SERVICE BULLETIN No. 34-41

WHEN A COIL EXPLODES ON A FORD V-8

Have you ever had a coil on the V-8 Ford explode like a bomb?

This is by no means an unusual occurrence, and the coil is often blamed for the phenomenon. Yet, it is no more at fault than is a steam boiler that explodes under abnormal pressure.

It is all in the resistor that is located out of sight under the dash on the V-8 Ford. The resistor operates in series with the primary winding of the coil and thus controls the amount of current flowing through the primary. The resistor is used for a very definite purpose: to reduce the amount of heat developed in the coil by the primary current.

All coils develop heat in the primary winding, but, as their outer cases are made of metal, which is a good heat conductor, most of the internal heat is conveyed to the outside of the coil by the metal case and thus dissipated to a considerable extent.

The Ford V-8 coil, however, is encased in bakelite, which is a very poor conductor of heat, so that the heat in the coil winding is retained inside the coil.

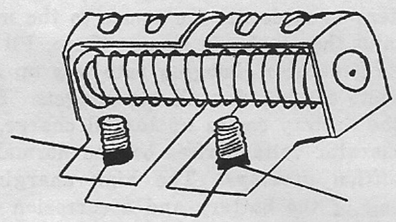
It was therefore found necessary in the original design of the Ford system to cut down the amount of current in the primary of the coil, which was really designed as a four-volt coil to the six to eight-volt system by cutting down the voltage across the coil and, with it, the current in the primary.

Let us suppose that in some manner the resistor becomes shorted. Full voltage will then be applied across the coil, and the primary current in the coil will double. As heat is proportional to the square of current, the amount of heat in the coil will increase four times, with the bakelite case keeping the heat confined within the coil. Under this abnormal condition, the insulating compound in the coil will become overheated and tend to expand. When the force created by the expansion of the compound reaches a certain magnitude the bakelite housing of the coil will give way or explode.

What produces a short in the resistor? Surprisingly, the short is often deliberately introduced in cases where the resistor burns out and the mechanic nas not a replacement resistor available. As the burning out of the resistor opens the primary circuit, and the ignition is then completely dead, the mechanic simply shorts out the resistor by connecting a piece of wire across it and then starts the car. If the car is then used for any length of time, the coil will overheat as described above and explode. It is exactly as when a fuse blows out in the house wiring and someone puts a penny under the fuse. The lights will go on but the house will probably burn down.

Sometimes the burnt out resistor is not completely shorted out by the mechanic, but only partly so. He takes hold of one of the burnt ends of the resistance wire, unwinds a couple of turns of the wire and connects the end to the opposite terminal. In this manner he gets the car started but with only a partial resistance in the coil circuit. By this method, the coil will not explode but will burn out after a short period of operation.

It means just one thing: before installing a new coil on a V-8 Ford the resistor must be carefully examined, both for opens and shorts. Prod the resistance wire with a screw driver to test for brittleness, so as to make sure that it is not about to burn out even if apparently O.K. in appearance. If you have any suspicion as to its serviceable condition, install a new one before releasing the job.



The resistor is located under the dash on a fibre base next to the fuse or circuit breaker, and consists of a white porcelain core with the wire wound upon it and protected by a curved, slotted metal case.

MOUNTING COILS ON THE FORD V-8

In mounting the coil on the Ford V-8, whether of the three-hole type as FD-375 or the two-hole type like the FD-450 or FD-460, never tighten one mounting bolt all the way and then the other or others, as that will cause the bakelite housing to crack.

Accepted practice demands that in installing a cylinder head, for instance, the bolts be tightened gradually and in certain rotation so as not to warp the head. Also, in mounting a wheel on the car, the good mechanic tightens the mounting nuts or bolts gradually and follows the routine of working on diagonally opposite bolts rather than adjacent ones. Otherwise the wheel disc will either warp or run out of alignment.

