, an increase of $432,000 over the preceding year, and year's net after taxes was $2,256,000, an increase of $305,000.

Special Radio Set for Submarines.—It is announced that the Navy Department has ordered fifty-nine sets of a special radio-telegraphic transmitting and receiving apparatus developed by the department's engineers for use on submarines. These sets are said to have a radius of 200 or 300 miles in ordinary daytime communication, and as they are to be constructed by remodeling surplus apparatus and making use of parts of the present equipment, nearly $300,000 will be saved as compared with entirely new sets.

Irrigation District Seeks to Purchase Power Lines.—The Turlock irrigation district has filed a petition with the California Railroad Commission asking the latter to fix just compensation for the electric distribution systems of the Pacific Gas & Electric Company and the Sierra & San Francisco Power Company in the district. The Turlock district is engaged in developing its own electric power in conjunction with an extensive irrigation project, and this application follows its recent decision not to wholesale power but to handle its own distribution at retail.

Campaign for St. Lawrence Development Opens in New York State.—A campaign to convert the people of New York State and Governor Miller to a belief in the St. Lawrence River as a source of power supply has been begun by the Northern New York Development League, which sees in the plan a prevention of fuel shortages and freight congestion. A statement issued by the league puts the cost of the proposed improvement at $252,000,000 for a waterway of 25 ft. depth and about $270,000,000 for one of 30 ft. depth. This estimate, it says, includes the total expense together with the building of power houses at the Long Sault dam, which would be equipped to deliver 1,500,000 hp.

Westinghouse War Memorial Scholarship Winners.—M. W. Meade, Jr., H. C. Klingenschmitt and Frank J. Schaer, all of Pittsburgh, and William A. Lewis, Jr., of Los Angeles, were the winners in the recent competitive examinations for the Westinghouse war memorial scholarships. These scholarships were established in 1919 to perpetuate the memory of employees of the Westinghouse Electric & Manufacturing Company and its subsidiary companies who lost their lives in the world war. Each scholarship carries with it the annual payment of $500 for a period not to exceed four years, the payment to be applied toward an engineering education in any technical school or college selected by the successful candidates and approved by the scholarship committee.

Fire Chief Corrects Reporter.—Two issues of the Glens Falls (N. Y.) *Times and Messenger* of recent date point the moral and adorn the tale of the reporter's propensity to blame fires on the electric wires. A fire occurred in a local hotel just before a thunderstorm, and the newspaper man promptly announced that "lightning came in on the light wires." Citizens read the report and some of them became apprehensive for the safety of their own houses; but their anxiety, it may be hoped, was dispelled when a central-station man called up the fire chief and the latter caused a correction to be made. Electricity, it appeared, was to blame only in the very remote degree involved by some one having dropped a lighted match into a box containing bulbs packed in excelsior while searching for a new lamp to replace one burned out!

Hydro-Electric Development in Quebec.—Announcement is made that the provincial government of Quebec is soon to begin to build a dam on Lake Kenogami at a cost of $2,000,000 for the purpose of creating a reservoir. The project has already received legislative autorization. The new dam will supply 70,000 hp. by raising the water level 15 ft. In recent years, E. Haldeman Dennison, United States Consul at Quebec, reports, the government of the province has given ever-increasing attention to the development of hydro-electric energy. Quebec is obliged to import every pound of coal it uses, and the continued rise in the price of this commodity has encouraged the provincial government to adopt a progressive policy concerning water storage. Two important storage dams have already been built. The larger of these made possible the Gouin reservoir, on the St. Maurice River, one of the largest reservoirs in the world, its capacity, when full, being 160,000,000,000 cu.ft. and the water area 300 square miles.

Associations and Societies

Arkansas Utilities Association. — A convention of this association will be held at the Eastman Hotel, Hot Springs National Park, Ark., on Oct. 9 and 10.

Society of Industrial Engineers.—The Society of Industrial Engineers will hold a three-day national convention in New York beginning Oct. 18. "Economics of Industry" will be the general topic of the convention, which will be attended by leading industrial engineers and members of the faculties of leading universities. The engineers will meet at the Hotel McAlpin. On the evening before the convention there will be a joint meeting of this society with the Taylor Society and the A. S. M. E.

Coming Meetings of Electrical and Other Technical Societies

A complete directory of electrical associations is published in the *Electrical World* in the first issue of each volume. See July 1 issue for latest list.

N. E. L. A. Geographic Divisions—Rocky Mountain, Glenwood Springs, Col., Sept. 11-13 (for program see issue of Aug. 19, page 393); Southeastern, Atlanta, Sept. 12-15; Great Lakes, French Lick Springs, Ind., Sept. 27-30 (for program see issue of Aug. 19, page 393.)

Colorado Electric Light, Power and Railway Association—Glenwood Springs, Col., Sept. 11-13.

Association of Iron and Steel Electrical Engineers—Cleveland, Sept. 11-15. J. F. Kelly, Empire Bldg., Pittsburgh, Pa.

Pennsylvania State Association of Electrical Contractors and Dealers—Philadelphia, Sept. 13-14.

West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers—Huntington, W. Va., Sept. 19-22. Herbert Smith, 211 Hobson-Pritchard Bldg., Huntington.

American Electrochemical Society — Montreal, Sept. 21-23. A. D. Spillman, Columbia University, New York City.

Illuminating Engineering Society—Swampscott, Mass., Sept. 25-28. Samuel G. Hibben, 29 West 39th Street, New York. (For program see issue of Aug. 5, page 292.)

American Institute of Mining and Metallurgical Engineers—San Francisco, Sept. 25-28. F. F. Sharpless, 29 West 39th Street, New York.

Indiana Electric Light Association—French Lick Springs, Ind., Sept. 28-30. Thomas Donohue, Lafayette, Ind.

Telephone Pioneers of America—Cleveland, Sept. 29-30.

American Electric Railway Association — Chicago, Oct. 2-6. J. W. Welsh, 8 West 40th Street, New York.

Empire State Gas and Electric Association —Lake Placid, Oct. 5-6. C. H. B. Chapin, Grand Central Terminal Bldg., New York.

Electrical Supply Jobbers' Association, Atlantic Division—Philadelphia, Oct. 6. E. Donald Tolles, 165 Broadway, New York.

Arkansas Utilities Association — Hot Springs, Ark., Oct. 9 and 10. R. I. Brown, Little Rock Ry. & Electric Co., Little Rock.

Society of Motion Picture Engineers—Rochester, N. Y., Oct. 9-12.

Association of Edison Illuminating Companies — White Sulphur Springs, W. Va., Oct. 11-14. Preston S. Millar, 80th St. and East End Ave., New York.

National Association of Electrical Contractors and Dealers—Cincinnati, Oct. 9-14. F. Johnson, 15 West 37th St., New York.

Public Utilities Association of West Virginia—Charleston, W. Va. Oct. 13-14.

Electric Power Club—Asheville, N. C., Oct. 30. S. N. Clarkson, 506 Laclede Gas Bldg., St. Louis.

Ontario Association of Electrical Contractors and Dealers—Toronto. Nov. 13-14. J. A. McKay, 24 Adelaide St. W., Toronto.

National Association of Railway and Utility Commissioners—Detroit, Nov. 14. J. B. Walker, New York Transit Commission, New York.

Commission Rulings

Right to Wholesale Consumption Rate.—An attempt by a company owning a building divided into stores to force the Public Service Electric Company of New Jersey to grant it a wholesale rate covering all the electrical energy furnished to the building and allow it to resell to the tenants at the regular retail rate has been thwarted by the New Jersey Board of Public Utility Commissioners, which declared: "The plan of the building as submitted by the petitioner clearly indicates separate and distinct stores with separate entrances and with nothing in common except the fact that they are under a continuous roof. They should, therefore, be treated as individual customers and supplied at the filed schedule rate for such customers."

When Property of Utility Should Not Be Represented in Rates.—In a decision of the New York Public Service Commission on petition of the Elmira Water, Light & Railroad Company the commission has held that consumers should not pay in rates for property not presently concerned in the service rendered, unless there is a probability of immediate future use or it is maintained for reasonable emergency or substitute service. Other points covered in this decision were that deduction should be made for accrued depreciation, that the burden of proof to establish "going value" was upon the company, and that the federal income tax, which it was held would make no appreciable difference in the rate arrived at, should be included as an item of operating expense.

Electric Utility Forced to Reconstruct Lines Causing Inductive Interference.—The Michigan Public Utilities Commission recently ordered the Economy Electric Company to reconstruct lines which were causing excessive inductive interference with telephone circuits previously built, the requisite distance between the conductors of the two companies being fixed by the commission at at least 6 ft. The commission remarked that the metallic circuit of the telephone company was not maintained in the best manner, the grounding of its lines making it very susceptible to inductive interference, but observed further: "Although the telephone company and the electric company have equal rights to the use of these highways, the telephone company having first constructed its line, the electric company should have constructed its line so as to cause the least possible interference. Had the electric company complied with the law of Michigan and filed its map showing where and how the new line was to be constructed, this commission or its predecessor might have required this company to construct its line differently. The electric company, having disregarded the law, cannot now object to the reconstruction of its line because of the necessary expense." This case differs from one recently decided in the Washington State Supreme Court (see issue of Aug. 12, page 345), because in that instance the power company's line was built in the best manner, while the telephone line had originally no metallic circuit.

Mutual Company Furnishing Light to Its Members Not a Public Utility.—A complaint made by the Community Bank of Dawn, Mo., against one J. M. Decker, who had obtained the permission of the Missouri Public Service Commission to discontinue his electrical service business and had then organized a mutual company for the supply of its members only charged him with subterfuge and the operation of a utility illegally discriminating against patrons it did not wish to serve. The commission found the allegation unproved and the company within the law.

No Deduction for Accrued Depreciation.—No deduction was made for accrued depreciation in a rate proceeding before the Idaho Public Utilities Commission affecting the Grangeville Electric Light & Power Company, the commission explaining: "It is shown that certain theoretical depreciation exists in the plant and system of applicant, but it is also shown that the actual physical condition is good. The applicant has met all demands for replacement and reconstruction and has not only maintained but materially improved the serviceability of the system, and at the present time no known depreciation exists which threatens a continuity of service, while the financial standing of the applicant appears to be such as reasonably to guarantee both continuity and quality of service, and therefore no deduction will be made for depreciation."

Purchase Price Should Be Left to Buyer and Seller.—Disclaiming a desire to regulate the price at which one utility may acquire ownership of another, the Missouri Public Service Commission, in authorizing the sale of utility property to the Green Light & Power Company, said: "It appears that the amount of the purchase consideration arrived at by purchaser and seller in a bona-fide sale of utility property should be left largely to the discretion of the participants in such a sale and not made a question for determination of this commission, unless such consideration is so grossly excessive as to endanger the future ability of the purchaser to render service to the public at reasonable rates. This is particularly true where the purchaser is a corporation of the character of the Green Light & Power Company, where any financial loss incurred in the purchase of the property at an excess price must fall on the stockholders, who are themselves the responsible corporate officers who enter into the purchase transaction."

Recent Court Decisions

Only Those Acts of Commission Alleged to Be Illegal Can Be Reviewed by Court.—Refusing to reverse a decision of the Public Service Commission alleged to establish a monopolistic jitney service, the Supreme Court of Errors of Connecticut said (Modesto vs. Connecticut Company): "Where an action of an administrative body involves only purely administrative matters, on a statutory appeal from such a body the court has before it only the question whether the body has acted illegally or has exceeded or abused its powers; otherwise the body's action, involving only an administrative matter, is final." (117 At. 494.)*

Responsibility of Electric Service Company for Death Apparently Due to Overcharge on Secondary Wires.—The Supreme Court of Iowa has sustained a judgment for the plaintiff in Duncan vs. Fort Dodge Gas & Electric Company, in which damages were awarded for the death of a man who was killed while grasping an electric fan with the intention of moving it. The court held that the evidence sustained the plaintiff's contention that death was due to excessive voltage escaping from the primary wires of the company. The court, however, sustained the contentions of the defendant regarding its non-liability for defects in the secondary system, which was not owned by it, and also to the effect that it was bound to exercise only ordinary and reasonable care and that if a person were killed by contact with a voltage of approximately 110 damages could not be recovered. (188 M. W. 865.)

