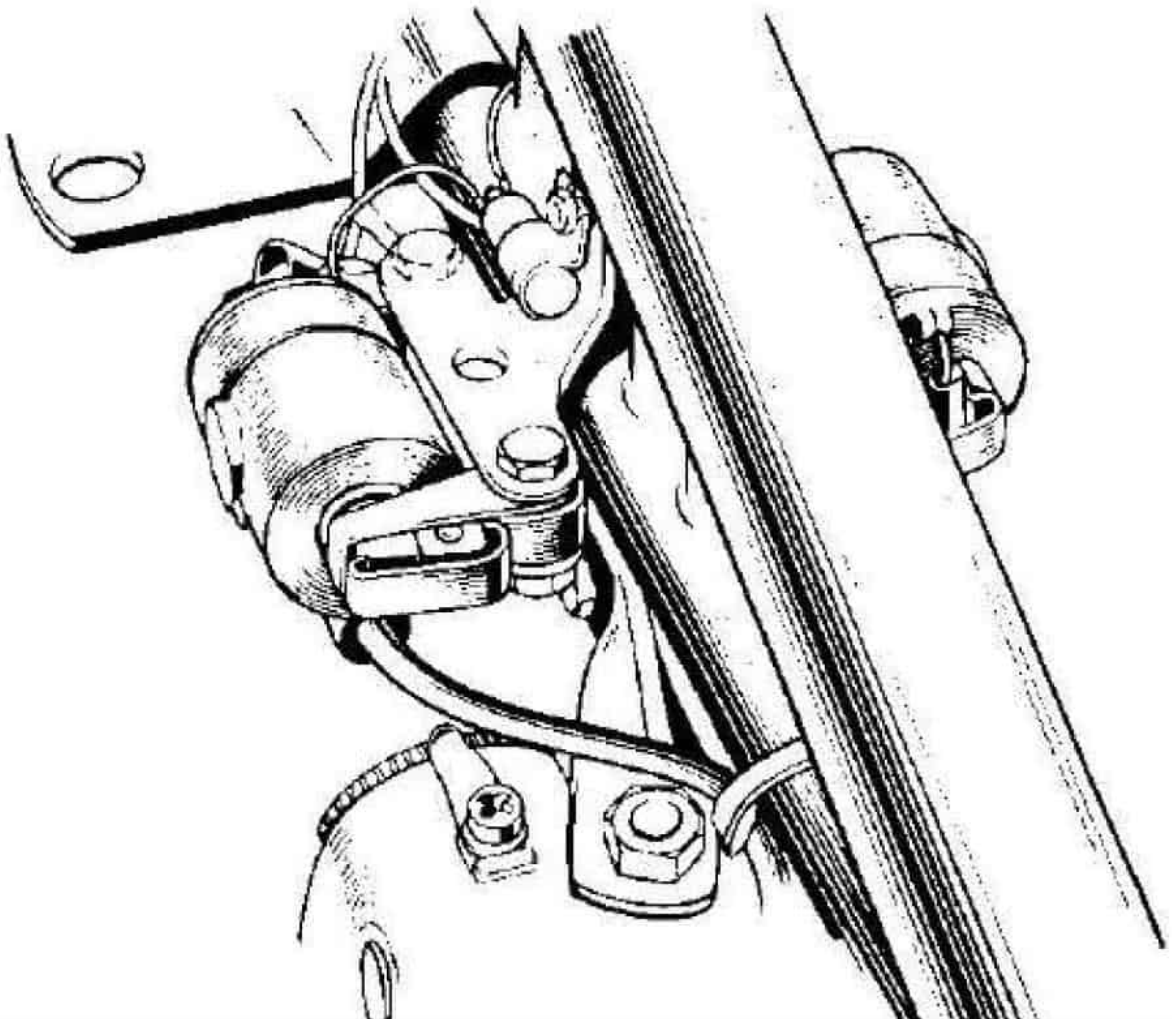

02 NOV

ELECTRICAL TECH, TUNING TIPS & TRICKS

Lucas ET Ignition Unraveled

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Lucas Energy Transfer (ET) ignition unraveled

Lucas AC or Energy transfer ignition was used on many competition motorcycles among them the BSA B44E, B50MX and Triumph models T20M Cub, T100C , TR6C and most famously the T120C or TT Special. Many of these bikes have been converted to DC coil ignition but if you are fortunate enough to get a bike still equipped with ET ignition and it doesn't start of runs poorly don't despair, there is hope, so don't phone home just yet!