The same practice holds true for the Ford coil mounting, only in this case, as bakelite is not flexible, the casing of the coil will break rather than warp.

PLEASE READ AND FOLLOW THE INSTRUCTION SHEET

SERVICE BULLETIN No. 22-39

WHEN WINTER COMES

For many years we have noticed a peculiar condition: from November to April of every year we receive numerous inquiries from our trade regarding the burning of points. Some think that condensers cause the trouble; some suggest that coils are at fault; still others blame it on the tungsten contacts themselves.

Peculiarly enough, from April to November we hear nothing at all about burnt points. The very same condensers, coils and tungsten that were public enemies Nos. 1, 2 and 3 from November to April, evidently decide to mend their ways, become respectable ignition parts and cause no trouble whatsoever.

As this happens year after year, we have made an intensive study of this phenomenon, and have discovered certain causes for it, which we herewith pass on to you.

Let us take the generator charging rate especially on cars not equipped with voltage regulators. The car owner, since purchasing the car has added a radio or a heater or both; he runs along in the summer time without using his headlights to any extent, and the generator furnishes sufficient current to operate the equipment and the added appliances. Then the days get shorter or daylight saving goes out, and he has to use his headlights; he still wants to use his radio, of course, and, perhaps, a heater, so that in few days the increased current demands are beyond the generator output and the battery runs down. He comes to the mechanic with his trouble and the mechanic says: "Sure, I'll fix you up". He boosts the generator charging rate way up and gives the owner sufficient current for all his gadgets. Everything is okay until the battery comes up to full charge, but when it does, the generator voltage rises beyond normal, *and a high voltage condition develops.* The high charging rate also causes gassing of the battery and a corrosion of the entire cable including the terminal; this corrosion still further aggravates the high voltage condition.

Even on cars equipped with voltage regulators, which are supposed to hold the voltage to a predetermined safe limit, a high voltage condition is often caused. First, the regulator may go out of adjustment and operate on a higher voltage; second, mechanics often accede to customers' demands for a higher charging rate and boost it by simply putting more tension on the regulator spring without the use of instruments. *In either case you will invariably find burnt points and coil failures due, again, to high voltage.*

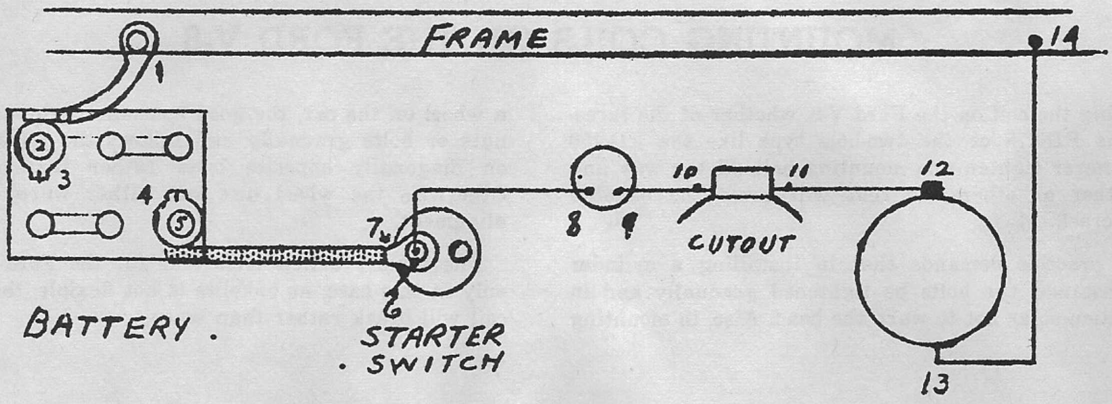
The ever present possibility of loose, corroded or rusty connections in the battery circuit is also aggravated in the winter time. Take the ground strap, for instance; it is fastened to the steel chassis by a steel bolt; water and slush work on these parts, creep in between the lugs, the bolts and the chassis with consequent rust deposits. The usual practice of pulling at the strap in search of loose connections does not mean anything: the connection may be as firm as you want it, yet have enough high resistance between it and the chassis, due to rust, to absolutely prevent the starter from operating. *Such a condition, again, means high voltage, burnt points and bad coils.*