Town Operating Power Plant Held to High Degree of Care as to Employee of Contractors Working for It.—In Loveless vs. Town of Wilton damages of $12,000 were awarded for the death of a workman employed by contractors whom the town had engaged to paint a water tank owned by it. The town, at the request of the contractors, had connected an electric lamp to service wires to illuminate the interior of the tank, and the victim, who was working on the exterior, had come in contact with the connecting wires, falling to the ground and receiving fatal injuries. It was claimed that no notice had been given to the workman that electric current had been turned on. The Supreme Court of Iowa, sustaining the judgment, held that the town was bound to exercise a high degree of care, that the man killed was an invitee as regarded his presence on the tank, and that contributory negligence was for the jury to decide. (188 N. W. 874.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel

Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

Heston Appointed Western Editor of "Electrical World"

Walter C. Heston, formerly industrial power engineer with the Portland (Ore.) Railway, Light & Power Company, has been appointed Pacific Coast editor of the *Electrical World*, with headquarters

W. C. HESTON

in San Francisco. He will assume his new duties on Sept. 15. Mr. Heston comes to the *Electrical World* staff after eleven years of experience in electrical engineering fields and three years' editorial work as the representative of the *Electrical World* at Portland. His early electrical engineering training was received at Benson Polytechnical School at Portland, after which he became identified with the Portland Railway, Light & Power Company. His work with that company has been particularly in the electrical distribution engineering field, where he was for two years superintendent of distribution. In 1919 he became industrial power engineer in the commercial department of the same company, which position he has held until the present time. Mr. Heston served for two years on the hydro-electric and technical committee of the Northwest Electric Light and Power Association and has just completed a term as chairman of the Portland Section of the American Institute of Electrical Engineers. His many years of activity in association work have given him a wide acquaintance among the electrical men of the Northwest.

E. M. Gilbert has been elected vice-president, to succeed Thomas Cheyne, of the W. S. Barstow Management Corporation, New York, N. Y.

Henry T. Hall of Salt Lake City has assumed the management of the Uintah Light & Power Company, Myton, Utah. For eight years Mr. Hall has been associated with the General Electric Company.

H. F. Scott, formerly connected with the Des Moines (Iowa) Electric Company, in the capacity of electrician, is now associated with the Cambridge (Neb.) Light & Water Company, as manager.

Edvard Svanoe, a widely known Norwegian hydro-electric engineer, will arrive in the United States Sept. 16 to attend the San Francisco meeting of the American Society of Civil Engineers. O. C. Merrill, the executive secretary of the Federal Power Commission, is arranging an itinerary for Mr. Svanoe which will allow him to visit some of the larger hydro-electric developments in this country prior to the opening of the meeting on Oct. 4.

O. C. Merrill, executive secretary of the Federal Power Commission, has returned to Washington after a visit to Niagara Falls and a trip down the St. Lawrence River as far as Montreal. He was impressed particularly with the splendid engineering evidenced in the construction of the tunnel extension to the new power plant of the Niagara Falls Power Company. In addition, Mr. Merrill visited the Salmon River development of the Niagara Falls, Lockport & Ontario Company as well as the Cat Island and Barnhardt sites.

Verne Leroy Havens, editor of *Ingeniería Internacional*, the monthly technical journal in Spanish published by the McGraw-Hill Company, Inc., is now in Rio de Janeiro, Brazil. Mr. Havens is chairman *pro tempore* of the joint committee appointed by the four national engineering societies to consider and act upon all matters arising from their participation in the International Congress of Engineering. This congress will be held in September in Rio de Janeiro in connection with the celebration of the first centenary of Brazilian independence. Upon the termination of the congress, Mr. Havens will visit Uruguay and Argentina before returning to the United States.

H. L. Wills of Georgia Company on Leave

H. L. Wills, operating manager of the electrical department of the Georgia Railway & Power Company, has secured temporary leave of absence from his duties to complete special work in the interest of the National Electric Light Association and the Georgia Railway & Power Company. T. F. Johnson, assistant operating manager, has assumed full charge of the operating and construction forces of the electrical department. Charles E. Bennett has been appointed electrical engineer and will take charge of all engineering matters in the electrical department.

Brockett Elected President of Northwest Association

Norwood W. Brockett, attorney for the Puget Sound Power & Light Company of Seattle, Wash., has been elected as president of the Northwest

N. W. BROCKETT

Electric Light and Power Association. Mr. Brockett took his law course at the University of Minnesota and went West upon his graduation in 1900. He followed newspaper work for two years, when he joined the former Snoqualmie Falls Power Company in Seattle as assistant counsel. He remained with that company until its consolidation with the Stone & Webster interests under the name of the Puget Sound Traction, Light & Power Company, when he joined the legal department of the new organization. His service with the electrical industry thus covers a period of twenty years, except for a period of eighteen months when he served in France as captain of field artillery. Mr. Brockett was one of the small group who met to form the present Northwest Electric Light and Power Association, and he served as its secretary during its first five years. He has three times served as vice-president of the association for the State of Washington and has been continuously a member of its executive committee. He has been most active in the public relations and affairs of the association and in handling questions of legislation affecting the industry and has represented the association in legislative matters for the last seven sessions of the Washington Legislature. Mr. Brockett is known in the association as the friend and advocate of the smaller companies.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Development of Electrical Market

Review Shows Eighty Manufacturing Establishments in 1880 Compared With 1,600 in 1922—War Period Brought Out Chief Progressive Measures

BY H. M. CUNNINGTON
Trade and Markets Editor, *Electrical World*

THAT the progressive steps in the remarkable growth of the electrical industry depended on the development of sales, and that varying conditions restrained or advanced the whole engineering or commercial fields, are outstanding features of the first review ever published of the electrical market covering the period of 1880 to 1922.

1880 TO 1920

A comparative summary of the industry shows that in 1880 there were approximately eighty manufacturing establishments. This number increased to 581 in 1899, to 1,404 in 1919 and to approximately 1,600 in 1922. Fewer than 750 persons were engaged in the industry in 1880, and in 1919 census figures show that 271,912 were engaged in these establishments. Cost of materials in these establishments in 1919 amounted to $425,098,211, and in 1879 cost amounted to $1,116,470. It is known that the value of products in 1880 amounted to about $2,500,000; in 1919 it was approximately $1,000,000,000.

New York is now the leading state in the manufacture of electrical machinery. Ohio, having made rapid strides during the last few years, is second. New York, Pennsylvania, Ohio, Illinois, New Jersey and Massachusetts together produced 80.3 per cent of the total value of products reported by the industry in 1919. These six states employed 78.1 per cent of the total number of wage earners.

In 1909 there were only thirty-one establishments producing machinery, apparatus and supplies yearly to the value of $1,000,000 or more. In 1919 there were 182 establishments maintaining this quota. These, which were 13 per cent of the total number in the industry, employed 79.7 per cent of the total number of wage earners and reported 82.1 per cent of the total value of products.

VALUE OF PRODUCTS PRODUCED

The following facts show the increase in production during the years showing the greatest progress in developing the industry. Electric measuring instruments produced in 1904 amounted to $5,004,763; in 1909, $7,800,010; in 1914, $8,786,506, and in 1919, $19,322,164.

Generating apparatus and parts produced in 1904 amounted to $11,084,234; in 1909, $14,077,071; in 1914, $17,865,542, and in 1919, $86,266,114.

Storage batteries produced in 1904 amounted to $2,645,749; in 1909, $4,678,209; in 1914, $13,080,964, and in 1919, $60,036,152. Primary batteries produced in 1904 amounted to $1,598,144; in 1909, $5,934,261; in 1914, $10,321,491, and in 1919, $32,427,043.

Arc lamps produced in 1904 amounted to $1,574,422; in 1919, $1,706,959; in 1914, $742,142, and in 1919, $606,771. Observe the diminishing values.

Incandescent lamps produced in 1904 amounted to $6,953,205; in 1909, $15,714,809; in 1914, $17,350,385, and in 1919, $57,646,900.

Telegraph apparatus produced in 1904 amounted to $1,111,194; in 1909, $1,957,432; in 1914, $2,248,375, and in 1919, $12,816,341.

Telephone apparatus produced in 1904 amounted to $15,863,698; in 1909, $14,259,357; in 1914, $22,815,640, and in 1919, $46,214,342.

Switchboards, panelboards, and cut-out cabinets for light and power produced in 1904 amounted to $3,766,044; in 1909, $5,971,804; in 1914, $8,989,111, and in 1919, $17,735,780.

Railway switches, signals and attachments produced in 1904 amounted to $1,451,337; in 1909, $5,377,843; in 1914, $6,393,551, and in 1919, $4,466,611.

Fuses, cut-outs, and fuse plugs produced in 1904 amounted to $868,079; in 1909, $1,001,719; in 1914, $1,757,430, and in 1919, $7,895,098.

Insulators produced in 1919 amounted to $6,504,147.

Sockets, receptacles, bases and attachment plugs produced in 1904 amounted to $2,010,860; in 1909, $4,521,729; in 1914, $5,512,609, and in 1919, $15,008,365.

Lightning arresters, choke coils, reactors and other protective devices produced in 1904 amounted to $587,124; in 1909, $940,171; in 1914, $1,188,773, and in 1919, $2,353,416.

Insulated wire produced in 1919 amounted to $66,570,958.

Insulated cable, rubber insulation, produced in 1904 amounted to $34,519,699; in 1909, $51,624,737; in 1914, $69,505,573, and in 1919, $32,520,587.

Insulated cable, paper insulation, produced in 1919 amounted to $26,789,302.

Pole-line hardware produced in 1919 amounted to $9,379,145.

Circuit fittings, not elsewhere given, produced in 1904 amounted to $3,525,446; in 1909, $1,080,287; in 1914, $2,067,683, and in 1919, $5,052,994.

Underground conduit produced in 1904 amounted to $2,416,245; in 1909, $5,098,264; in 1914, $4,874,709, and in 1919, $890,749. Interior conduit produced in 1919 amounted to $18,375,880.

Annunciators and push-buttons produced in 1904 amounted to $185,870; in 1909, $235,567; in 1914, $263,806 and in 1919, $709,941.

Electric clocks and time mechanisms produced in 1904 amounted to $373,926; in 1909, $352,513; in 1914, $410,774, and in 1919, $1,797,909.

Bells, buzzers and signal gongs produced in 1919 amounted to $3,616,281.

Therapeutic apparatus, including X-ray tubes, produced in 1904 amounted to $1,036,962; in 1909, $1,107,858; in 1914, $2,653,098, and in 1919, $8,895,402.

THE STORY OF THE MARKET

In 1916 manufacturers produced to their utmost, yet the market was unsatisfied. Production of electrical goods in 1916 went beyond the five-hundred-million-dollar mark.

There was placed in this year a volume of orders for electrical equipment of about $750,000,000, a large total for an industry that has grown up within the present generation.

Raw-material costs soared rapidly. Manufacturers were forced to make frequent price advances in order to insure profits.

Although prices were higher, profits made by electrical manufacturers in 1916 were in actual percentage less than in 1915.

Labor was a difficult problem to handle in 1916. Not counting bonuses, it is estimated that wages advanced 25 per cent during the year. At the same time it was hard to obtain efficient labor.

In addition to the inefficiency of labor there was a scarcity of all products. The war controlled and in some cases stopped the supply of many products for which electrical manufacturers of this country had depended on for the work of the world.

Production of turbines, both steam and water, was very large, especially the former, of which the 1916 output was about 3,000,000 kw.

The jobbing business was exceptionally large in 1916. Jobbing picked up in the fall of 1915 and has continued very large since that time. The 1916 jobbing business was at least 50 per cent over that in 1915.

Wire, conduits, fittings, fans and household appliances sold very well. Better factory lighting brought the sale of large quantities of lighting material.

Starting from the year 1916 with approximately $250,000,000 worth of unfilled orders, the electrical manufacturing industry in 1917 far exceeded the record set in 1916.

Although the country was engaged in war nine out of the twelve months of the year the industry showed on the whole no diminution of output, but rather a very considerable increase.

Careful and conservative estimates placed the 1917 billing of electrical manufacturers in the near neighborhood of $750,000,000, while unfilled orders at the close of the year were certainly not less than $300,000,000.

Trade acceptances were in greater evidence in the trade, and there was a decided movement, particularly among jobbers, to institute a more general use of this credit system.

Prices, except for raw materials, advanced throughout the year, but not to such a degree as in 1916. Heating appliance prices advanced every few months. Prices of glass and porcelain products increased, as did those of many other staples.

In May, for the first time in the history of the industry, the *Electrical World* started publishing current market prices, and it has continued this work ever since.

THE YEAR 1917 STARTED WELL

Demand for materials, as before stated, was particularly large. Lamp manufacturers for many months found it impossible to keep up with orders. Shortages developed in every section of the country, being particularly acute in the far West and in New England. Every effort was made to cope with the situation, and by the late fall months the manufacturers were able to lay in local stocks in most standard sizes, but still were behind in miniatures.