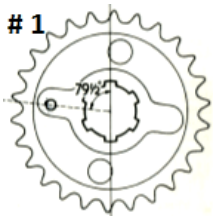
First off this is not an in depth discussion of theory or an engineers description of how this works, it is a practical guide gleaned from years experience with this mostly reliable ignition system.

Identification of components

The ET ignition has some parts particular to this type of ignition that look the same or similar to battery coil (DC) ignition but are not interchangeable.

A. **Alternator rotor** can be identified by the 3 holes in the back marked "S" meaning standard, "R" standing for Racing and "M" for mid position. The rotor engages a pin in the engine sprocket on most Triumph and BSA twins. For most applications the "S" hole should be used. If the holes are not marked then use the hole closest to the rotor keyway. **Do not use a rotor key**! If you have removed the engine sprocket it is important that it be installed on the crankshaft in the proper position. With the pistons at top dead center the pin engaging the rotor is as per illustration #1. With the crankshaft turned to 17 degrees before Top dead center the magnets on the rotor should be about 1/16" ahead of the pole on the stator as shown in illustration #2. Use the peg holes (S,R,M) on the rotor to get this alignment as needed.

1



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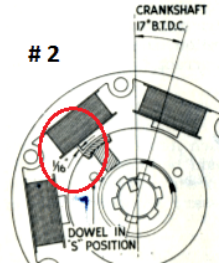
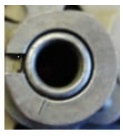


Dowel Location	Ignition Timing Full-Advanced	Dowel Remarks
"S"	37° B.T.C.	Standard
"R"	41° B.T.C.	Racing
"M"	39° B.T.C.	"Mid" position

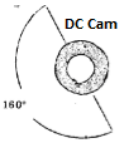
B. **The advance** unit for ET ignition has only 5 degrees of advance. It will be marked on the back with this number. The DC ignition advance has either 10 or 12 degrees of advance and will not work for ET ignition. Another way to tell is the points cam profile. The ET cam has a single cam lobe that opens the points for 15 degrees of rotation. The DC cam opens the points for 160 degrees of rotation. ET cam on the left has very short duration of points opening, DC cam on the right has much longer opening.

ET 15' Cam

Add a drop of oil to the notch in the cam to lubricate the shaft

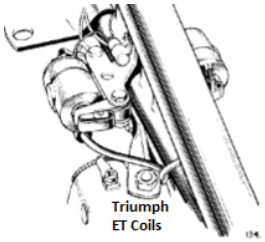


DC 160' Cam



(Note: use an ET cam for running without a battery on DC ignition bikes and starting will be greatly improved at the expense of high RPM performance. Great for desert sleds on BSA/Triumph singles) Be sure also that the advance advances in the right direction. The cam should turn against the springs in the direction of rotation. Triumph twins advance clockwise, Norton and BSA advance counter clockwise

C. **Coils.** The ignition coils for ET ignition are completely different than DC ignition. The original Lucas coils had a brown shellac covering that tended to shrink and crack with age. These often will work even if cracked badly but modern coils are available from Emgo that work perfectly even if they don't look like the originals. Take special care however as the original Lucas coils use a solid brass wire for grounding that is easily broken off where it enters the coil body. Emgo coil (45149R, Emgo 24-71532) on left, cracked original Lucas on right. The original coil pictured actually worked fine even in the condition pictured. Note that there is a condenser attached close to the coil as well. This is a must for the system to work. Lucas number 60410181. It is recommended you replace this part.



