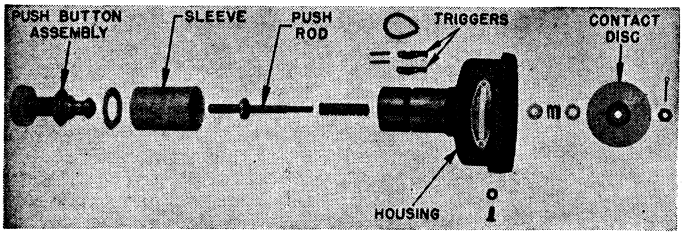

Fig. 10 Exploded view of series-parallel switch housing

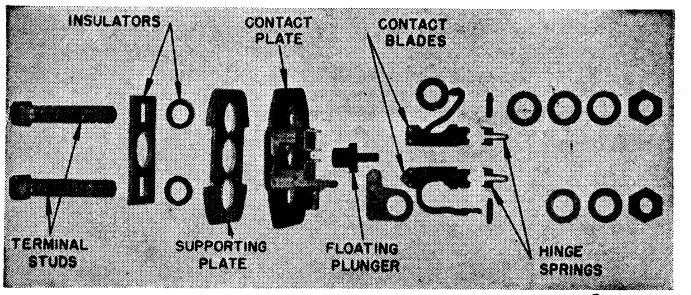

Fig. 11 Exploded view of contact and terminal stud assembly

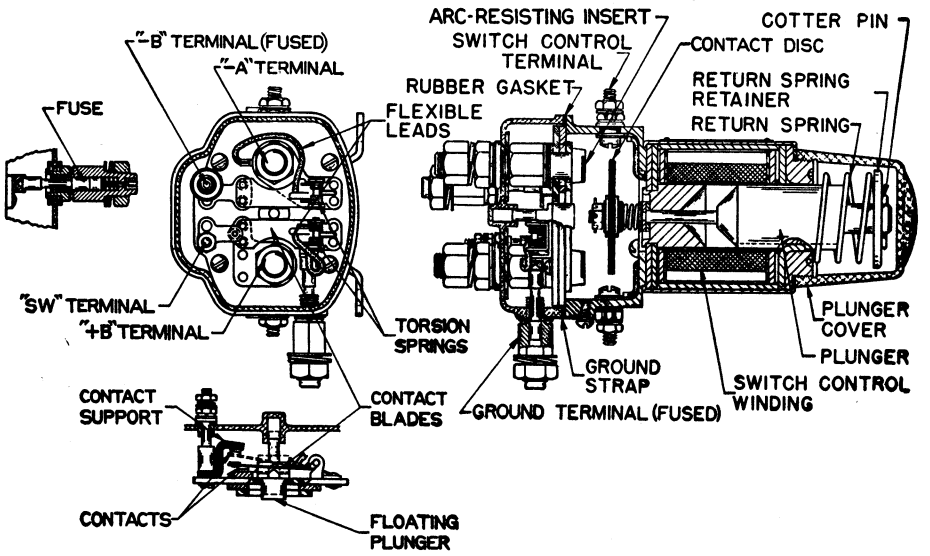

Fig. 12 Solenoid operated series-parallel switch. This switch is similar to the manually operated type except that it is operated by a solenoid controlled by a push button

assembled to the contact plate so that the heavy tungsten inserts on the stud heads will be located as near the centerline of the switch as possible. This will permit the maximum area of contact between the tungsten inserts and the contact disc when the switch is operated.

Since series-parallel switches are used on applications where heavy-duty starting motors and higher voltage batteries are installed, it is extremely important to avoid grounding any terminal on the starting motor or switch while the battery or batteries are connected. Due to the low resistance of the circuits, any ground would permit such a high current to flow that fuses would be blown and serious damage might result to the equipment. For this reason, it is strongly recommended that all exposed terminals be protected with friction tape and shellac, rubber tape, or rubber boots. In addition, care should be used to make sure that all leads and terminal clips are adequate to withstand the high current and mechanical shock and vibration on the installation.

DASH GAUGES

CONSTANT VOLTAGE DASH GAUGES

First introduced on some 1957 vehicles, the constant voltage system incorporates a voltage regulator as well as "senders" that are different from those used in previous systems, Fig. 1A. The new system can easily be tested with a voltmeter having a range up to 15 volts and with a fuel-gauge sending unit.