Wholesale fan stocks were sold out earlier in 1917 than ever before, and, as in 1916, the season closed with the market practically void of fan stocks. The great hot wave in the first week in August, 1916, put into the users' hands almost all fans available.

Turbine production for 1917 was sold out early, and by the first of June production for larger sizes had been booked.

Transformers and motors in large sizes were hard to obtain after six months' time Production had been booked far ahead. In the early fall it was estimated by good authority that manufacturers were 150,000 motors behind orders.

The second-hand market flourished during the year. Dealers found it very difficult to obtain equipment. Much of this was ordered only until such time as the goods could be delivered. In this way some machines were sold and resold many times during the year. The government frequently found the second-hand men to be very valuable when especially quick deliveries were needed.

STARTLING CHANGES IN 1918

Startling changes took place during the year 1918. The industry had gone through a period of maximum production, government control, priorities, etc., and was once more in a free market.

During the months before the signing of the armistice the industry was almost entirely engaged in producing goods for government or allied function. The trade during the larger part of that time was serving only essential demands.

Commercial business was reduced to the barest minimum. It is estimated that this business represented less than 30 per cent of the entire output of the industry for the first ten months of the year. Even domestic appliances had a big war demand.

Following the armistice there were many cancellations of war and other contracts, and incoming business was small. The total output for 1918 was probably no larger than in 1917, which was in the neighborhood of $750,000,000. Throughout the year of 1918 labor and raw materials were the controlling factors. In addition to a very acute shortage of each, labor had been very undependable.

The output of fans was curtailed to 40 per cent less than the 1917 production, vacuum cleaners for six months were curtailed to 75 per cent of six months of 1917 production, production of heating appliances to 50 per cent of 1917 output, and so forth.

For the first time in the year, the price of incandescent lamps advanced. The first increase was on Jan. 1, 1918, and called for 10 per cent. Ten months later vacuum-type tungsten lamps advanced 15 per cent. Miniatures, carbons and gems advanced 10 per cent during July, 1918.

Copper wire was higher at the close of the year than at the beginning, but the average throughout the year was below that for 1917. The increase during the year was due to higher copper prices, higher carbon and higher labor. During December wire base dropped a couple of cents. The highest for rubber-covered wire base was, considering all discounts, 34 cents.

Throughout the year sales of electrical appliances were very large, stocks were short and manufacturers were behind on orders. Washing-machine manufacturers, even though they early in the year had decided to eliminate 171 distinct styles, by the first of June in many plants were 2,000 to 3,000 machines behind in orders.

It seemed almost impossible to get a stock of licensed flat-irons after the middle of the year. Even electric ranges sold better in 1918 than in 1917, reports up to August of 1918 indicate. Sales were mostly in small quantities and in small cities. The big cities having ceased to push ranges during the war.

Fans were sold out early to the trade. The consumer demand was greater than the supply in 12-in. and 16-in. oscillators, but not so good in the small sizes. Government demand was large.

Central-station companies during the year received recognition in the way of a discount and differentials in the distribution of electrical ranges, while the jobber received similar recognition in the distribution of sockets and heating devices.

Large power equipment was hard to get throughout the year. In November six months was quoted on motors of more than 100 hp. Turbines of over 500 hp. were taken under complete government control as to distribution. After the armistice was signed deliveries on large turbines were quoted at four months and longer, depending on the condition of the individual factories. At the close of the year there was still a large volume of unfilled business in steam turbines. In the spring stocks of small power equipment began to appear, and conditions in this line have been getting better and better. The used-equipment dealers, while finding it difficult to take care of inquiries for large equipment, reported the market for small machines dull.

OHIO PRODUCED MOST BATTERIES

During the year 1919 Ohio surprised all the states in the production of storage batteries, followed by Pennsylvania, New York, New Jersey and Indiana, in the order named. The value of battery supplies and parts—storage and primary—increased from $3,265,616 in 1914 to $6,985,780 in 1919, equivalent to 113.9 per cent.

Incandescent lamp production in 1919 showed an increase in value over production for 1914 of $40,296,515, or 232.3 per cent. The tungsten type formed 80.9 per cent of the value of all incandescent lamps manufactured in 1919 and 68.5 per cent in 1914.

PERIOD OF 1920 TO 1922

The feature of 1920 was the large gain in electrical exports. These showed an increase of $4,000,000 over 1919 figures.

Domestic demand slumped. Construction was very inactive and much labor was inactive. Credits and collections became more important.

Stocks of copper wire were plentiful. Bookings during the first few months were double the 1919 rate. Quotations to the trade were as high as $14 per 1,000 ft. in 5,000-ft. lots in New York City. In December the price of $8.50 was reported.

Shortest stocks were noted in conduit. Smaller sizes were depleted because of the added demand in the oil industry.

Lamp sales showed a very large increase in 1920. There were 230,000,000 large lamps sold in this year, compared to 183,000,000 in 1919. Spotty stocks, which were reported, were due to failing transportation and a raw-material shortage. On April 1, 1920, price increases varying from 10 to 15 per cent were applied on the common run of large lamps.

The armored-conductor market was weak during this year. A shortage of steel strip, because of slow delivery, and a shortage of raw material were to blame for the poor showing up to the latter months of 1920.

Pole-line equipment showed much activity. New extensions by central stations on larger scales were responsible for this increase in business. Foreign buying was known to be very heavy. Stocks were only fair owing to unsettled labor conditions.

RECOVERY SHOWN IN 1921

Exports of electrical apparatus and materials during the first months of 1921 were very high.

Resumption of construction during the summer months helped the schedule-material manufacturers. Supplies of raw material were better than in 1920, labor conditions were improved, and some of the producers started operating at capacity for the first time in many months. Price cutting was noted, but this was conservative, it seemed, to prepare for a better period of business.

At the beginning of the year stocks of armored cable were plentiful, but as the year progressed manufacturers received better calls for their product.

Some lamp companies, however, reduced operations because of the lowered demand. During the latter months the market became noticeably better.

Fair sales were reported for smaller appliances. Vacuum cleaners and washing machines also recovered.

Buyers in the wire market were able to obtain many concessions during the early months of 1921. Quotations fell from $8.50 per 1,000 ft. of rubber-covered in 5,000-ft. lots to as low as $6.15. Readjusting in the latter months, prices stiffened.

RUGGED CONDITIONS OF 1922

Strikes, both rail and coal, shortages of materials and the foreign exchange situation have little deadening influence on the present year's good position. Most price changes have been advances.

During the early weeks of the present labor troubles the electrical market experienced only certain shortages of stocks. The amount of orders did not suffer loss. Few districts reporting to the *Electrical World* note anything but progressive strides.

Survey of Business Conditions

Electrical Sign Sales Show Much Improvement

An important manufacturer of signs in Albany, N. Y., says:

"Current sales compared with those of six months ago have greatly improved owing to the general improvement of business conditions. Our deliveries are no longer than normal at the present time. Prices have changed but slightly recently, and we do not anticipate any material change in the near future. The outlook for the next six months in our opinion is continued improvement owing to general business conditions and the improvement of labor conditions."

Toy Sales Running About 25 per Cent Higher

Toy sales are running about 25 per cent higher than a year ago, according to the statement of a leading electrical toy manufacturer of Chicago to the *Electrical World*. Better business conditions have brought about this increase in sales. He says:

"Deliveries are about normal, but we look for a very heavy demand as soon as the dealers really begin buying in the fall. There is no anticipation of price changes unless there is a further increase in the cost of material.

"The outlook for the next six months is good, and, I believe, contrary to the opinion of some buyers, the radio craze instead of decreasing the sale of other electrical toys is going to increase it, because as people become more and more accustomed to electrical toys of all kinds the resistance to electrical toys is less pronounced and they become more popular."

Warns American Business Men of German Frauds

The low price level in Germany has induced a multitude of American business men to make buying trips or to send their representatives to that country on buying tours, Vice-Consul Walk, Hamburg, has informed the Department of Commerce. In many instances, he states, these men have not taken the necessary precautions in dealing with the German firms which had charge of the details of buying and forwarding of the goods and, unfortunately, have been victimized.

German concerns, according to Mr. Walk, will generally insist on making their contracts with Americans in dollars, since, among other reasons, they believe that they can more nearly approximate the world prices for goods if they talk to an American in dollars rather than in marks. "When an American desires to buy in marks and at current domestic prices he is sometimes induced to do this through a German middleman. A case in which this arrangement worked out in a particularly disastrous manner has recently come to the attention of the consulate at Hamburg, the American having to pocket a loss of $2,000 and leave for home without prosecuting the culprit as his business required his immediate return to the United States."

Issue Specifications Relative to Armored Cable Labels

The Underwriters' Laboratories of the National Board of Fire Underwriters, Chicago, have issued a new page relative to the issuance of labels for armored cable or armored cord, as follows:

"The labels are issued in three denominations which vary only with respect to the footage of armored cable or armored cord which they represent. The three denominations are of the following footages: 50 ft., 100 ft. and 250 ft.

"The labels are furnished in strips, one label wide and ten long, with perforations between labels. The labels are of paper with gummed backs and are applied to the tag which is furnished with each coil of armored cable or armored cord. One or more labels shall be so used with each coil that the footage represented by the labels is approximately the same as the length in feet of the cable or cord in the coil. Variations not to exceed 10 per cent either way shall be allowed, and it will be assumed that such variations will be compensating in any given period of time with respect to any particular factory.

"The labels as issued are serially numbered, and a record is kept by means of these numbers of the manufacturer to whom they are issued, the date of issue and the approximate date of use.

"It is not expected that two labels for a single coil or reel, even if of the same denomination, will necessarily have consecutive serial numbers.

"The inspector will at each inspection observe and report the lowest serial number of the labels on hand and not attached to product.

"The inspector shall call the attention of the manufacturer to a failure to use the labels in the consecutive order of their serial numbers.

"The price of labels is at present 20 cents per 1,000 ft. This price is calculated to cover the cost of the label itself and a proportionate part of the following: Salaries and carfares of inspectors, salaries and expenses of engineers at Chicago testing station; salaries and expenses of special agents, overhead charges and cost of field follow-up service."

Brass Company Is Readjusting Discount Schedules

The discount schedules of the F. W. Wakefield Brass Company, Vermilion, Ohio, on commercial lighting hangers are being readjusted as of Sept. 1. The lower prices will affect "Red Spot" standard hangers, ornamental hangers and general-purpose hangers of both suspension and ceiling types commonly used in the industry.

Prevailing Conditions Affecting Cost and Volume

Number of Freight Cars Needing Repairs Decrease.—As bearing on the strike situation generally, the Association of Railway Executives has announced that, despite the absence of the striking shopmen from their jobs, the number of freight cars in need of repairs decreased 9,438 between Aug. 1 and Aug. 25, although the total on the latter date was 10,992 above the figure for July 1, when the strike began. The number listed as needing attention on Aug. 15 was 335,575, or 14.8 per cent of the whole number on all lines. The association's statement did not cover the condition of motive power, nor did it show how many of the cars out of commission were of coal-carrying types. It was said at the organization's headquarters, however, that reports from throughout the country indicated that there now were upward of 100,000 surplus coal cars in good condition.

Loading of Revenue Freight Increases.—Loading of revenue freight totaled 856,219 cars during the week which ended on Aug. 19, which was an crease of 3,639 cars over the preceding week, according to reports just received by the American Railway Association from the rail carriers. This was an increase of 41,072 cars over the corresponding week last year, but a decrease of 111,884 cars under the corresponding week in 1920. Merchandise and miscellaneous freight, which includes manufactured products, totaled 555,275 cars, an increase over the previous week of 6,971 cars.

Decrease in Volume of Business.—The volume of business for the week ending Aug. 30, as measured by debits to individual accounts reported to the Federal Reserve Board for banks in leading centres, totaled $7,219,000,000, or $215,000,000 below the total for the preceding week. All of the larger centres, except Chicago and Milwaukee, show smaller figures than the week before. New York City reports a decline of $51,000,000, or of 1.3 per cent, for the week as compared with an average decline of 2.9 per cent for all reporting centers.

Liquidation of $42,000,000 of Loans.—Liquidation of $42,000,000 of loans and discounts, largely of loans against corporate securities, as against an increase of $16,000,000 in investments, is shown in the Federal Reserve Board's weekly statement of condition on Aug. 23 of 791 member banks in leading cities. All classes of bonus show smaller totals than the week before. Changes in the investment account include increases of $41,000,000 in United States bonds and of $8,000,000 in Treasury notes, as against reductions of $19,000,000 in Treasury certificates and of $14,000,000 in corporate and other securities.