And don't let us overlook the engine ground strap which is often disregarded in a checkup, but is very important for the perfect functioning of the electrical system. Practically all cars from 1932 on have rubber mounted engines in one form or another, so that the metallic connections between the engine and the chassis is not perfect. To offset this, the engine is grounded directly to the chassis by means of the engine ground strap. When that breaks or is loose, the generator grounding is interfered with, giving the same effect as if the battery ground were imperfect; it also affects the starter which is grounded through the engine.

A sulphated battery also means a high resistance in the charging circuit and a resulting high voltage.

And watch this trickster that likes to hide in dark corners: the ammeter connections on the car. Just a slight loosening of one of the two terminal nuts on the ammeter will produce a high voltage. This should be checked at all times, regardless of the seasons.

While the subject of high voltage was discussed in detail in our Service Bulletin 9-38, we feel that we cannot overemphasize the necessity for guarding against this enemy of



good car operation. It is so easy to check for high voltage that there should never be a question of its presence in the system. All you have to do is to run the engine at a speed that will show the maximum charge on the ammeter; then connect one prong of a voltmeter to the terminal on the generator and the other prong to a clean spot on the chassis. If the voltmeter shows a reading of more than 8.3 volts—you are getting high voltage and trouble. *Do this every time you find burnt points on a car and you will save yourself time, trouble and, often a customer.*

Now, if you have a voltmeter with a 3-volt scale, you can locate exactly what is causing the high voltage. This also is easy if you keep in mind that there should exist no difference in voltage, (voltage drop) between any two parts that are connected to each other. For instance: the battery post and battery cable terminal on that post should have no voltage difference, so that if you connect the 3-volt meter to the post and its terminal, the meter should show no reading, or at most a reading of less than two-tenths of a volt when you step on the starter with the ignition turned off. The same applies to all points shown in the diagram on the preceding page.

Test between the frame of the car and 1, between 1 and the battery post; between 2 and 3; between 4 and 5; between 6 and 7; between 6 and 8; between 9 and 10; between 11 and 12 and between the generator housing and the car frame. In no case should the needle move appreciably and never more than one small division on the 3-volt scale (1/10 volt). If it does, the connection should be removed, thoroughly cleaned and tested again after replacing.

And here is a stunt that will look like magic to your customer. While the voltmeter is still connected as above, turn off the ignition, step on the starter for about ten seconds (to discharge the battery somewhat). Then start the engine; speed it up to maximum charge and watch the voltmeter. IF THE NEEDLE CLIMBS SLOWLY FROM 6 up to 8 VOLTS—TELL YOUR CUSTOMER THAT HIS BATTERY NEEDS WATER. We have seen it done many times and, in every case, the customer was very much impressed by this "magic" demonstration.

In other words, if you are far-sighted and want to develop a reputation for expert work and knowledge, you will invest in a double-scale voltmeter, having one scale reading from 0 to 15 volts and a second scale that goes from 0 to 3 volts. This type of meter is made by several manufacturers at prices ranging from $10.00 to $15.00. It will more than pay for itself in the saving of time and the added prestige it will give you with your customers.

SERVICE BULLETIN No. 63-51

NEW TYPES OF VOLTAGE REGULATORS ON 1950 CARS

1. Temperature Compensation on the Current Control Unit

Equipment voltage regulators on 1950 passenger cars have a new feature: temperature compensation on the current control unit.