Responsible for the greater ease of testing is the greater simplicity of the new system. Essentially, it consists, in addition to the new-type senders, of a voltage regulator which changes the variable input from the car battery and charging system to a constant output of the gauges. When the ignition is turned on, the regulator current flows through a heating coil which encircles a bimetallic arm. Resulting heat causes the arm to bend and separate the contacts. Repeated making and breaking of the circuit supplies current at a pulsating 5 volt pressure to the gauges.

Senders for the fuel and oil-pressure gauges are rheostats. In the fuel-tank unit, the sliding contact brings full resistance into the circuit when the tank is empty and only a small amount of current flows through the dash-gauge heating coil. The bimetallic arm deflects the gauge pointer to "Empty." As the tank fills, the float arm moves the contact, decreasing resistance. As more current flows to the dash unit heating coil the pointer deflects toward "Full."

In the oil line, a contact, attached to the diaphragm, moves as pressure increases or decreases, varying the resistance in the circuit, and deflecting the gauge needle accordingly.

The sender for the temperature gauge contains an element in which resistance to the flow of electrical current increases with cold. As the engine warms up, resistance falls and the fuller flow of current to the gauge moves the pointer toward "Hot."

Trouble Shooting

When trouble develops, you can quickly put your finger on the cause through the use of the voltmeter and the fuel-gauge sending unit already mentioned. The latter should have a short ground lead and clip.

A word of caution about grounding: When testing or making replacement of a unit under the dash, be careful not to ground the wires to the gauges, sending units or regulator. A full flow of current through the regulator to ground will burn out this unit.

All the trouble that can develop in a constant-voltage gauge system falls into the following four distinct classes: 1. All gauges read too high; 2. All gauges read at high limit; 3. All gauges read too low; 4. One gauge is inaccurate or erratic.

When All Gauges Read Too High

When all gauges read too high, you will usually find that the voltage regulator is not properly grounded. To be sure, make a quick check with a jumper connected from the regulator case to the sheet metal of the instrument panel. Clean the mounting area to provide a good ground.

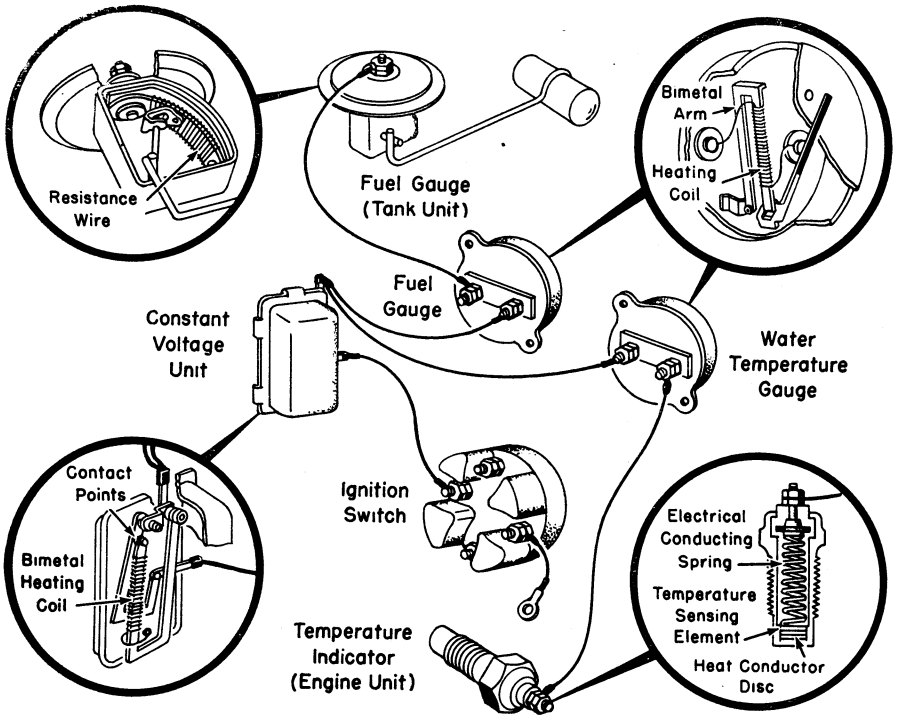

Fig. 1A Typical constant-voltage system with units enlarged to show their construction