Germany Increases Export Duties.—Effective Sept. 3, export duties in Germany are advanced 60 per cent. Effective Sept. 6, number of paper marks required for import duties is advanced to 290 times the gold rates of custom tariffs, against 220 to date and 40 in January.

Speaks of Labor Shortage.—There is a labor shortage throughout the country, according to the *Industrial Digest*, which has canvassed the situation through leading industrial publications. Any one who had predicted a year ago that we were going to have a shortage of labor would have been subjected to ridicule, but we have it now," says the *Digest*. "Complaints from Detroit and other automobile centers, from the building trades, and especially from road contractors, are merely foretastes of what will happen this fall. This shortage applies especially to unskilled labor, and, of course, most wage reductions affect unskilled labor more severely than they do the more strongly organized skilled workmen."

German Steel Industry Restrained by Decline of Mark

Reviews of the German steel and iron trade point out that in midsummer the export movement fell off heavily because the home movement of German prices had practically balanced the depreciation of the mark, and that when the further decline in the mark occurred, home demands were so largely increased as to make it impracticable for the industry to take large orders for export.

New England Collections Are Considered Spotty

Uneven collections are a feature of the New England electrical credit situation as the fall begins, but underlying trade conditions are strong and outstanding accounts are usually rounded up within sixty or seventy days. Widespread complaint among dealers as to the slowness of consumers to settle accounts is heard, and this hampers cleaning up credits with the wholesalers.

Public utilities and railroads are paying satisfactorily, but industrial concerns show marked variations in time required to settle bills. One large jobber collected 15 per cent more money in the first half of August than in any corresponding fortnight this year. A decided improvement in business is anticipated this month and better credit conditions should accompany it. Treasurers of jobbing houses are working hard for account settlements, and money is now relatively cheap.

Strikes Have Not Affected Credit Situation

Coal and railroad strikes have apparently been without effect upon the credit situation, which seems to have been influenced by more fundamental conditions. For many months past increasing commodity prices and a general increase in trade and industrial activity have facilitated the liquidation of many commercial bank loans of long standing.

During the past month, however, the downward movement in the volume of commercial loans has ceased, but the volume of bond investments in banks outside of New York City has continued to increase, presumably as a cumulative effect of the liquidation of the past year and of the continuing imports of gold. The volume of bills discounted by the Federal Reserve banks is at almost the lowest point of the year.

Metal Market Situation

Copper Remains Quiet with Firm Prices—Consumers Awaiting Further Developments

The copper market during the past week remained quiet with firm prices. Foreign sentiment is better, and British dealers are again trying to buy electrolytic copper, but at slightly under the price of American producers, offering 13.80 cents aside ship, New York.

Consumers both here and abroad seem desirous of awaiting developments in the American and foreign situation before making further commitments. The fuel situation is such that most domestic consumers, while having sufficient coal to last another month or so, feel it inadvisable to lay in more copper until they are more certain of the ability of the railroads to deliver fuel as fast as required.

American copper producers are beginning to realize that for the next few months the future of copper depends more upon domestic consumption than upon export business. The optimism of Judge Gary as to domestic conditions, therefore, has encouraged them greatly. Today domestic consumption of copper is about 25 per cent larger than before the war. Necessity of depending largely upon domestic consumption is making it more evident that no marked rise in the price of copper is to be expected for some time, even if copper is selling out of line with most other metals and commodities.

While there is little indication that there will be any important buying for some time yet, consumption both here and abroad continues in good volume. Owing to the good cash position of all important producers of copper there is little probability that there will be any material weakening in price.

NEW YORK METAL MARKET PRICES

	Aug. 30, 1922 Cents per Pound	Sept. 6, 1922 Cents per Pound
Copper		
Prime Lake	14.00	14.00
Electrolytic	14.00	14.00
Casting	13.45	13.45
Lead, Am. S. & R. price	5.75	5.75
Antimony	5.25	5.25
Nickel, ingot	36.00	36.00
Zinc, spot	6.50	6.50
Tin, Straits	32.20	32.20
Aluminum, 98 to 99 per cent	19.10	19.10
OLD METALS		
Heavy copper and wire	11.00–11.25	11.00–11.25
Brass, heavy	5.75– 6.25	5.75– 6.25
Brass, light	5.25– 5.50	5.25– 5.50
Lead, heavy	4.62½–4.75	4.62½–4.75
Zinc, old scrap	3.00– 3.37½	3.00– 3.37½

The Week in Trade

Prices When Quoted Are Those Reported at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

GREAT improvement in the electrical industry is reported from all important districts of the United States. Central-station outputs are showing wide gains over the corresponding period of last year. A fair volume of sales of farm-lighting outfits is noted. Residential and industrial construction nearing completion is holding up the demand for armored conductor. Jobbers have accumulated excellent stocks of portable lamps during the summer months and are expecting a very good season. Popular buying of radio apparatus is increasing somewhat, but the many distributors and retailers absorb the demand easily. Stocks all along the line are being built up in anticipation of a busy season.

New York

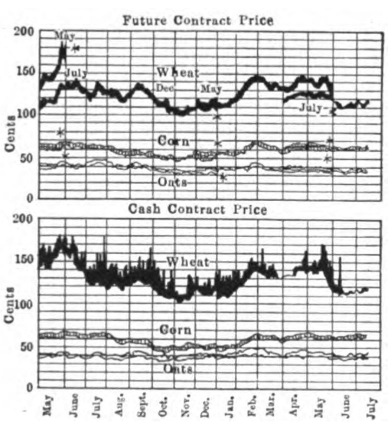
Storage Batteries in Demand—Insulators Selling Well—More Interest in Appliances Shown

Business in the electrical industry is reported to be the most active for some weeks. Conduit sales are holding their own and wire sales are increasing rapidly. Central-station outputs are reported to be gaining and more extensions are noted. Labor conditions are improving.

Storage Batteries.—Excellent demand is reported with fair stocks. Prices are reported firm.

Rigid Conduit.—A slight increase in building has strengthened demand, but some dealers are refusing large orders because of depleted stocks. Prices are stronger.

Porcelain Material.—All insulators are selling in large quantities. Prices are comparatively firm and stocks fair.



DAILY RANGE OF GRAIN PRICES AT CHICAGO. BREAK IN CURVE REPRESENTS CHANGES FROM ONE OPTION TO OTHER BECAUSE PREVIOUS OPTION RUNS OUT. (FROM FEDERAL RESERVE BANK OF CHICAGO)

Appliances.—Washers, flat irons, toasters, vacuum cleaners and percolators are all receiving more interest than a few weeks ago. Stocks are plentiful.

Chicago

High-Tension Equipment Continues Good—Conduit and Armored-Conductor Supply Is Limited

The electrical trade continues its normal stride. The demand for wire and conduit is very good. Dealers in lighting fixtures also report a very good business. Lighting-fixture prices are low at the present time because of the stiff competition in this line. Conduit and armored-conductor stocks are limited. The demand for radio equipment has shown a slight increase.

Wire.—Continued activities in the building program are causing a good demand. The No. 14 rubber-covered is available in 5,000-ft. lots at from $6.10 to $6.35 per 1,000 ft. Bare and weatherproof are moving steadily and prices remain the same.

Conduit.—Jobbers are expecting a further increase in the price of this material because of the present conditions in the steel and copper markets. Demand is very good and supply remains low.

Flexible Armored Conductor.—Business is spotty at the present time, but with the passing of the summer months and the vacation period the demand for this material is expected to increase. Prices remain steady.

High-Tension Equipment.—Manufacturers report a good amount of business, especially in fuses. A number of large orders have been booked by local manufacturers during the past week, among them a sale for furnishing equipment, including a number of indoor switches for an addition to a power station in Davenport, Iowa.

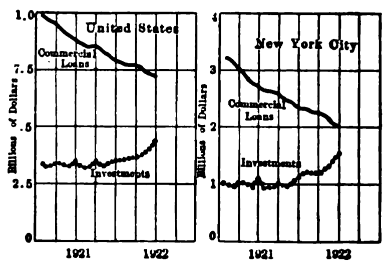
Boston

Good Volume of Business Reported—Credit Conditions in Contracting Field Sharply Followed

Business continued in good volume up to the holiday week end. Interest in appliances is increasing, and the sale of heavier wiring material is active and varied. Building operations are in good volume and the industrial labor conditions in New England are improving. One jobber reports that for the past four years every month has shown increased earnings compared with the corresponding month of the previous year. Deliveries are not so good on rigid conduit, and manufacturers are worrying somewhat over raw-material shipments. Central-station outputs are gaining and more line extensions are being undertaken. Credit conditions in the contracting field are being sharply followed.

Lamps.—Demand holds up well and very active sales are expected as the fall trade opens. Stocks are well-rounded and prices firm.

Wire.—Rubber-covered and weatherproof wire are both moving actively. At $6.25 per 1,000 ft. in 1,000-ft. lots, No. 14 of the former is in good supply. At present the demand for outside wire is such that it is none too easy to build up jobbers' stocks, at least in some cases. Bare wire is very dull, barring sporadic sales for radio aerials and occasional high-tension line work.



CHANGES IN COMMERCIAL LOANS AND TOTAL INVESTMENTS OF REPORTING MEMBER BANKS IN THE UNITED STATES. (FROM FEDERAL RESERVE BANK OF NEW YORK CITY)

Industrial Electric Trucks.—Distributors and agents are much busier on inquiries than a year ago, and actual sales are better. One manufacturer reports that the best sales for several years are now on the books.

Cleveland

Manufacturers Report Business Is Spotty—Radio Interest Increasing—Cleaners Active

Some manufacturers report business spotty. Building operations have been active up to now, but are slowing down owing to shortage of material caused by the railroad strike.

In general, however, business has been more active than last week, and the receipts are a substantial initiation into the fall season.

Radio Equipment.—An appreciable increase in sales is reported. Business houses are interesting themselves in the possible utilization of radio as a means of communication. Several inquiries have been received and manufacturers have prepared estimates. One radio manufacturer anticipates the resumption of activity with several large orders and has accelerated production to meet the expected demand.

Vacuum Cleaners.—These are held by some to be a seasonal product, and hence the activity in sales is regarded as unusual, although the supply is sufficient to permit prompt deliveries.

Washers.—The end of the vacation season has tended to invigorate sales and a fair market is expected.

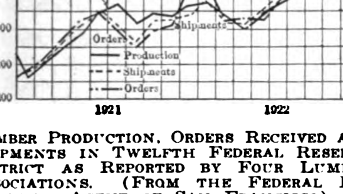
Ironers.—Window demonstrations by jobbers and retailers have stimulated the market in a satisfactory manner, and sales are in accord with the sale of washers.

St. Louis

Pole-Line Hardware Sales Reported in Good Volume—Stocks Generally Are Incomplete

Notwithstanding greater difficulties in conduct of business because of the rail situation, St. Louis jobbers report sales holding up well. Stocks are incomplete. Deliveries are increasingly difficult, resulting in more small orders calling for express shipment. Coal mines are buying in larger quantities, especially for goods used in maintenance work. Prices generally are firm.

Pole-Line Hardware.—Sales continue in good volume, but inquiries show a decline. Stocks are low and in many cases incomplete. Substitutions are the rule and are readily accepted by the purchasers.



LUMBER PRODUCTION, ORDERS RECEIVED AND SHIPMENTS IN TWELFTH FEDERAL RESERVE DISTRICT AS REPORTED BY FOUR LUMBER ASSOCIATIONS. (FROM THE FEDERAL RESERVE AGENT OF SAN FRANCISCO)

Poles and Cross-Arms.—On account of uncertainty of shipments and previous anticipation of transportation difficulties, orders show a decline. Construction work planned for this season is well under way and heavy buying is not now anticipated before next year. Local stocks are very spotty.

Dry Cells.—A strong demand continues. Local stocks are fairly good, but dealers' stocks out of town are short because of freight delays. The regular is selling for $31.04 per 100 and the igniter for $32.04 per 100, both in barrel lots.

Atlanta

Industrial Conditions Are Reported Unsettled—Fair Stock of Farm-Lighting Outfits

Industrial conditions throughout the section are considerably unsettled as a result of shortage in fuel and an apparent indefinite continuation of the railroad strike. Some of the mills have already shut down because of lack of fuel, noticeably brick and cement plants, while fear is expressed that a great number of textile plants will find fuel exhausted within the next two weeks. Those mills operating on hydro-electric power, of course, will not be affected, as they have accumulated sufficient stocks for heating and slashing.