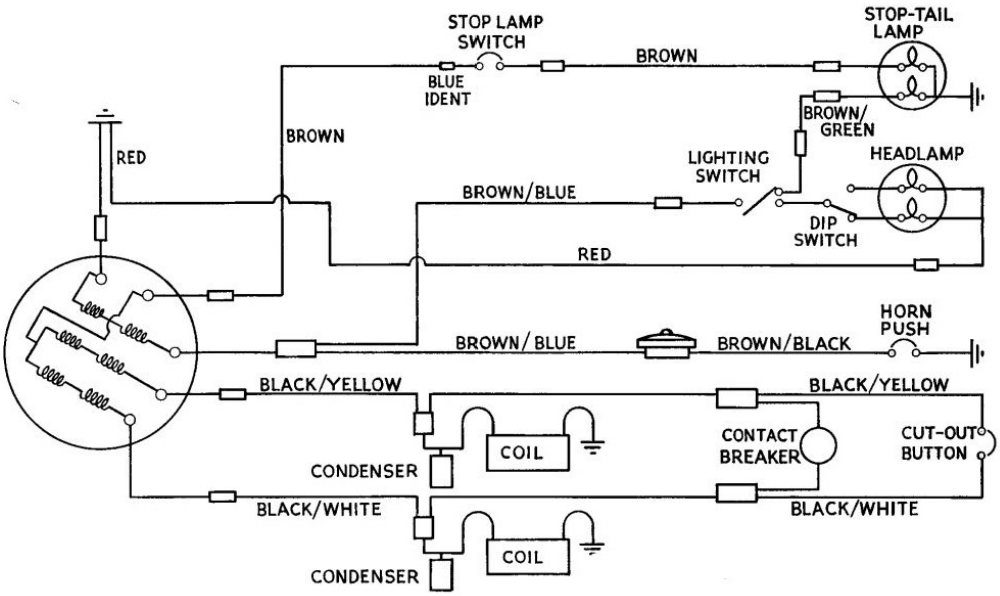
D. The **alternator stator** was supplied in several configurations: 5 wires for twins, 4 wires for singles. Refer to our tech article on **Lucas alternators** for details regarding identification.

Energy Transfer continued

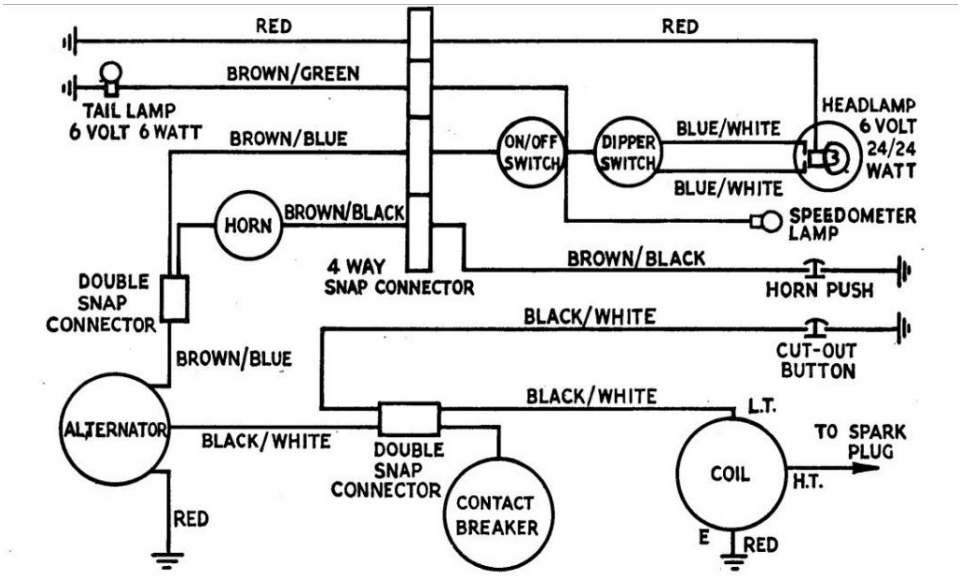
1. Wire connections.