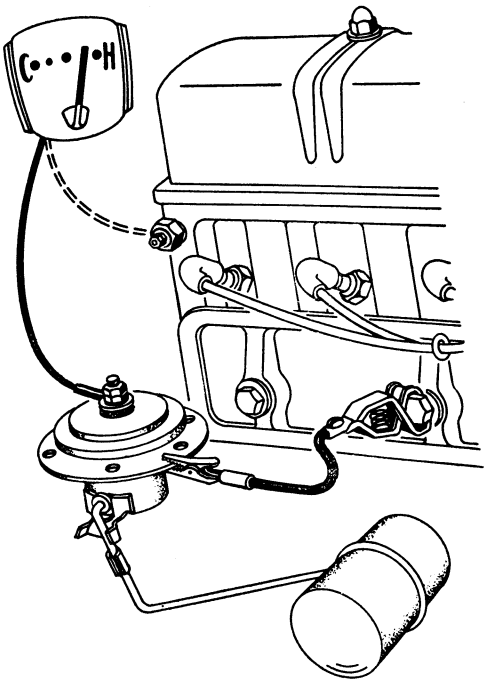

Fig. 1B When tank is used to test temperature gauge, raising float through arc should swing needle of dash unit over toward "hot" side

When All Gauges Read At High Limit

When all gauges read at the maximum of the needle travel, look for the trouble in stuck points or an open winding in the heating coil in the voltage regulator.

In checking for this trouble, connect the voltmeter to the regulator output terminal and to ground. This will show the output voltage of the regulator. If output shows a steady unregulated voltage equal to the battery voltage, the regulator is defective and should be replaced. A normally operating regulator will cause the voltmeter needle to fluctuate between zero and 7 volts with a 12 volt input.

(While this method does not give an absolutely accurate voltmeter reading, it does indicate whether the regulator is functioning and can be relied upon as a quick service test.)

When All Gauges Read Too Low

There are three possible reasons for all gauges to read too low. Regulator input may be less than the required 5.5 volts, the circuit to regulator may be open or there may be an open circuit in the regulator itself.

This fault is quite simple to check. Test the input to regulator. If battery voltage is normal, regulator is defective and must be replaced.

Single Gauge Trouble

When only one gauge is inaccurate or erratic, the trouble is simple to trace. The cause can only be a loose connection, poor ground, or a defective dash gauge or sending unit.

To pinpoint the trouble, first disconnect the wire from terminal on fuel-level, oil-pressure or temperature sender unit. Connect the wire to the terminal on a new gas tank unit and ground the unit housing with a jumper, Fig. 1B.

With the float in the "Empty" position and the ignition switch turned on, the gauge should read at the low end of the scale. Move the float to the "Full" position, allow the gauge a minute to react and the panel indicator should swing to the top of the scale. If the indicator responds correctly, both the wire to the gauge and the gauge are normal and the sending unit is either defective or not properly grounded.

When a suspected tank unit is being tested, it must be grounded to the tank and the tank to the body and frame. If a jumper wire connected between the tank unit housing and the frame or body does not restore normal gauge action, replace the defective tank unit.

If the indicator does not respond accurately, disconnect the lead wire to the indicator and make a direct connection of the new tank unit to the indicator. If the "Empty" and "Full" tests now give normal indicator action, repair or replace the lead wire. If the indicator does not register accurately, replace it.

AC FUEL GAUGE

The gauge consists of two units: (1) The indicating or dash unit which is mounted on the instrument panel; (2) the tank unit which is installed in the fuel tank. These two units are connected by a single wire and each unit is grounded in its respective location.

Fig. 1 shows a wiring diagram of the gauge. The dash unit consists of two coils spaced 90 degrees apart with an armature and integral pointer at the intersection of the coil axis. An inertia dampener is provided on the armature to prevent vibration on rough roads.

The tank unit consists of a housing enclosing a rheostat or resistance unit with a brush which contacts the resistance unit. This contacting brush is actuated by the float arm—movement of which is controlled by the height of the fuel in the tank. Variations in resistance (height of fuel) change the value of the indicating unit coils so that the pointer indicates fuel availability. A calibrated friction brake is included in the tank unit to prevent wave motion of the fuel in the tank from oscillating the pointer on the indicating unit.

Gauge Service

If the gauge does not give an accurate indication of the amount of fuel in the tank, check to locate the trouble as follows:

First, make a tester using an extra AC tank unit known to be in good condition. Then attach a spring terminal clip to a five-foot length of colored wire. Connect the other end of this wire to the binding post of the tank unit. Next, attach two spring terminal clips to a similar piece of black insulated wire and the tester is ready for use.