Farm-Lighting Outfits.—A fair volume of sales is reported, with prospects looking up for fall business when crops are harvested. Good stocks have been accumulated, but deliveries from factory are badly delayed.

Conduit.—An increase of three points in the price of this item is reported this week, with the demand excellent. A shortage in this line is reported, and little hope for better stocks is held until the railroad strike is over.

Salt Lake City—Denver

Agricultural Industry Progressing—Retailers Are Not Stocking Heavily

Reports indicate that the agricultural industry is making a rapid and satisfactory recovery. Financing institutions are now meeting all urgent demands for money. requiring the regular collateral. Wages in a number of lines of work show a tendency upward. Harvest money is circulating freely, giving retail business a decidedly healthier tone. Retail dealers are not stocking heavily but show some signs of preparing for fall trade. Some good orders are being placed for lamps, and greater interest is shown in fixtures and electroliers.

Vacuum Cleaners.—There has been no brisk movement in the summer months, but some aggressive selling campaigns are now under way to stimulate interest in fall cleaning. No price changes have been noted during the past week.

Portland—Seattle

Railroad Strike Is Beginning to Make Itself Felt—Household Appliance Prices Drop—Cleaners Active

The railroad strike is at last beginning to make itself felt in the Northwest. Apple growers are very much alarmed over the situation, and fear is felt that a part of the crop may be lost for lack of transportation to Eastern markets. The lumber industry is also beginning to suffer from the strike. The coal strike is in a fair way to be settled, and it is expected that many mines closed by the strike will resume operation within a few days. Building activity throughout the Northwest continues unabated.

The Seattle lighting department is about to begin on a large program of extensions to its distribution system and street-lighting circuits. The work, which includes new substations, will cost about $2,000,000. Electrical jobbers find business very good. Report comes from Seattle that a shortage in stocks of conduit and wire exists as a result of the coal and railroad strikes.

Household Appliances.—A small drop in price is recorded on practically all flat irons and silver-plated ware. Ranges are in good demand. Stock replacements in Portland are seriously interfered with by the railroad strike. Washers and cleaners are in good demand.

San Francisco

Contractors Have Much Work—Ranges Are Selling Actively—Conduit Advances Are Reported

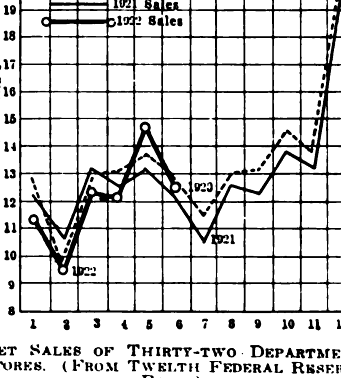
Contractors have all the work they can handle. The expected let-up in construction has not materialized. Payments are rather slow, and credit men are not only vigorously shepherding their own accounts but are finding it necessary to help dealers follow theirs. Few new firms are reported, but there is much reorganization. Sporadic radio firms are disappearing. Local conditions are much better. Fruit shipments are declared almost normal by railroad officials, and packing plants are again operating at capacity except in a few districts. Railroad construction has been rather hindered by strike conditions, but promises to run high during the latter part of 1922. Southern Pacific and Central Pacific separation would mean practical duplication of present terminal facilities and much other parallel construction.

Ranges.—Following a highly successful season, several health resorts, notably Yosemite camps, are planning extensive electrification in the way of heating and cooking equipment. A large San Francisco hotel is installing an electric grill. Household range sales have been greatly stimulated by the "Flying Circus" form of traveling demonstrations sponsored jointly by power companies and manufacturers.

Radio.—Complete reorganization of broadcasting service is demanded within the next sixty days. Present service is spotty in quality. Many inquiries are rife for broadcasting equipment. Sales of complete receiving and amplifying outfits are still rather low. Part sales are good, but radio firms are literally working day and night in constructive advertising and demonstrating, which will surely produce a splendid fall business.

Conduit. — Two recent advances amount to approximately 10 per cent. Local stocks are depleted because of heavy ordering prior to the advance.

Rubber-Covered Wire.—Movement of regular sizes and styles is steady, but not remarkable.



NET SALES OF THIRTY-TWO DEPARTMENT STORES. (FROM TWELFTH FEDERAL RESERVE BANK)

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Westinghouse Company's Springfield Plant Employs 3,800

The Westinghouse Electric & Manufacturing Company now employs 3,800 persons in its Springfield (Mass.) plant, of whom 2,500 are in the automotive equipment division, whereas the total force in all departments—automotive, small motors and radio—on Feb. 1, last, was only 1,300. The increase since then has been continuous and promises to be maintained through the rest of the year. Production of lighting, starting and ignition apparatus is being rushed for the equipment of 1923 motor-car models, including sixty-seven different makes of vehicles. Thirty new Westinghouse automotive service stations have been opened in different parts of the United States, bringing the total number to 301. These stations serve as the principal distributing agencies for replacement parts sold directly to the trade, as distinguished from equipment supplied to car manufacturers.

Imboden Hydro-Electric Power Firm Organized

Announcement of the organization of the Imboden Hydro-Electric Power & Manufacturing Company at Walnut Ridge, Ark., last week has been made. This concern has a capital stock of $100,000, $25,000 of which is paid in, and it plans to develop 1,500 hp. to 2,000 hp. without the construction of a dam.

The officers of the concern include: President, W. R. Lane, president of the Planters' National Bank; vice-president, L. F. Wheeless, patentee of the Wheeless flexible harrow; treasurer, W. L. Bugg, cashier of the Planters' National Bank; secretary, G. G. Dent.

Wickwire-Spencer Corporation Special Meeting Sept. 8

A special meeting of stockholders of the Wickwire-Spencer Steel Corporation has been called for Sept. 8 in Worcester, Mass., to ratify the purchase of the capital stock of the American Wire Fabric Company and to authorize the sale of $1,775,000 ten-year 7½ per cent convertible gold notes to pay for the stock.

It will also be proposed to change the 250,000 common shares of the Wickwire company now outstanding of the par value of $5 each to an equal number of shares of no par value and to authorize the issuance of 350,000 shares additional of common stock of no par value. A further provision is for the exchange of the 80,000 Class A common shares of the par value of $5 each now outstanding for 120,000 shares of the new common stock and the cancellation of the Class A shares so exchanged.

H. W. Doddard, chairman of the Wickwire-Spencer Steel Corporation, says the new acquisition had earnings in the last nine years averaging $400,000 yearly after taxes and depreciation. Its sales last year amounted to $4,000,000.

Utah Copper Company Producing 10,000,000 Lb. Monthly

Production of at least 10,000,000 lb. of copper a month is indicated in the quarterly report of the Utah Copper Company. This is at the rate of 120,000,000 lb. annually. While rated capacity is close to 200,000,000 lb., the management does not favor an output of more than 60 per cent of normal pending a better price for copper.

Utah Copper is steadily whittling down costs. Final figures for the second quarter averaged 10⅝ cents a pound, including expenses incident to resumption after a year's shutdown. Production amounted to only 22,160,000 lb., of which nearly 50 per cent was made in June.

Production cost is understood to have been under nine cents for the 9,500,000 lb. of copper produced in that month. It is safe to assume that cost in the current quarter will not exceed 9 cents for the 30,000,000 lb. Even on the current metal market of 14 cents, this would permit net profits of nearly $1 a share on the 1,624,490 shares, against current dividends of 50 cents quarterly.

Owen-Dyneto Electric Corporation Formally Organized

Formal organization of the Owen-Dyneto Electric Corporation, Syracuse, N. Y., has been completed. The company will take over the assets of the Dyneto Electric Corporation, manufacturer of generators and electric starting devices for automobiles and lighting systems for motor cars.

Directors elected are Ray M. Owen, New York City; Harry M. Ballard, Chicago; Hamilton Sanford, C. S. Estabrook and James D. Grant, Syracuse. Mr. Owen was elected president, Mr. Ballard and Mr. Grant vice-presidents, Mr. Estabrook secretary and Mr. Grant treasurer.

The Dyneto Electric Corporation failed last year as a result of the business depression. It was placed in the hands of receivers and sold June 30 to Mr. Owen for $205,000. Mr. Owen had large interests in the firm prior to its difficulties.

Cataract Electric Company Is Selling Stock to Employees

In order to secure additional capital with which to seize its rapidly growing opportunities, the Robertson-Cataract Electric Company, Buffalo, N. Y., is offering a limited amount of its treasury stock, common and preferred, to its employees and through them to the public.

No changes in the control or policies of the company are contemplated. Since 1902 the control of a substantial majority of the total issued stock of the company has been in the hands of the Robertson and Sidway families, and according to W. E. Robertson, the general manager of the company, it will remain there after the sale of the present offering.

"In the past," says Mr. Robertson, "our employees have subscribed liberally to both common and preferred stock which has at all times been offered on exactly the same basis as that upon which the officers and directors have purchased."

"Employees' holdings at present amount to $181,300. In giving publicity to this offering it should be understood that there is no radical change in our policy of the past. This is not a new issue created especially for the purpose of raising additional funds, but is an allotment of unissued shares of the treasury stock of the company held in reserve in anticipation of such an opportunity for business expansion as the present offers.

"In selling this stock the only departure from our policies of the past is in respect to permitting the public to subscribe through our employees. This action has been taken because the additional capital that can be used to advantage is in excess of that which our employees can absorb. The stock is being sold entirely through the employees."

The company was founded in 1895 by James D. Robertson. It is the largest distributor of electrical supplies in western New York and one of the twelve largest in the United States. It also handles on a large scale electrical apparatus, appliances, storage batteries, fine lighting fixtures and radio equipment.

Through the ownership of the Robertson-Electric Construction Company as subsidiary, it manufactures switch boards, distributing panels, junction and meter protection boxes and kindred equipment.

The earnings of the company applicable to preferred-stock dividends have never been less than four times the amount required on outstanding preferred stock.

Dividends of 6 per cent or more have been paid on the common stock of the company regularly since its incorporation. Dividends on preferred stock have been paid each quarter since it was issued in 1907.

The company owns the land and buildings occupied by it at the corner of Mohawk and Elmwood Avenues.

"Good Health Week" and Fans

BY H. M. C.

PROMOTION of "Good Health Week," to be observed from Oct. 23 to 30, is being helped by fan manufacturers, who are pointing out the necessity of better ventilation in odorous kitchens, musty bookstores, cattle compartments, shoe stores, factories and other places where dust and smoke are known to be. Heat sells fans in summer; education of the consumer sells them in winter. Is not education wonderful?

"Get ready for 'Good Health Week,'" is the order from the ILG Electric Ventilating Company, Chicago, which apparently is doing the most to educate the consumer in the use of fans for better health. Manufacturers of all kinds of fans, of course, will benefit by the interest created by "Good Health Week." But more advertising is needed; bulletins to salesmen are necessary. The ILG company has many good selling points already covered. Officials of this firm say:

"It is obvious that 'Good Health Week' will start the public thinking, reading and talking good-health measures, and every word spoken, printed or written will create that much more interest in ventilation, sanitation and personal hygiene—which are the basic fundamentals of health since the birth of man."

Thus, a market of wide possibilities is opened for manufacturers of washers, vacuum cleaners and appliances of every description. Talking good health is good business.

Extensive Pension Program by Wire Company Announced

Announcement has just been made by the John A. Roebling's Sons Company, Trenton, N. J., to the effect that all employees who have been with that company a year or longer on Sept. 1, 1922, will be protected by group life insurance and pension plans. By arrangements made with the Equitable Life Assurance Society of the United States the insurance went into force automatically on midnight of Aug. 31.

The insurance is graded according to length of service, all employees more than one year and less than two years with the company to receive $500, increasing $100 each additional year of service until the maximum of $1,500 is reached for eleven years of service and over.

The insurance benefits will be payable to the beneficiary named by the employee, or in the event of his becoming totally and permanently disabled before reaching the age of sixty, it will be paid to him.

The pension plan contemplates retirement at the age of sixty for males and fifty-five for females, and in the event that this class of employee has served twenty years or more, they may request a pension or be retired at the discretion of the company. Any employee, however, who has served thirty years or more, or any male employee fifty-five years of age or female employee fifty years of age whose term of service is twenty-five years or more, may at the discretion of the company be retired from active service and granted a pension.

The plan is further liberalized in that pensions may be allowable in cases of total disability arising from non-occupational injuries and illnesses.

The amount of pension is determined by multiplying 1 per cent of the average annual pay during the ten years preceding retirement by each year of service. A minimum of $25 per month and a maximum of $250 a month has been established and will apply, except in cases where the pension is being paid in cases of total disability above referred to, where the minimum may be less than $25 per month.