It is vital that the red lead from the alternator be well grounded. Also if using a twin cylinder alternator on a single cylinder machine the Black/White lead must be grounded and the Black/Yellow attached to the coil. If these are not well grounded you will not get any spark. The Brown /blue wire is for lighting and the brown wire is for the brake lamp. Be careful when fitting lights to the machine. The hi/low beam switch must be a special type that keeps one beam lighted while changing to the other beam (Lucas 31356) , If you use a conventional switch then when switching beams a voltage spike can occur and blow the tail lamp bulb. Then when the headlamp bulb engages it will also fail and then when shifting to the other beam it will also fail. It should be noted that ET systems use low wattage 6v bulbs. A 24/24W bulb must be used in the headlamp. Tail lamp uses a 6v 6/18W special bulb. Fitting higher wattage bulbs will make the lights very dim.

Twins:

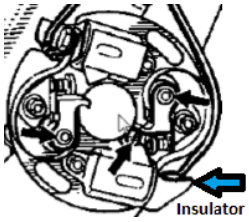


Singles:



Some singles will have 4 or 5 wires. This diagram shows the Triumph Cub 3 wire ET. The 4 wire would have an additional brown lead for the tail light as on the twins. Single cylinder 5 wire stator has an additional black/white or black/yellow wire. To function the additional black/white lead must be grounded or joined in a common connection with the red stator wire. Click here for the service bulletin.

2. Setting the points gap and ignition timing.



A. It will be noted that the 4CA points plate also has a pair of condensers fitted. Be sure that the points faces are clean and flat. If in doubt replace them (54415803). Make sure the points spring are not touching the inside of the points cavity also. Make sure the cardboard insulators are in place (see arrow) and add a drop of oil to lubrication points pivot (arrows over points plate). Replacement condensers are available (54415803) however they are slightly longer than original and can be hard to fit in the points cavity. If you have replaced the condensers by the coils you should be alright.

B. Remove both spark plugs. Rotate the engine until the rubbing heal of the points lines up with the scribed mark on the points cam. Set the gap at .015" inch and do the same for the other side. Now using a long screwdriver with a thin shaft insert the blade into the plug hole and slowly turn the engine over until the pistons are at the top of the stroke. It is helpful to have the rear wheel off the ground and to make fine adjustments with the bike in gear and moving the rear wheel. Don't worry if it isn't exact. Now make a mark on the screwdriver that lines up with a reference point on the head, usually a head fin. Now make a mark 7/16" (650) or 5/16" (500) above the original mark on the screwdriver. Rotate the engine backward until the second mark lines up with the reference point on the cylinder head. Turn the advance as far advanced as it will go by placing the blade of the screwdriver in the notch and pushing, clockwise on a Triumph or counter clockwise on a BSA single. Turn the points plate until the set of points closest to the notch just begins to open. A bit of foil clamped between the points will help here, gently pull on the foil and it will come away as soon as the points begin to open. Lock down the points plate and turn the engine over to the second set of points. Here you need to open the points gap instead of moving the points plate to set the timing. Don't worry if the gap is wider. Now for the dodgy part. Put both spark plugs in their caps and lay them on the cylinder head. After taking the bike out of gear kick the engine through and see if you have a bright spark. If not , and here is why the measurement on the ignition is not super critical, move the points plate a little in one direction. If you get spark keep going a bit more to see if it gets better. If so lock down the plate. If you get good spark on one but not the other get the best spark possible on the side that you kept the .015 points gap on (not the side you opened the gap on to time). On the other side open or close the points gap slightly until optimal spark is achieved. Replace the plugs and fire the bike up. Take it for a ride. If you feel the bike labor or act rich at higher RPM then retard the timing plate 1 or 2 degrees. If starting is hard but it runs well try advancing the timing plate 1 or 2 degrees. If the bike seems to eight stroke at higher rpm that is a sign that the timing is still advanced and when the auto advance goes full advance it is moving out of phase, the term for when the rotor magnets are creating maximum output.

I know this sounds crude but it is the accepted method for fine tuning the spark with ET ignition and will work. All connections must be clean and dry and free of oil. It takes very little to interrupt the ignition process.