Testing Dash Unit

1. Turn off the ignition switch.
2. Disconnect one of the battery cables.

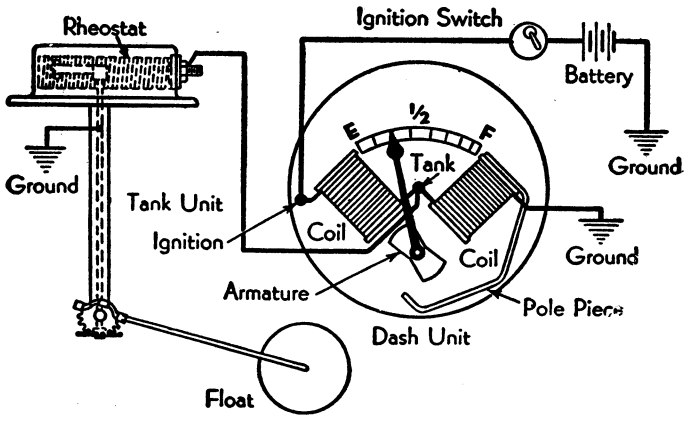

Fig. 1 AC electric fuel gauge

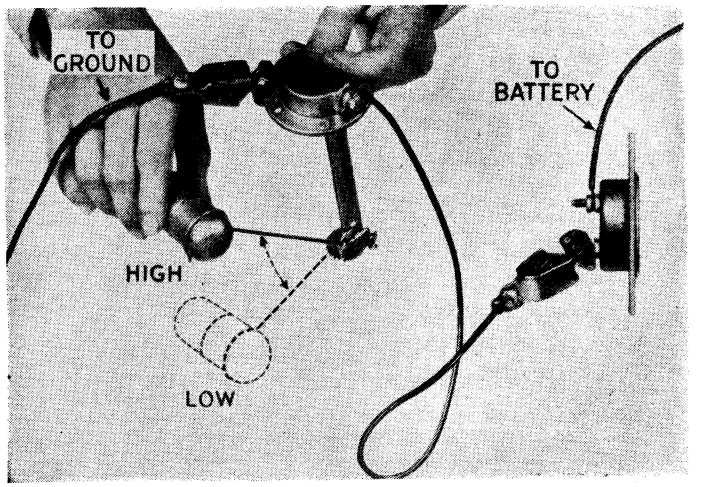

Fig. 2 Showing use of spare tank unit to check operation of dash unit

3. Disconnect the wire which leads to the tank unit.
4. Using the spring clip, connect your colored tester wire to the binding post from which the wire was removed.
5. Connect the black wire to the flange of the tester and to any convenient ground—such as the unpainted part of the instrument panel.
6. Turn on the ignition switch.
7. Connect the battery cable. Move the arm of the tester back and forth slowly, Fig. 2. If the dash unit is okay, the pointer will move from "Empty" to "Full" freely. If the pointer doesn't move, or only moves part way, the dash unit is defective and a new AC dash unit must be installed.

Test Wiring from Dash to Tank

1. Turn off ignition switch. Disconnect battery and reconnect wire to dash unit.
2. Follow wire from tank unit to "bayonet connection" or the terminal junction block. Disconnect the wire at this point and clean wire contacts by scraping with a knife or sandpaper, Fig. 3.
3. Attach the colored wire to the end of the wire which runs to the instrument panel. Attach the black tester wire to the car frame for a ground.
4. Connect the battery cable and turn on the ignition switch. Move the arm of the tester back and forth. If the wiring is okay, the pointer on the dash unit will move from "Empty" to "Full" freely. If the pointer doesn't move or only moves part way, the trouble is in the wire from the dash unit to the tank.
5. If the pointer does move correctly, the trouble is in the tank unit or the wire which runs from it to the "bayonet connection", Fig. 3, or terminal junction block. If the connections are all clean and tight, and there are no breaks or chafes in the wire from the bayonet connection to the tank, then a new AC tank unit must be installed.

AUTO-LITE FUEL GAUGES

Thermostatic Type

Figs. 4 and 5—With this type gauge two wires are used to connect the dash unit with the tank unit. The dash unit contains two thermostatic strips heated by resistance wires wound around the strips. The two bimetal strips that are not heated take care of variations in temperature.