All voltage regulators have temperature compensation on the voltage control unit in order to maintain a more-or-less constant voltage at the various temperatures of the voltage control winding. This winding is made of many turns of comparatively fine wire, and changes its resistance with temperature, so that a cold winding has less electrical resistance than a warm or hot winding. As soon as current begins to flow in the voltage control winding, its temperature begins to rise, and its resistance rises accordingly. As its resistance rises, its magnetic output diminishes correspondingly, so that by the time the winding reaches its operating temperature of about 150°F., the resistance in the unit is high enough to cut down the magnetic output to a considerable extent.

As this would seriously affect the proper operation of the voltage control unit, temperature compensation, in one form or another, is used to neutralize the effect of the temperature change and to enable the voltage control unit to operate evenly regardless of its temperature.

The current control unit is entirely different in construction from the voltage unit. Whereas the voltage winding consists of about 500 ft. of fine wire with about 30 ohms of resistance, the current winding uses only about 1 ft. of heavy wire with a very low resistance, in the magnitude of about 1/100th part of an ohm. With this extremely low resistance, the effect of heat on the current winding is insignificant and does not affect the operation of the unit. That is why until recently it was found unnecessary to compensate the current control unit for temperature. However, in the new regulators, compensation of the current control unit has been introduced for a different purpose. The idea is that when a lot of current is drained out of the battery when starting, for instance, it is beneficial to replace the current as quickly as possible, and that is where the compensation of the current control unit comes in.

Let us take a regulator which is supposed to operate at 36 amperes, for instance. In the new type of regulator, when the car is first started and the regulator is cold, the current control unit will permit a charging rate of about 40-42 amperes to reach the battery. As the regulator warms up in operation, the current control compensator steps in and gradually cuts down the charging rate to normal. In fact, on one of the new Delco-Remy regulators which is used on the popular General Motor cars with a 35 ampere generator, the charging rate will vary from 32 to over 40 amperes depending upon the temperature of the regulator.

While it is true that when 40 or more amperes are drawn out of a 35 ampere generator, the generator is somewhat overloaded, it is evident that the original equipment engineers do not consider this temporary overload hazardous or detrimental to the generator.

In every case where the new type current compensated regulator is used, the old type without compensation can be successfully used if you happen to be out of the new type. In such cases, all that will happen is that instead of starting with a 40 ampere charge which would cut down to 36 amperes in about 10 minutes and then continue to cut down to 32 amperes, you will start with a 36 ampere charge and maintain this charge until the battery is refilled.

2. Higher Amperage Generators and Regulators

There is still another change in 1950 voltage regulators, and this change is due to the new, higher output of generators used in 1950. Practically all passenger cars prior to 1950 were limited to a 36 ampere generator output; in 1950 the output of the generator was boosted to 40, 45 and in a very few cases to 50 amperes.

This means that heavier gauges of wire have to be used in the current-carrying circuit of the regulator. Previously a #10 gauge copper wire was sufficient to take care of the maximum current handled by the regulator, but for the heavier currents produced by the 1950 generator, a #9 gauge wire has to be used in order to carry the higher current without overheating.

We know that at the present time, there is a tendency in the trade to readjust the older types of regulators to a higher charging rate when the newer type of regulator is not available. This procedure is not advisable as it may result in overloading and overheating the current-carrying portion of the regulator with damage to it.

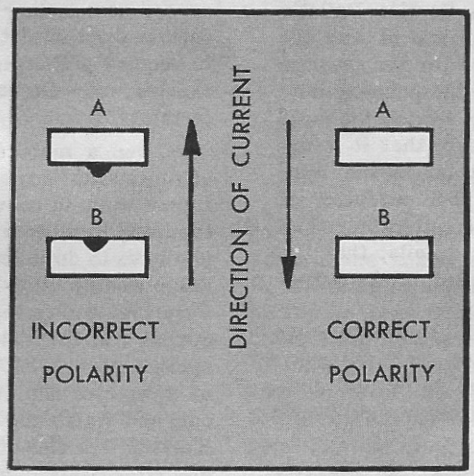
If, for instance, you come across a car equipped with a higher output generator, and it is necessary to replace the regulator when a high output regulator is not available, use a 36 ampere regulator "as is" rather than readjust it to the higher amperage. If you do that, you will be safe, as all that will happen is that you may lose 4 amperes of charging rate by using a 36 ampere regulator with a 40 ampere generator. On the other hand, if you readjust the lower amperage regulator to a higher output rate, you may overheat and burn out the regulator.