Testing a 5 wire ET Stator

H8 PART A. A.C. IGNITION

The accurate and efficient working of the A.C. ignition system is dependent not only upon the piston/spark relationship that is involved but also the rotor/stator relationship at the instant of ignition. The stator is fixed to the left crankcase and requires no maintenance other than to check that the leads are not rubbing on either of the chains. The rotor is located on the crankshaft by means of a dowel fitted to the engine sprocket. When the rotor is removed care should be taken to refit it in the appropriate position with the rotor hole located as shown in the tabel below, in accordance with ignition timing requirements.

Dowel Location	Ignition Timing Full-Advanced	Dowel Remarks
"S"	37° B.T.C.	Standard
"R"	41° B.T.C.	Racing
"M"	39° B.T.C.	"Mid" position

It is beyond the scope of this Manual to advise on a deviation from the standard setting, as so many factors are involved. If it is required to alter the settings from standard, then advice should be sought from a local Triumph Dealer or the Triumph Engineering Co. Ltd., Service Department.

The 3 E.T. coil, condensers (capacitors), and high tension leads must be kept clean and free from dirt or water. Also, it is important that the sparking plug is maintained at the correct gap setting and that the centre electrode is kept clean.

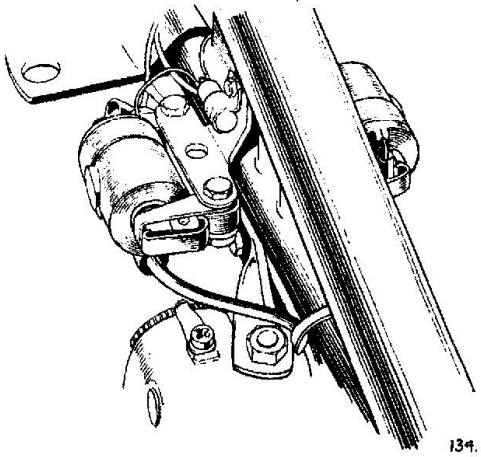


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Fig. H18. A.C. ignition coils fitted on machine

Both sets of contact breaker contacts must be kept clean and adjusted correctly to the gap setting given in General Data. A fault at either set of contacts will adversely affect the ignition spark at BOTH cylinders.

H8 PART B. TESTING THE A.C. IGNITION SYSTEM

First, ensure that the timing, contact breaker and plug gaps are satisfactory, and then disconnect both H.T. leads and check that a spark is available by holding each of the cables about $\frac{3}{16}$ inches (4 mm.) from the cylinder head in turn and operate the kickstarter. A good spark should be produced. If it is not, then the 3 E.T. coil and alternator ignition supply are suspect.

As it is not possible to test the 3 E.T. coils accurately on the machine, the following test procedure should be adopted.

Two 6 volt external batteries are used for the next two tests, in conjunction with the A.C. ignition coils on the machine.

A.C. ignition coils are not designed to run under such conditions, overheating occurring in the primary windings.

Each test should be undertaken in as short a time as possible, and the batteries connected in circuit only when actually necessary to run the test.

(1) Disconnect the five alternator leads under the engine.

(2) Unplug the black/yellow lead from the condenser at the right hand side coil (under the petrol (gasolene) tank.

(3) Connect the black/yellow lead to the positive (+ve) terminal of a (6V) test battery.

(4) Connect the negative (—ve) battery lead to the condenser terminal.

(5) Unplug the black/white lead from the condenser at the left hand side coil (under the petrol (gasolene) tank).

(6) Connect the black/white lead to the positive (+ve) terminal of a second (6V) test battery.

(7) Connect the negative (—ve) terminal of the second test battery to the left hand condenser terminal.

(8) Remove the sparking plug wire from each plug in turn and with battery wires connected, open and close the contact breaker points. If the coils and condensers are satisfactory, a good spark will jump from the plug lead to earth (ground).

(9) If a poor spark (or no spark) is noted, check all wiring connections, and repeat (8) above. If the system still does not spark, instal new condensers and repeat (8). If still there is no spark, check the ignition coils by substitution.

H8 PART C. CHECKING THE ALTERNATOR OUTPUT (A.C. Ignition Models)

To facilitate a check to be made on the alternator output, a separate ignition circuit must be used as given in Section H8 Part B above, so that the engine can be run at 3,000 r.p.m. (approximately 45 m.p.h. in top gear).