The two terminals of the dash unit marked "1" and "2" are connected by separate wires to the tank unit terminals marked "1" and "2".

Movement of the float arm in the tank, due to changes in fuel level, moves a contact arm across a resistance winding in the tank unit. This varies the resistance in the windings of the dash unit, raising and lowering the temperature of the bimetal strips. The strips bend, depending upon the amount of heat they receive, moving the gauge pointer.

Due to the heating of the bimetal strips, the thermostatic type fuel gauge action is slow, and the pointer does not react to sudden changes in fuel level due to sloshing of the gasoline in the tank.

SERVICE—The gauge can be tested by using a spare tank unit known to be in good condition. The procedure is as follows:

Fig. 3 AC fuel gauge connection

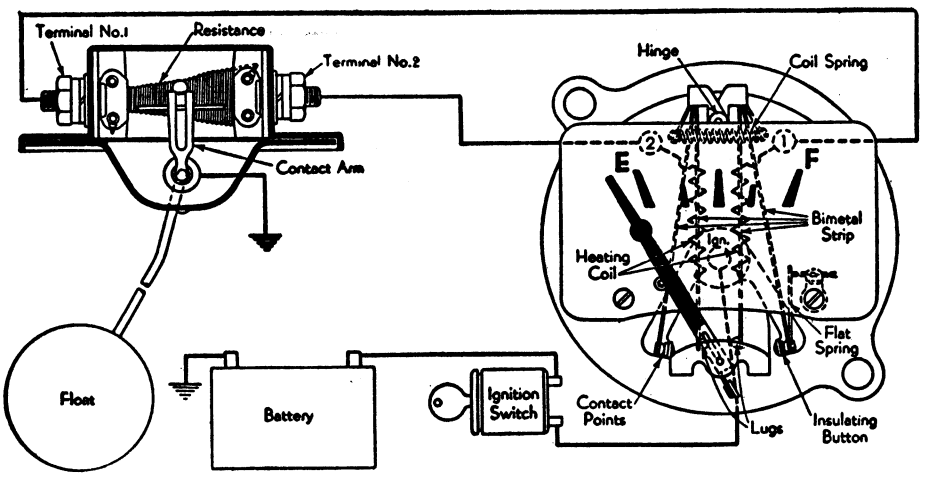

Fig. 4 AUTO-LITE thermostatic fuel gauge

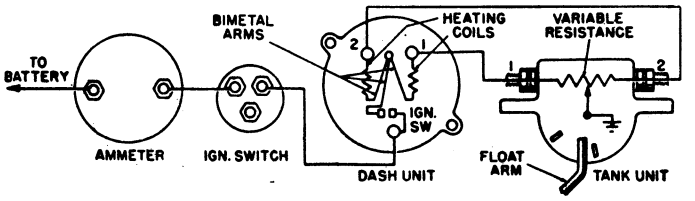

Fig. 5 AUTO-LITE thermostatic fuel gauge wiring diagram

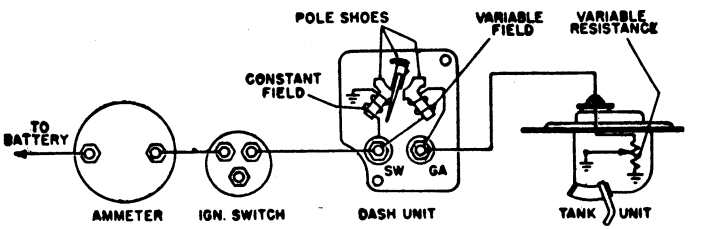

Fig. 6 AUTO-LITE magnetic fuel gauge wiring diagram

1. Disconnect wires from terminals marked "1" and "2" on the tank unit.
2. Connect the disconnected wires to the corresponding terminals of the spare tank unit.
3. Then connect a third wire to the frame of the spare tank unit and to any good grounding point on the car.
4. Turn on ignition switch. Allow about one minute for the dash unit to heat, then operate the float arm of the spare tank unit (see Fig. 2).
5. If dash unit does not indicate correctly, install a new Auto-Lite dash unit. If dash unit works properly, the fault is in either the wiring or the tank unit.
6. If the dash unit is okay, reconnect the wires to the terminals and disconnect the wires from the tank unit. Ground the No. 1 wire and allow approximately one minute for the dash unit to reach its indication —which should be above the "Full" position. Then ground both wires and the gauge should return slowly to the "½ Full" position. If the indications are not as described it indicates a grounded or open-circuited wire which should be repaired.
7. By elimination, if the gauge operates correctly in the above tests, the tank unit can be regarded as the cause of the original inoperation.
8. When reconnecting the leads to the dash or tank units, be careful not to interchange them as this would reverse the indications.
9. Erratic or incorrect indications may be caused by a loose connection or ground in the wiring or terminals. A fluctuating pointer is usually caused by dirty contacts in the dash unit. Sticking pointers may be caused by a bent pointer or frame or by interference between the gauge and dash panel. Remove the gauge from the panel and inspect for a bent pointer or pointer bearings. Check to see that there is a slight amount of end play in the pointer shaft and that the pointer turns freely. Clean the contacts by drawing a strip of clean bond paper between them.