Prima Radio and Tool Works Consolidate

Consolidation of the Prima Radio Coporation, New York City, and the Manufacturers' Tool & Die Works, under the corporate title of the Prima Radio Corporation, has been formally announced. The new corporation is capitalized for $50,000 8 per cent preferred stock, par value $10, and 1,500,000 shares of $1 par value common. There is no bonded indebtedness.

William Schilling is president of the corporation and Andrew E. Puckrin chairman of the board of directors.

The Manufacturers' Tool & Die Works have been engaged in the manufacture of various tools, dies and instruments since 1912. The new corporation's plant is in Brooklyn, N. Y.

Announce Establishment of Standard Electric Works

W. J. Howard and G. T. Key, Jr., announce the establishment of the Standard Electric Works, 17 Bibb Street, Montgomery, Ala. This firm will specialize in the repair and rebuilding of motors and generators.

G. T. Key, Jr., was master mechanic of the American Agriculture Chemical Company and has had twelve years of experience in electrical and mechanical work.

W. J. Howard was chief engineer for the Durham Public Service Company, a subsidiary of Henry L. Doherty & Company.

The Charles Parker Company, tool manufacturer, Meriden, Conn., has awarded the contract for extensive changes to its power plant.

Wico Electric Company Awards Contract for Plant Unit

The contract to build the first unit of the Wico Electric Company's plant in West Springfield has been awarded to the Fred T. Ley Company, the building to be a brick monitor, 400x90 ft., to be finished by Jan. 1.

The Aeolian Company, Meriden, Conn., has let the contract for a one-story addition to its power plant, dimensions 50 ft. x 30 ft. and of brick construction.

The Safety Car Heating & Lighting Company, New Haven, Conn., has taken out permits for the construction of two new factory buildings. One will be an addition one story high, 115x106 ft. The other will be an entirely new structure, one story high and 56x195 ft. These buildings will cost about $100,000. Stovel & Brinkerhoff, 136 Liberty Street, New York, are the engineering contractors.

The Englert Manufacturing Company, 2,131 Carson Street, Pittsburgh, Pa., manufacturer of automobile batteries and operating a general battery repair plant, has purchased property at South Twenty-fifth Street and Jane Streets, 68 ft. x 120 ft., as a site for a new plant. Plans will be prepared at an early date. Harry N. Englert is head.

The Boustead Electric & Manufacturing Company, Inc., Minneapolis, has been appointed Northwestern distributor for the Ideal Electric & Manufacturing Company of Mansfield, Ohio, manufacturer of squirrel-cage direct-current and synchronous motors, alternating-current and direct-current generators up to 1,000 kw., motor-generator sets, electroplating outfits, etc. The Boustead Electric & Manufacturing Company has for years specialized in rebuilt motors and generators and at the present time maintains one of the largest repair shops in the Northwest. The company also manufactures a complete line of switchboards for every purpose.

The American Lamp Company, 25 West Forty-third Street, New York City, has acquired the factory of the former New England Products Company, Stamford, Conn., previously owned by the Borg Products Company, for a consideration said to be about $40,000 and will occupy the plant at once for the manufacture of incandescent lamps, including the refilling of burned-out lamps. The machinery formerly used by the New England company, now installed at the plant, has been purchased from Arthur G. Jessup, receiver for the latter organization. The American Lamp Company is capitalized at $2,000,000 and has plans under consideration for the establishment of similar plants in other cities, including Chicago, Detroit, Philadelphia, Newark, N. J., and New Orleans, La. It is also planned to operate large works at Long Island City.

Foreign Trade Notes

REGULATIONS GOVERNING WATER POWER IN RUMANIA.—With a view of making needful modifications in the present law, as well as to draw up regulations for the use of water power in Rumania, *Commerce Reports* states, the Ministry of Public Works has appointed a commission to be presided over by the general engineering inspector of the Ministry of Communications.

PROPOSED HYDRO-ELECTRIC PROJECT IN ESTHONIA.—A representative of some Belgian industrial concerns, according to *Commerce Reports*, was in Reval early in June negotiating with the Esthonian authorities for a concession to exploit the Narva waterfalls and the Reval electric railway. After obtaining a concession to utilize the water falls, it is stated that it is proposed to construct a large power station in Narva capable of supplying electricity throughout Esthonia.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency and purchase is desired by parties in Italy (No. 3,420) for machinery, electrical material, motors, etc.

A street-railway company in Spain (No. 3,426) planning extensive improvements, for which electrical material will be required, desires to purchase supplies in the United States.

A mercantile firm in Italy (No. 3,430) desires to secure an agency for radio telephones.

THE VICTORIAN ELECTRICITY COMMISSION, 22 William Street, Melbourne, Australia, will receive tenders until Jan. 15, 1923, according to the *Electrical Review*, for four water-tube boilers, each 4,500 sq.ft., with pumps, piping and structural steel work for boiler house. Tenders will also be received until Jan. 23, 1923, for a back-pressure steam turbine, including a 1,500-kw. turbo-alternator.

POWER HOUSE EQUIPMENT FOR SOUTH AFRICAN RAILWAYS.—Tenders will be received until Oct. 18 by the South African Railway Board, according to the *Electrical Review*, for powerhouse equipment in connection with the electrification of the Maritzburg-Glencoe Railway, including coal-handling plant, ash-handling plant and circulating water screening plant. Specifications, forms of tender, etc., may be obtained at the office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W. C. 2. Merz and McLellan, 32 Victoria Street, S. W. 1, London, are consulting engineers.

ELECTRIC INDUSTRIAL TRUCKS FOR VICTORIAN RAILWAYS.—Tenders will be received by the Victorian Government Railway Commissioners, Melbourne, Australia, until Nov. 29, the *Electrical Review* states, for three electric storage-battery industrial trucks, capable of carrying 4,000 lb. at five miles an hour.

ELECTRIC CRANES FOR AUCKLAND, NEW ZEALAND.—Tenders will be received by the Harbor Board, Auckland, N. Z., until Feb. 1, 1923, according to the *Electrical Review*, for twenty-two electric cranes for Princes Wharf.

New Apparatus and Publications

CIRCUIT BREAKERS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently brought out an oil circuit breaker of larger capacity, known as type "F-22."

DECORATIVE LIGHTING.—The Reflector & Illuminating Company, 565 West Washington Street, Chicago, is distributing a booklet describing its "Color-O-Lite" film holder and "Spot-O-Lite" equipment for decorative lighting. The company has issued an eight-page leaflet covering its "Pittsburgh" reflector for colorful lighting.

FLEXIBLE COUPLING.—The Steel-Flex Coupling Corporation, Detroit, has recently placed on the market an all-steel flexible coupling, known as the "Steel-Flex" coupling.

INDUSTRIAL APPARATUS.—The Condit Electrical Company, Boston, 27, has issued an "Industrial Hand Book" covering its industrial apparatus. It also gives some handy tables and Underwriters' motor rules.

STREET LIGHTING.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently published a pamphlet on street lighting, known as reprint No. 123.

COAL AND ASH-HANDLING SYSTEM—The Chain Belt Company, Milwaukee, has recently brought out a new pivoted bucket-carrier system for handling coal and ashes for power plants, etc.

RADIO APPARATUS.—A new radio receiving set has recently been placed on the market by the Killark Electric Manufacturing Company, Easton and Warne Avenues, St. Louis.

PHENOL PRODUCTS.—The Redmanol Chemical Products Company, 636 West Twenty-second Street, Chicago, has issued a thirty-six-page booklet listing the various uses of its product, "Redmanol."

STEAM RAILWAY ELECTRIFICATION—"Progress in Steam Railway Electrification" is the title of bulletin No. 44,016 issued by the General Electric Company, Schenectady, N. Y., in which it describes some of the prominent railway electrifications throughout the world for which it has supplied the apparatus.

TRANSFORMERS.—The Kuhlman Electric Company, Bay City, Mich., is distributing bulletin No. 111, covering the "Kuhlman" single-phase distribution and power transformers. Bulletin No. 112 issued by the company describes its three-phase distribution and power transformers.

RADIO TOWERS.—The Milliken Brothers Manufacturing Company, Inc., Woolworth Building, New York City, has issued catalog No. 16, describing the "Milliken" galvanized radio towers.

INDUCTION MOTOR.—The Electric Controller & Manufacturing Company, Cleveland, is putting on the market a squirrel-cage induction motor.

ELECTRIC HOISTS.—Bulletin No. 544-DD distributed by the Northern Engineering Works, Detroit, describes the Northern frame "B," type D electric hoist, which is furnished in sizes from ½ ton to 1 ton.

PUMPS.—Bulletin No. 48,028 issued by the General Electric Company, Schenectady, N. Y., gives several illustrations of the application of electric motors for driving pumps and general descriptions of motor control.

LUBRICATING SYSTEM.—The Carr Fastener Company, Boston 39, is distributing two leaflets, covering the "Dot" high-pressure lubricator for use in industrial plants, turbines, conveying machinery, etc.

New Incorporations

THE HAWKINS (WIS.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $6,000 by Frank Prochaska, F. W. Lonks, J. Hawkins and others.

THE FRANKLIN (VT.) ELECTRIC LIGHT COMPANY has been incorporated by Charles H. Gates, Rodney D. Gates, R. R. Strait, Frank Peverly and others. The company is capitalized at $30,000 and proposes to generate and distribute electricity in Franklin, Sheldon, Highgate and Berkshire.

THE STODDARD WAVE POWER CORPORATION, New Rochelle, N. Y., has been incorporated by Edward D. Stodder, Guy L. Gleason and Donald J. McLean, all of New Rochelle. The company is capitalized at $25,000 and proposes to utilize the ocean waves to generate electricity, etc.

THE SAN GORGONIO POWER COMPANY has been organized with a capital stock of $1,000,000 to construct a hydro-electric plant in the Whitewater River district, near Riverside, Cal. The directors are: R. R. Scarborough, president; W. T. McAllister, M. S. Hazen and J. A. Lamour, all of Los Angeles.

THE EAST BRUNSWICK MUTUAL POWER & LIGHT COMPANY, 40 Patterson Street, New Brunswick, N. J., has been incorporated with a capital stock of $125,000 for the purpose of furnishing electricity in East Brunswick Township. Klammer Kalteissen is agent.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

SALMON FALLS, N. H.—The Salmon Falls Manufacturing Company has authorized an increase of $200,000 in capital stock, the proceeds to be used for additional water-power development, at its mill, increasing the output from 1,200 to 3,000 hp.

REVERE, MASS.—Plans for the new vocational school, to cost about $250,000, provide for a vocational department.

MERIDEN, CONN.—The Aeolian Company is planning to build a one-story addition to the power house at its local plant.

TORRINGTON, CONN.—A committee of merchants and property owners have submitted a proposal to the Borough Council offering to install ornamental lamp standards on Main Street from Smith Street to City Hall Avenue, provided that the borough would maintain the lamps.

North Atlantic States

BEDFORD HILLS, N. Y.—The Montefiore Home, Gun Hill Road, is taking bids for the erection of a power house. Robert D. Kohn, 56 West Forty-fifth Street, New York, is architect.

HORNELL, N. Y.—The Hornell Electric Company contemplates the erection of a high-tension transmission line from Hornell to Arkport, 5 miles, to cost about $25,000.

JAMESTOWN, N. Y.—The Niagara, Lockport & Ontario Power Company, Buffalo, contemplates building a power plant in the vicinity of Jamestown and extensions to its system, to cost about $750,000.

LONG ISLAND CITY, N. Y.—Conveying equipment, loading and unloading machinery, elevators, etc., will be installed in the new warehouse to be erected at Long Island City by James Butler, Inc., 391 Washington Street, New York City, to cost about $1,500,000. William Higginson, 21 Park Row, New York City, is architect.

MT. KISCO, N. Y.—The Westchester Lighting Company is preparing plans for a two-story building to be used for general mechanical and operating service. May & Hilliard, 15 East Fortieth Street, New York, are architects.

NEW YORK, N. Y.—The Car Lighting & Power Company, 61 Broadway, has issued $1,000,000 in bonds, the proceeds to be used for plant construction and improvement.

NEW YORK, N. Y.—Work will soon be started on the proposed power plant to be erected at Columbia University, Teachers' College, to be used in connection with a new library building on 120th Street near Broadway.

ROCHESTER, N. Y.—The Northeast Electric Company, 348 Whitney Street, is planning to build an addition to its plant, 51 ft. x 90 ft., to cost about $30,000.

ROCHESTER, N. Y.—Plans are being prepared by the Rochester Telephone Corporation for the construction of a service and repair building on St. Paul Street, to cost about $125,000.