SERVICE BULLETIN No. 64-51

DOES POLARITY MAKE A DIFFERENCE IN VOLTAGE REGULATORS?

In a previous Service Bulletin, we discussed the matter of correct polarity as applied to ignition coils and said that, while a coil with incorrect polarity will not always cause ignition failure, there are cases where such failures will occur.

The story is entirely different when incorrect polarity is involved in the operation of voltage regulators. Here, failure will *always* occur and you can never get by where a regulator with incorrect polarity is used on a motor vehicle. The failure will be caused by "metal transfer" or "pitting" as it is commonly known. Whenever electrical contacts make-and-break at a fast rate, there is a tendency of the metal from one contact to transfer to the other contact, so that a pit is left in the contact from which the metal is transferred and a tip is built up on the contact to which the metal is transferred. The direction of the flow of current between the contacts is one of the factors which determines in which contact the pit will form and on which contact the tip will build up.



There are a number of methods of minimizing the metal transfer tendency, and one of the most popular of these is the use of dissimilar metals in the mating contacts. These metals are so chosen and matched that the direction in which the metal would normally tend to transfer is opposite to the direction of the current flowing through the contacts. In other words, if metal would normally tend to transfer from contact "B" to contact "A," leaving a pit in contact "B" and a tip on contact "A" (illustration) the manufacturer so designs the circuit that the current in it will flow from contact "A" to contact "B" thus nullifying the tendency for the metal to transfer.

The above principle is used in the manufacture of most voltage regulators and it is of extreme importance both in the manufacturing and in the handling of voltage regulators. As long as there are two different polarities in the various cars, that is as long as one car manufacturer grounds the negative side of the battery, and others the positive side, it will be necessary to use voltage regulators of different polarities to match the different car polarities.

This is what happens when the polarity of the voltage regulator is different from the car polarity. As the voltage regulator contacts go into operation and begin to make-and-break at the rate of fifteen thousand times per minute, a tip builds up in the form of a needle point on one contact, while a corresponding deep, but very narrow pit develops in the other contact. The needle point tends to stick in the narrow pit, locking the contacts and preventing them from vibrating, thus destroying the normal function of the voltage regulator. Every once in a while, the two points manage to separate whereupon a part of the needle point breaks off, and the regulator operates normally for a short time. However, almost immediately, a new needle point begins building up and soon the points lock again. This cycle repeats itself a number of times and gradually the tip becomes larger and larger and so does the pit until the correct gapping between the contacts is destroyed, and the regulator goes out of operation.

The regulator may work for a day or a week on a wrong polarity, but it is a positive fact that it will not continue to operate properly and even while it is operating, it will do so erratically. In the end, it will fail completely. We cannot urge you too strongly: ***always match the polarity of the regulator to that of the car on which it is used.***

SERVICE BULLETIN No. 47-46

VOLTAGE REGULATORS AND OIL CAPS

On Ford cars equipped with three unit voltage regulators, the regulator is mounted in a semi-horizontal position.

It often happens that while oil is being put into the crank case, the oil tube cap is temporarily deposited in a convenient spot, which happens to be next to the voltage regulator. The attendant sometimes forgets to replace the cap on the oil tube and it remains next to the regulator when the customer drives off.

It does not take long before the cap rolls down and rests against the regulator terminals. This has in numerous cases resulted in completely burnt out regulators.