Magnetic Type

Fig. 6—The dash unit has two magnetic circuits, each having a separate winding to produce two distinct magnetic fields. One of the windings is grounded internally, and sets up a constant pull toward the "Empty" indication when the ignition switch is turned on. The other winding, called the variable field winding, is grounded through the tank unit. This winding pulls the pointer across the gauge dial to indicate the amount of fuel in the tank.

The tank unit contains a resistor and a contact arm which moves as the float moves. The tank unit case is grounded to complete the fuel gauge circuit.

The magnetic field around the variable winding changes with a change in the amount of the fuel in the tank. As the float in the tank moves from "Full" to "Empty", the strength of the magnetic field is gradually reduced. When the float moves from "Empty" to "Full," the strength of the magnetic field is increased.

The pointer is mounted on a magnetic vane which is attracted by the two lower magnetic poles and assumes a position between them depending upon the combined magnetic field. A counterweight is mounted on the pointer to bring the reading back to "Empty" whenever the ignition is turned off.

SERVICE—If the gauge does not give an accurate indication of the amount of fuel in the tank, check to locate the trouble as follows:

1. Disconnect the lead from the "GA" terminal on the back of the dash unit.
2. Turn on the ignition and the pointer should stay against left stop pin ("Empty").
3. Ground the "GA" terminal and the pointer should move to the right stop pin ("Full").
4. Check the wiring from the ignition switch to the "SW" terminal and replace the dash unit if it does not act as described.
5. Reconnect the lead to the "GA" terminal and disconnect the lead from the tank unit. The gauge should stay against the left stop pin when the ignition is turned on. If it indicates "Full", look for a ground in the wiring between the dash and tank units.
6. Ground the lead at the tank unit. If the gauge does not move to the right pin, look for open circuit in wire.

NOTE—The above tests checked for faults in the dash unit variable field winding and for opens or grounds in the connecting wires, but did not check the constant field winding or tank unit. To test these parts, proceed as follows:

1. Connect a spare tank unit, known to be in good condition, to the "GA" terminal on the dash unit and ground the tank unit case.
2. Operate the float arm manually and observe the readings. If the dash unit indications are incorrect, remove and calibrate the dash unit; if the dash unit indicates correctly, replace the tank unit.
3. If no spare tank unit is available to make this check, remove the tank unit and use it for the above check. If the dash unit constant field winding is open or grounded, the gauge will read "Full" over a large part of the float arm movement. If the tank unit is faulty, the gauge will be erratic or will not operate at all.
4. If the operation of the gauge is erratic it may indicate that there is interference with the pointer movement. Remove the dash unit and inspect the pointer and armature assembly. Straighten the pointer if it has been bent and rubs against the dial and frame. Check to make sure there is a slight amount of end play in the pointer shaft and that the bearing plates have not been bent out of alignment.
5. Make sure bearings are clean. If the adjustable bearing is loose, or after adjusting the end play, apply a drop of air drying varnish to prevent the bearing from turning. Later gauges do not have this adjustable bearing screw; the shaft being held in position between the bearing plates, the upper one being loose and held in place by the dial screws. In no case should varnish be applied to this type bearing and adjustment is not necessary.
6. To calibrate the dash gauge, remove it from the panel and mount it in the same position. Check to make sure the pointer turns easily and returns to the left hand stop (empty) from any position. The pointer should return promptly and have a very slight bank against the stop.
7. Connect the "SW" terminal on the dash unit to one battery terminal and ground the dash unit frame to the other battery terminal.
8. Connect the tank unit to the "GA" terminal and connect the tank unit case to the battery ground terminal.
9. Place the float arm in the "Full" position and turn the right hand pole shoe so that the pointer just indicates "Full."
10. Place the float in the "Empty" position and turn the left hand pole shoe to give the correct indication.
11. To rotate the pole shoes, pry the U-shaped lug on the top edge of the shoe.
12. Check the indications at the "Full", "½ full" and "Empty" positions.