ST. GEORGE, N. Y.—The Baltimore & Ohio Railroad Company has plans in progress for the electrification of the lines of the Staten Island Rapid Transit Company, a subsidiary, including power plants, substations, etc.

CLOSTER, N. J.—The capital stock of the Rockland Electric Company of New Jersey has been increased from $200,000 to $300,000.

FLORENCE, N. J.—The Township Committee is negotiating with the Public Service Electric Company to extend its service to Florence.

HACKENSACK, N. J.—Bids will be received by the Hackensack Improvement Commission until Sept. 25 (Contract No. 3) for furnishing pumping equipment, consisting of A. B. Wood patent trash pumps, motors and switchboards to be installed in the structures to be erected for the city of Hackensack under another contract, which is known as Contract No. 1. Lemuel Lozier is engineer of the commission.

JERSEY CITY, N. J.—The new freight house to be erected at the foot of Chapel Avenue by the Lehigh Valley Railroad Company, at a cost of about $650,000, will be equipped with freight-handling, loading and conveying machinery, industrial trucks, etc.

NEW BRUNSWICK, N. J. — The East Brunswick Mutual Power & Light Company, 40 Patterson Street, recently organized with a capital of $125,000, plans to install an electric plant and system in East Brunswick Township. Klemmer Kalteissen heads the company.

WHIPPANY, N. J.—R. B. McEwan & Sons contemplate rebuilding its power house at their paper-board mill, recently damaged by fire. The loss is estimated at about $30,000.

ALTOONA, PA.—The Penn Central Light & Power Company has issued $167,000 in bonds, part of the proceeds to be used for extensions and improvements.

EASTON, PA.—An underground conduit system will be installed in North New Street for an ornamental street-lighting system.

HANOVER, PA. — The Hanover Light, Heat & Power Company has issued $75,000 in bonds, part of the proceeds to be used for extensions and improvements.

HARRISBURG, PA.—Plans are under way for the installation of an ornamental lighting system on Front Street from Market Street north. Clark E. Diehl, city electrician, is in charge.

PHILADELPHIA, PA.—The Philadelphia Electric Company will build an addition to its Ontario substation and to the substation at Susquehanna Avenue and American Street.

PHILADELPHIA, PA. — Electrical and mechanical equipment will be installed in the eight-story printing plant to be erected by the Lutheran Publishing Company, Ninth and Sansome Streets, Philadelphia, to cost about $500,000.

PHILADELPHIA, PA.—Plans have been prepared by Eugene S. Powers & Son, 315 South Fifteenth Street, consulting engineers, for a one-story power house for the St. Joan of Arc School, Frankford Avenue and Venango Street.

SNYDERTOWN, PA.—The Snydertown Power & Light Company recently organized, will install a local distributing system. The company has contracted with the Pennsylvania Power & Light Company for power supply.

STATE COLLEGE, PA.—The Keystone Power Corporation, Philadelphia, has issued $719,000 in bonds, the proceeds to be used to acquire the plant and holdings of the State Center (Pa.) Electric Company and for extensions and improvements.

YORK HAVEN, PA.—The York Haven & Power Company will build a series of generating units to double its present capacity, estimated to cost about $1,000,000.

HARRINGTON, DEL. — The Eastern Shore Gas & Electric Company, Laurel, is negotiating for the purchase of the property and holdings of the Kent County Electric Company, now furnishing service at Harrington, Felton, Frederica and vicinity. Extensions and improvements are planned.

BALTIMORE, MD. — Extensions to the water filtration plant at Montebello, to cost about $1,500,000, are under consideration. New equipment, including electrically operated pumps and other machinery will be installed. Chief Engineer Megraw, Water Bureau, is in charge.

FROSTBURG, MD.—New electric pumping equipment will be installed at the municipal waterworks in connection with other extensions and improvements, to cost about $60,000.

HAGERSTOWN, MD.—The Potomac Public Service Company, a subsidiary of the American Water Works & Electric Company, 50 Broad Street, New York, will build a 30,000-hp. hydro-electric plant on Cacapon Creek, near Edes Fort, W. Va., to cost, including transmission system, about $3,000,000.

GLEN WHITE, W. VA.—Arrangements are being made by the E. E. White Coal Company for the installation of additional electrical and mechanical equipment, to cost about $200,000.

LEEHALL, VA.—An electric plant will be installed in connection with a new garage being erected by S. R. Curtis & Sons. The proposed plant will supply electricity for lighting purposes in Lee Hall and vicinity.

ROANOKE, VA.—The Liberty Light & Water Company, recently organized, contemplates the installation of an electric system in this section. M. C. Hughson is president.

WASHINGTON, D. C.—Bids will be received by the Board of District Commissioners until Sept. 12 for 25,500 ft. of telephone and signal cable for the electrical department.

WASHINGTON, D. C.—Bids will be received by the Chief Signal Officer, United States Army, until Sept. 22 for 260,000 ft. silicon bronze antenna wire (Circular PR-12469-2CP); also, until Sept. 25 for two 80-ft. radio towers for use at the Montgomery intermediate depot.

North Central States

DETROIT, MICH.—Parke, Davis & Company have filed plans for the construction of a power plant at their drug factory, Guoin Street, to cost about $75,000.

MUSKEGON HEIGHTS, MICH. — The installation of an ornamental lighting system is under consideration. The cost is estimated at $35,000, and the system will include 190 lamp standards. C. S. Gamble is city engineer.

OMER, MICH.—The Council has authorized the purchase of a site on the Rifle River for a municipal electric light and power plant.

MARYSVILLE, OHIO.—The Marysville Light & Water Company expects to erect a transmission line to the village of Ostrander, a distance of 5 miles, within the next thirty days. Mayne Mackan is superintendent.

LOUISVILLE, KY. — Arrangements are being made by the Louisville Cement Company for the erection of a new cement mill at Speed, Ind., to cost about $500,000. It will be equipped throughout with electrically operated machinery.

NEWPORT, KY.—The Cincinnati, Newport & Covington Street Railway Company is planning to rebuild its local power plant, recently damaged by fire.

NEWPORT, KY.—The power plant of the South Covington & Cincinnati Street Railway Company was recently damaged by fire, causing a loss of about $15,000.

FORT WAYNE, IND.—The Home Telephone & Telegraph Company has applied to the Public Service Commission for authority to make extensions and improvements, including the installation of underground conduits, to cost about $300,000.

INDIANAPOLIS, IND.—A new municipal electric power plant will be erected in connection with the proposed sewage-disposal plant, to cost about $115,000. The Board of Sanitary Commissioners is in charge.

MARION, IND. — The Faulkner-Burge Packing Company is planning to rebuild its power house, recently damaged by fire.

KEWANEE, ILL. — The Consolidated Light & Power Company has submitted a proposal to the City Council offering to sell its plant to the city. Bonds to the amount of $125,000 have been voted to establish a municipal electric plant.

ANTIGO, WIS. — Plans are being prepared by M. D. Robrecht for the erection of a three-story cold-storage warehouse, 40 ft. x 100 ft., which will be equipped with a 150-hp. to 200-hp. power plant and artificial ice and refrigerating unit.

DANE, WIS. — The Wisconsin Power, Light & Heat Company is erecting a 66,000-volt transmission line from Dane to Fond du Lac, a distance of 75 miles, which will deliver energy from the Prairie du Sac hydro-electric plant of the Wisconsin River Power Company to the distribution system of the Eastern Wisconsin Electric Company.

FOND DU LAC, WIS.—The Eastern Wisconsin Electric Company, Sheboygan, has been granted a franchise to extend its transmission line to Van Dyne.

ST. PAUL, MINN.—A two-story power house, 40 ft. x 98 ft., will be erected on Hoffman Street for the St. Johns Hospital.

WILLMAR, MINN.—The City Council has awarded contract to the Power Construction Company, Minneapolis, for the installation of an underground conduit system in the business district.

DES MOINES, IOWA.—The City Council is considering replacing the gasoline lamps now in use in the city public parks with electric lamps.

KANSAS CITY, MO.—The City Hospital Association will build a one-story power house at the city hospital, Twenty-second and Cherry Streets. F. C. Gunn, 1107 Republic Building, is architect.

MARYVILLE, MO.—The Maryville Electric Light & Power Company has been granted a franchise for the construction of a transmission line to Bradyville, Iowa.

HOT SPRINGS, S. D.—Plans are being prepared by the Hot Springs Water, Light & Power Company for the construction of a 450-hp. plant to replace the one destroyed by flood. The Hollister Engineering Company, Bankers' Life Building, Lincoln, is engineer.

PRESHO, S. D.—The proposal to issue bonds for the establishment of a municipal electric plant will soon be submitted to the voters.

CORTLAND, NEB.—An election has been called to vote on the proposal to issue bonds for the installation of a municipal lighting system.

DEXTER, KAN.—Preliminary plans are being prepared by the Dexter Helium Company of America, Winfield, for the erection of a new helium plant at Dexter, to cost about $1,000,000. The plans include a power house, mechanical shop, etc.

Southern States

CHERRYVILLE, N. C.—Extensions and improvements are contemplated to the water and light systems. Funds to the amount of $50,000 are available for the work.

FOUNTAIN, N. C.—Bonds to the amount of $15,000 have been approved for the installation of an electric lighting system.

COLUMBIA, S. C. — The Parry-Mann Electric Company is reported to be in the market for a 300-hp. engine and a 225-kw. generator, with exciter, switchboard and auxiliary equipment.

LEXINGTON, S. C. — The Lexington Electric Light & Power Company contemplates increasing its capital stock from $10,000 to $30,000.

LOUGHMAN, FLA.—The Everglade Cypress Company will build an electric generating plant for service at its proposed lumber mill.

MARIANNA, FLA.—The Federal Power Commission has granted the Chipola Light & Power Company permission to construct a dam and power plant at Look and Tremble Shoals on Chipola River, 12 miles south of Marianna.

ST. PETERSBURG, FLA.—Bids will be received by the Department of Public Utilities until Sept. 11 for the construction of a municipal electric lighting plant. Bonds to the amount of $300,000 have been voted to establish a municipal plant.

BIRMINGHAM, ALA.—The Lehigh Portland Cement Company, Allentown, Pa., will build a power plant in connection with its proposed local cement mill, to cost about $500,000.

OPELIKA, ALA.—The Alabama Power Company, Birmingham, it is reported, is planning to erect a substation at Aubrey, 5 miles from Opelika.

TUSKEGEE, ALA.—Bids will be received by the Supervising Architect, Treasury Department, Washington, D. C., until Sept. 22 for lighting fixtures for the veterans' hospital.

WATERFORD, ALA. — The Houston Power Company, Newton, will soon commence the construction of a hydro-electric power plant here. The Southern Engineering Corporation, Albany, Ga., is engineer.

COLLINS, MISS.—Bids will be received by the Mayor and Board of Aldermen until Sept. 11 for improvements to the municipal electric light plant as follows: Two oil engines directly connected to alternators, switchboards, pumps, one 12,000-gal. oil-storage tank, concrete foundations, new building, etc. Swanson-McGraw, Inc., United Fruit Building, New Orleans, La., are engineers.

UTICA, MISS.—The Council has authorized plans prepared for the installation of an electric light and power system.

POCAHONTAS, ARK. — The Central Power & Light Company, Walnut Ridge, contemplates the construction of a hydro-electric power plant on the Elevenpoints River.

GIBSLAND, LA.—The installation of a municipal electric plant and water system, to cost about $50,000, is under consideration.

ST. FRANCISVILLE, LA.—Bonds to the amount of $20,000 have been approved for extensions and improvements to the municipal electric plant.

MUSKOGEE, OKLA.—The Muskogee Gas & Electric Company will soon begin work on its proposed hydro-electric electric plant on the Arkansas River, to cost about $1,000,000. Transmission lines will be erected to connect with the distributing of the Oklahoma Gas & Electric Company and the Fort Smith Light & Traction Company. The H. M. Byllesby Construction Company, Chicago, is in charge.

NOBLE, OKLA.—Plans are under way for the erection of a transmission line to Norman, to secure electricity for local service.

CLIFTON, TEX.—Bonds to the amount of $35,000 for improvements to the municipal electric light plant have been approved by the Attorney General's Department, Austin.

CORSICANA, TEX.—The Council contemplates the installation of a modern electric fire-alarm system throughout the city.

DALLAS, TEX.—The City Commission has given its approval of the proposal of the Dallas Power & Light Company for the construction of a new electric generating station, to cost about $2,180,000.

DALLAS, TEX.—Steps have been taken by the Pacific Avenue Improvement League for the installation of an ornamental lighting system on Pacific Avenue. Harry Olmsted is president of the league.