We strongly urge the repairmen to exercise all due caution to avoid placing the oil cap or any other metallic object near the regulator terminals, and eliminate this unnecessary hazard.

DO NOT SHORT OUT THE RESISTOR ON A FORD

As a general rule, a Ford V-8 engine starts easily. Should it fail to start reasonably fast, it is a sure indication of trouble somewhere in the system, and this trouble should be immediately located and fixed.

One of the most important parts of the Ford V-8 ignition system is the resistor which operates in series with the primary winding of the ignition coil. In Service Bulletin No. 34-41 we explained in detail the functions of and the necessities for this resistor; that it is there for the purpose of reducing the amount of current through the primary wire of the coil; that this is done in order to reduce the heat developed in the coil by the primary current; that it is extremely important to keep down the heat inside the Ford coil due to its bakelite casing, which is a poor conductor of heat and tends to keep the heat within the coil rather than dissipate it, as is the case in metal-enclosed coils; that the shorting out of the resistor has often resulted in the actual explosion of the coil.

It has come to our attention that a special switch is being used to replace the regular starting button on Ford cars. This switch cuts out the resistor, referred to above, each time the engine is started and is supposed to provide "easy starting."

We contend that instead of accomplishing this purpose, the installation of this switch is a possible source of serious trouble in the ignition system, and here are the reasons:

Keeping in mind the well-known fact that a normal Ford starts easily, it is obvious that there would be no purpose in installing a special switch on such a car. Now let us take the case of a Ford where some difficulty is experienced in starting. This may be due to any number of causes: improperly synchronized breaker points, weak condenser, valve trouble, carburetor trouble, or even a simple and frequent cause like dirty and moist porcelains on spark plugs. If, instead of locating and removing the trouble, a special switch is installed to by-pass it temporary relief may be gained thereby, but the carburetor will still remain out of adjustment, the spark plugs will still leak current, etc. In the meantime, two new troubles will be introduced by this switch: heat and arcing.

The injurious heat condition will develop within the coil, as the resistance value of the resistor is just about half the total resistance value in the coil circuit. With the resistor shorted out, the current in the coil primary will be double its normal value, and the heat developed will be four times normal, as the heating effect of current is proportional to the square of the current value. In other words, double the current will produce four times the heat. While this abnormal heating will occur only during the limited periods of starting, no one can predict how long these periods will actually be, as we are dealing now with an engine in which definite defects exist, and the extent of the defects may be such as to require prolonged starting periods even with the resistor shorted out. Damage to the coil winding is then almost a certainty.

Even a more serious condition resulting from the use of this switch is the heavy arcing between the breaker points. If you want to convince yourself of the extent of the arcing that will develop with the resistor cut out of the circuit, all you have to do is to mount a Ford distributor in a Distributoscope or any other distributor adjusting machine, connect a Ford type coil in the regular manner, with the resistor in the circuit, run the distributor at about 300 RPM and watch the spark. Now, with the distributor running, touch two ends of a wire to the two terminals of the resistor, shorting it out, and watch the heavy, intense spark between the points. Keeping one end of the wire on one terminal of the resistor and alternately touching the other end of the wire on-and-off to the other terminal of the resistor, you will be able to see the difference between the normal spark and the spark produced when the resistor is cut out. We do not think there will be any doubt in your mind after this demonstration as to the possible damage to the breaker points.

Again it may be argued that the arcing is only temporary and for short duration while the engine is being started. That may be so, but each time the heavy arcing takes place, the points burn a little, and eventually you will have a condition where the points will be oxidized to the extent where the operation of the coil will be permanently affected, so that instead of easy starting you will have no starting at all.

What this sums up to is that there are no safe short-cuts to correct procedure in trying to cure troubles in the electrical system of the car. No one can foresee an emergency that may not be vital enough to justify shorting out the resistor for one start, but to install any permanent switches or accessories on a Ford car that will short out the resistor every time the car is started, is simply begging for trouble.