Pay careful regard to the warning given in the previous section (H8 part B) concerning the possible overheating of the A.C. ignition coil primary windings.

The preferred alternative method is to use two MA6 ignition coils, bolted together, with the machines C.B. leads, BLACK/WHITE, BLACK/YELLOW connected to the appropriate C.B. terminals on the test ignition coils. The test coil S.W. terminals are linked together and fed to a test battery (—ve) negative terminal and the battery (+ve) positive connected to the ignition coils cases. A jumper lead is also required between battery (+ve) positive, and motorcycle frame earth (ground. The H.T. leads are connected to the appropriate sparking plugs.

With all five alternator leads disconnected under the engine start up the engine and run at 3,000 r.p.m. (equivalent to approximately 45 m.p.h. in top gear). Connect an A.C. voltmeter (0–10V) with a 1 ohm resistor in parallel between the pairs of alternator leads given in table, Fig. H19 Section H20.

(i) If the readings are equal to or higher than the figures quoted for the particular model, then the alternator is satisfactory.

(ii) A low reading on any group of coils indicates either that the leads concerned are chafed through or damaged due to rubbing on the chains or that some of the coil turns are short circuited.

(iii) Low readings from all parts of the test indicates a partially demagnetized rotor. In this case the rotor must be renewed.

(iv) A zero reading for any group of coils indicates that a coil has become disconnected and is open circuit, in which case the stator should be replaced.

(v) A reading obtained between any one stator lead and earth (ground) indicates that some coil turns have become earthed (grounded) to the engine. In this case, brush the stator with paraffin (kerosene) or petrol (gasoline). DO NOT LEAVE TO SOAK. Retest on the machine. If still faulty, replace the stator.

If any fault does occur always check the stator leads for possible chain damage before attempting repair or renewing the stator. It is beyond the scope of this manual to give instruction for repair of faulty stator windings. However the winding specification is given in table, Fig. H19 to provide the required information for local repair work, should a correct replacement stator not be immediately available.

H8 PART D DIRECT LIGHTING SYSTEM

The electrical power for the direct lighting system is supplied by three of the five alternator leads, namely the red, brown and brown/blue. The leads are connected as shown in the wiring diagram (Fig. H20 in Section H17). In order that no one pair of coils is overloaded, the electrical loads are connected as shown and no deviation from the standard arrangement shown should be made.

An apparent loss or reduction of power at any of the lights may well be due to a high resistance caused by a loose or faulty connection. In the event of a fault occuring, always check the wiring connections, giving particular attention to the red earth (ground) lead from the alternator and headlamp. Note that a short circuit in the brown stop lamp lead will result in the ignition system failing, hence the stop lamp switch connections should be always kept clean and dry.

In the event of a fault occuring which cannot be traced to the circuit connections the alternator should be checked as described in Section H8, Part C above.

Stator number	System voltage	D.C. input to battery amp. @ 3,000 r.p.m.			Alternator Output **minimum** A.C. volts @ 3,000 r.p.m.			Stator coil details			
		Off	Pilot	Head	A	B	C	No of coils	Turns per coil	S.W.G.	
47188	6 V.	Not applicable			5·0	1·5	3·5	2	250	25	IGN.
								2	98	20	IGN.
								1	98	20	LIGHT
								1	98	21	LIGHT