EL PASO, TEX.—Work has begun on extensions to the electric plant of the El Paso Electric Railway Company, to cost about $75,000. It is proposed to increase the output by 2,200 kw.

SAN BENITO, TEX.—Plans are under way for the construction of a municipal electric plant and water system, for which bonds have been approved.

Pacific and Mountain States

MONTESANO, WASH.—The Washington Coast Utilities, Inc., Seattle, will erect a 13,000-volt transmission line on the Olympia Highway, about 5½ miles long.

CORNING, CAL.—W. H. Lampson, Corning, and associates have applied to the State Water Commission for permission to build a 125,000-hp. hydro-electric plant on the Trinity River, to cost $5,000,000.

LOS ANGELES, CAL.—The Council has approved ordinances for the installation of ornamental lighting systems on Sixteenth Street, Vermont, Berkshire and Grand Avenues.

SANTA ANA, CAL.—The Council is considering plans for the installation of a lighting system on West Fourth Street from Ross to Artesia Street.

MACKAY, IDA.—The Republic Consolidated Mining & Refining Company, recently organized with a capital of $3,000,000, is preparing plans for a hydro-electric plant to be used in connection with a new cyanide mill. W. P. Barton is in charge.

Canada

ELKO, B. C.—The Wigman Pulp & Paper Company, Ltd., Victoria, B. C., recently organized, contemplates the construction of a power plant in connection with its proposed pulp and paper mill at Phillips Bridge, near Elko, to cost about $2,500,000.

VANCOUVER, B. C.—The City Council has engaged J. G. G. Kerry, engineer of Kerry & Chace, Ltd., Confederation Life Building, Toronto, Ont., to investigate water power facilities here with a view of establishing a hydro-electric plant.

HAMILTON, ONT.—Contracts will soon be awarded by the Ontario Hydro-Electric Commission, London, for a new hydro station and also for extension of transmission lines along the Beach Road, to cost about $40,000.

ST. THOMAS, ONT.—Plans are under consideration for an electric distributing system and substation in Yarmouth Township, to cost about $28,000. W. C. Caughell, 386 Talbot Street, is township clerk.

Mexico

NOMBRE DE DIOS, DURANGO—Cesar G. Torres has petitioned the state government for a concession to build a dam across the Chavarria River and a hydroelectric plant. The water will also be used for irrigation purposes.

GUANAJUATO, GUANAJUATO—The transmission system of the Guanajuato Light & Power Company will be extended to a number of towns in the States of San Luis Potosi, Guanajuato, Aguas Calientes, Michoacan and Jalisco as soon as an additional generating unit can be installed at its plant at Elduro.

VICTORIA, TAMALULIPAS—Application has been made by J. J. Healy to the Mexican government for a concession to construct and operate a large hydro-electric plant, transmission system and street railway in the State of Tamaulipas and Victoria, the capital. The plans also involve a reclamation scheme.

Electrical Patents

Announced by U. S. Patent Office

(Issued Aug. 22, 1922)

1,426,388. CURRENT-COLLECTOR CONTRIVANCE; K. Jacquet, Zurich, Switzerland. App. filed May 2, 1921. For trolley wire suspended over center of rails or midway between two tracks.

1,426,407. OIL-WELL HEATER; H. Pennington, Wichita Falls, Tex. App. filed Oct. 29, 1920. To heat oil to make it flow more freely.

1,426,411. ELECTRIC HEATING UNIT; C. B. Rogers, Seattle, Wash. App. filed Aug. 16, 1920. Thermostatic control.

1,426,421. CONDENSER-CEMENTED SECTIONAL INSULATOR; S. S. Sonneborn, Brooklyn, N. Y. App. filed Feb. 27, 1917. Sections of insulators separated by metallic filling.

1,426,433. STOVE; C. F. Wiley, Taunton, Mass. App. filed July 8, 1921. Combined coal and electric stove.

1,426,465. VARIABLE RESISTANCE; E. G. Danielson, San Francisco, Cal. App. filed Feb. 14, 1921. Mixture of non-conducting material and finely divided graphite.

1,426,478. UNIVERSAL CORD CIRCUITS; J. E. Hilbish, La Grange, Ill. App. filed Jan. 30, 1919. For interconnecting magneto and common-battery telephone lines.

1,426,490. ELECTRIC LIGHTING MECHANISM; H. G. Lewis and W. S. Mayer, Philadelphia, Pa. App. filed March 12, 1920. Automatically closing device for series lighting circuits.

1,426,507. SMELTING AND ELECTROLYZING PROCESS; R. Rodrian, New York, N. Y. App. filed March 3, 1922. Recovery of metals from molten mass by electrolytic treatment.

1,426,516. INSULATOR; L. Steinberger, Brooklyn, N. Y. App. filed April 29, 1918. Provided with strain members to lessen stress and strain within body.

1,426,549. PRINTING SURFACE; J. A. Corey, London, England. App. filed March 4, 1919. Produced by electrotyping process.

1,426,603. ELECTRIC VULCANIZER; E. J. Rohne, Minneapolis, Minn. App. filed Nov. 21, 1919. For pneumatic tire casings.

1,426,604. ELECTRIC HEATER; H. E. Roys, New York, N. Y. App. filed Oct. 1, 1920. Attachable to electric fans.

1,426,619. ELECTRICAL MEASURING INSTRUMENT; C. E. Vawter, Philadelphia, Pa. App. filed July 30, 1919. Direct-reading ohmmeter.

1,426,620. RAIL-BOND TESTER; C. E. Vawter, Philadelphia, Pa. App. filed Oct. 10, 1919. Resistance measurement through bonded section.

1,426,669. CIPHERING DEVICE; R. E. Pierce, Larchmont, N. Y. App. filed July 23, 1920. For enciphering and deciphering messages of printing telegraph mechanism.

1,426,703. ELECTROLYTIC TREATMENT OF ORES CONTAINING ZINC, CADMIUM AND COPPER; D. Avery, Melbourne, Victoria, and R. H. Stevens and R. T. D. Williams, Risdon, Hobart, Tasmania, Australia. App. filed March 16, 1920.

1,426,733. METHOD AND MEANS FOR PREVENTING AMPLIFIER FROM OSCILLATING; R. A. Heising, East Orange, N. J. App. filed Feb. 14, 1918. By properly proportioning parts of circuit.

1,426,734. METHOD OF MANUFACTURING AUDIONS; W. F. Hendry, New York, N. Y. App. filed April 30, 1919. Production of unitary multiple-surface electrodes.

1,426,743. ELECTROMAGNETIC SOUND-PRODUCING DEVICE; F. J. and W. L. Kaehni, Cleveland, Ohio. App. filed June 9, 1922. Phonograph reproducer consisting of vibratory magnetic member controlled by coil.

1,426,751. THERMIONIC REGULATOR; P. K. McGall, West Orange, N. J., and H. R. Menefee, New York, N. Y. App. filed Aug. 13, 1919. Vacuum-tube type for small electrical generator.

1,426,754. CIRCUITS FOR ELECTRON DISCHARGE DEVICES; R. C. Mathes, New York, N. Y. App. filed Oct. 23, 1916. Method for compensating for fluctuations in potential of output circuit battery.

1,426,755. VACUUM-TUBE CIRCUITS AND METHOD OF OPERATING THEM; R. C. Mathes and H. S. Read, New York, N. Y. App. filed May 9, 1919. Multistage amplifier circuits using vacuum tubes.

1,426,757. ACOUSTIC DEVICE; C. R. Moore, Wyoming, N. J. App. filed June 24, 1919. Translates vibrations into variations in electrical circuit.

1,426,768. PRINTING TELEGRAPH RECEIVER; H. Pfannenstiehl and E. P. Bancroft, East Orange, N. J. App. filed Oct. 10, 1917. Power-driven mechanism controlled by line impulses.

1,426,769. PROCESS FOR PLATING; G. H. Pinney, South Manchester, Conn. App. filed Oct. 26, 1921. Electroplating tableware.

1,426,775. AUTO TRANSFORMER; A. D. Riccia, Brussels, Belgium. App. filed Dec. 2, 1921. For supplying two symmetrically disposed secondary circuits.

1,426,786. STORAGE BATTERY; J. B. Speed and F. Hutchinson, New York, N. Y. App. filed April 3, 1920. Hermetically sealed storage battery with 1.437 volts between electrodes.

1,426,788. INSULATOR STRAIN MEMBER; L. Steinberger, Brooklyn, N. Y. App. filed Nov. 26, 1918. Evenly distributes stresses and strains.

1,426,789. INSULATOR; L. Steinberger, Brooklyn, N. Y. App. filed Jan. 28, 1922. Bridge portions act as electrostatic stress distributors.

1,426,791. ELECTRIC CONTOL SYSTEM; H. M. Stoller, New York, N. Y. App. filed June 21, 1921. Used in conjunction with internal-combustion engines.

1,426,801. REPEATER FOR UNDULATORY CURRENTS; W. Wilson, East Orange, N. J. App. filed March 21, 1917. Reinforcing current waves of any frequency or form.

1,426,803. PRINTING TELEGRAPH; A. H. Adams, Galion, Ohio. App. filed July 21, 1920. Operation controlled by line impulses.

1,426,807. METHOD OF AND SYSTEM FOR TESTING TRANSMITTERS OR RECEIVERS; H. D. Arnold and J. P. Minton, East Orange, N. J. App. filed Nov. 12, 1917. Testing diaphragms, granular carbon, etc.

1,426,810. REPEATER SYSTEM; W. E. Beatty, Bayside, N. Y. App. filed Sept. 30, 1918. Two-way telephone operation with reversible one-way repeater.

1,426,811. ELECTRIC SWITCH; R. B. Benjamin, Chicago, Ill. App. filed June 26, 1919. Pull-switch sockets.

1,426,817. TELEPHONE EXCHANGE SYSTEM; E. H. Clark, Richmond Hill, N. Y. App. filed Dec. 11, 1919. High-resistance relay holds interoffice trunk busy until disconnection.

1,426,818. TELEPHONE-EXCHANGE SYSTEM; H. P. Clausen, Mount Vernon, N. Y., and C. L. Goodrun, New York, N. Y. App. filed Dec. 28, 1918. Controlling operation of machine-switching system.

1,426,821. TELEGRAPH SYSTEM; G. C. Cummings, East Orange, N. J. App. filed Dec. 24, 1919. Signals composed of positive and negative impulses.

1,426,826. ELECTRON-DISCHARGE DEVICE CIRCUITS; H. C. Egerton, Passaic, N. J. App. filed July 19, 1917. Unilateral impedance between filament grid providing leakage for positive charge.

1,426,861. MEASURING DEVICE; A. Haddock, East Orange, N. J. App. filed Dec. 17, 1919. Thermocouple mounted in evacuated vessel.

1,426,868. CADMIUM-TEST DEVICE; B. J. Haskins, Kansas City, Mo. App. filed May 10, 1920. Enables operator to note various tests, without changing position of device.

1,426,899. RADIOGRAPHIC PLATE CHANGER; A. Mutscheller and K. Stoye, New York, N. Y. App. filed Feb. 15, 1919. Trayholder for plate in X-ray photography.

1,426,921. ELECTRICAL APPARATUS; A. R. Smith, Schenectady, N. Y. App. filed May 6, 1919. Switchboard unit for electrical apparatus.

1,426,923. ELECTRICAL SYSTEM; R. Steck, Fort Wayne, Ind. App. filed Oct. 26, 1920. Battery and generator supply current to power and lighting circuit.

1,426,924. ELECTRICAL SYSTEM; R. Steck, Fort Wayne, Ind. App. filed Oct. 26, 1920. Generator and battery apparatus.

1,426,925. ELECTRICAL SYSTEM; R. Steck, Fort Wayne, Ind. App. filed Oct. 26, 1920. Relates to system where several circuits are supplied from single dynamo-electric machine.

1,426,939. MOTOR CONTROL; J. D. Wright, Schenectady, N. Y. App. filed Jan. 2, 1919. For operating hoists where speed of lowering may be in excess of hoisting speed.

1,426,940. ELECTRICAL APPARATUS; L. Wulff, Pittsfield, Mass. App. filed Oct. 13, 1920. Retaining windings in predetermined spaced relation in transformers, reactances, etc.

1,426,943. HIGH-FREQUENCY ALTERNATOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Sept. 23, 1916. Radio-frequency alternators of inductor type.

1,426,944. RADIOSIGNALING SYSTEM; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Sept. 4, 1917. Multiplex signaling system for transmitting and receiving several messages simultaneously.