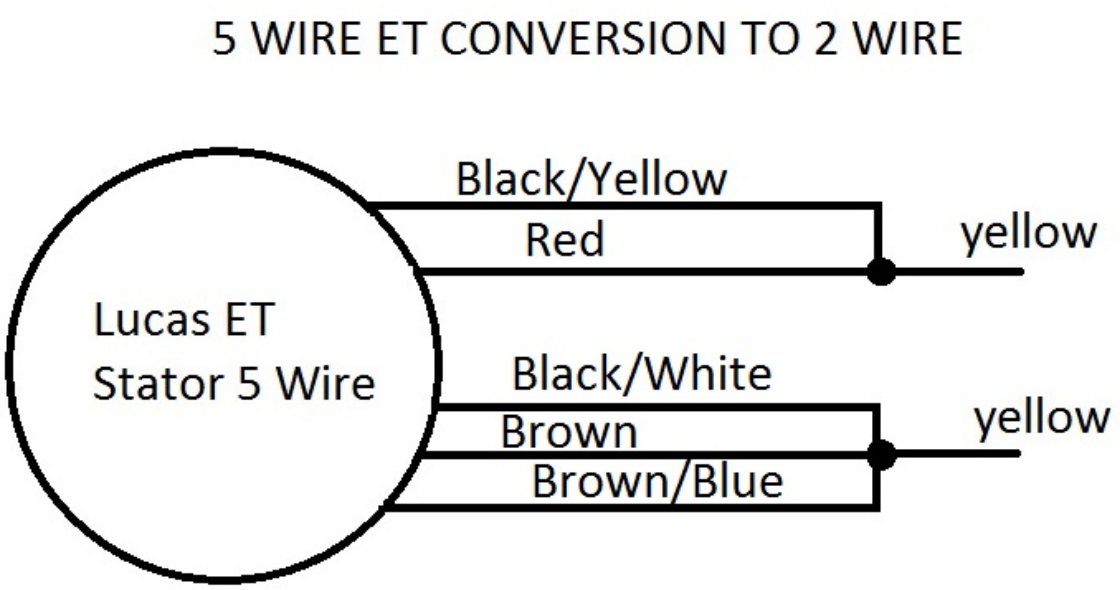
A=Red and Brown/Blue
B=Black/Yellow and Black/White
C=Black/Yellow and Brown

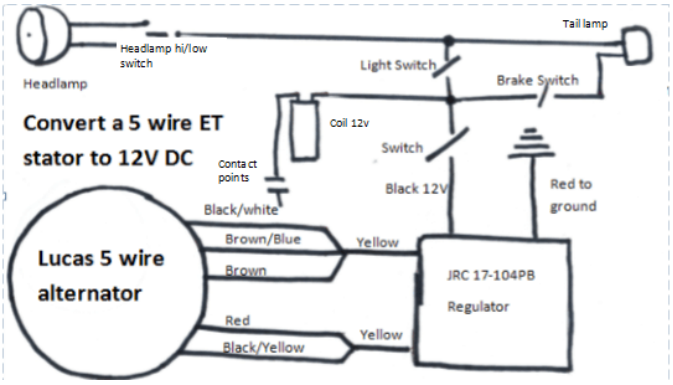
Convert a 5 wire ET to 12V DC

If you become frustrated with all this it is possible to convert your ET stator to DC by making the following connections: CONNECT: BLACK/YELLOW & RED LEADS TOGETHER. THIS FORMS ONE LEG

CONNECT: BROWN/BLUE, BROWN, & BLACK/WHITE. THIS FORMS THE SECOND LEG

Note: Some 4 wire ET stators can not be converted using this method. For example, due to internal wiring differences, the T20 Cub stator can not be wired as a 2 wire. Use 47205T with 57-0989 dowel x3.





You can then connect a solid state regulator JRC 17-104PB. This unit contains a built in capacitor to enable running without a battery. Above is a simple wiring diagram for this conversion.

Caveats:

1. Lucas ET rotors are now all over 60 years old. Left in the stator coil they will retain magnetism for a very long time but if your rotor was left standing without being in a stator or with out “keepers” it will have lost magnetism and output will be greatly reduced.
2. Many 5 wire stators do not have the later epoxy encapsulation. Those with exposed coils used a stiff cardboard for insulation. This breaks down with time. It is recommended to replace all non-encapsulated stators with the later type.

3. **Alternator wire plastic insulation tends to become brittle with age and it is easy to have a crack in the wire covering allowing the alternator wires to short against each other. I have never had much luck trying long term repairs for this condition.**

1 thought on “Lucas ET Ignition Unraveled”

ADD A COMMENT

Andy May 28, 2019 at 7:53 am Reply

What a brilliant and informative site.

Toll Free Order Line: 1(800) 634-3250

JRC Engineering Inc. 3110 Indian Ave Ste. E, Perris, CA, 92571