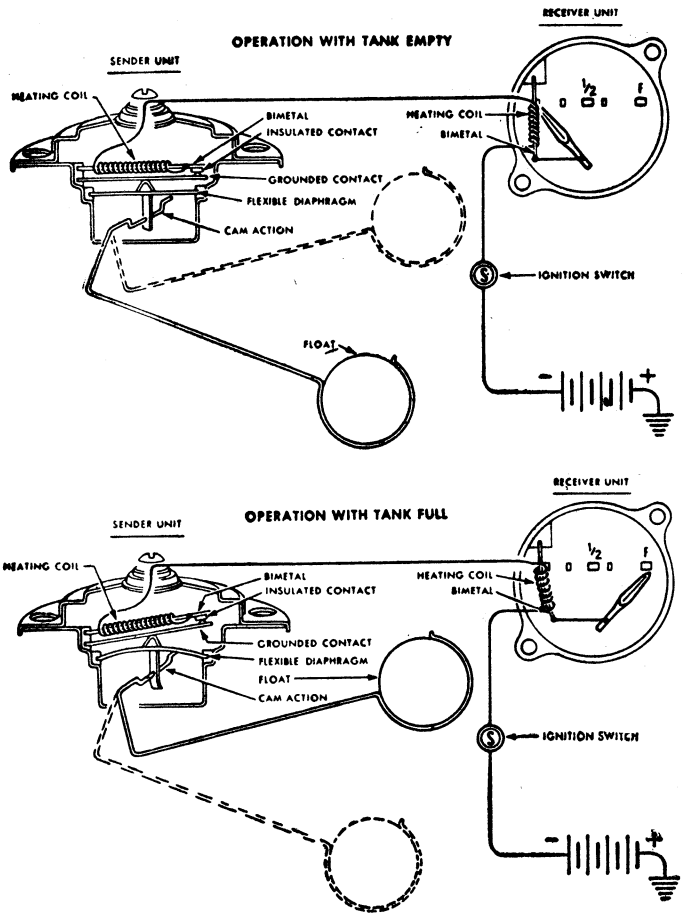

Fig. 7 FORD and KING-SEELEY fuel gauges

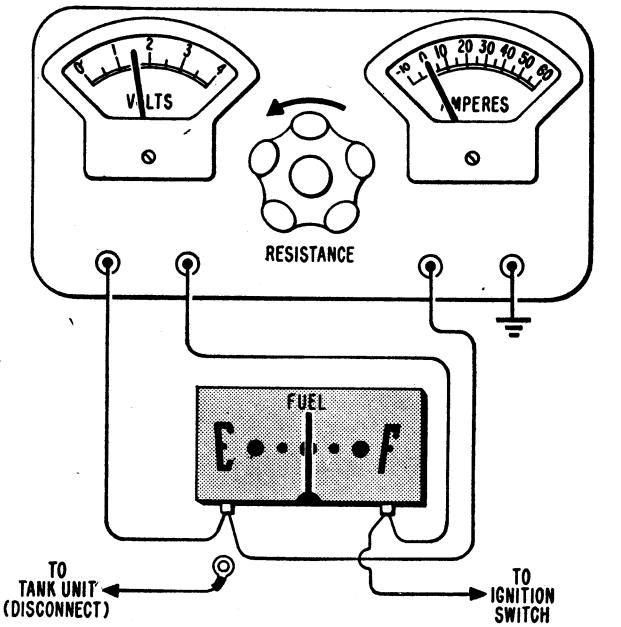

Fig. 7A Testing dash unit fuel gauge with volt-ammeter test set

13. When calibrating, it may be necessary to spread or reduce the indicator movement. This is done by bending the upper shoe to increase or decrease the air gap between the pole and armature.
14. After all adjustments are completed, apply a drop of air drying varnish to each shoe to prevent slipping.

KING-SEELEY & FORD FUEL GAUGES

Fig. 7—This type gauge consists of a receiver and sender unit. The sender, of course, is the tank unit, whereas the receiver is the dash unit.

The sender unit contains a heating coil formed around a bimetal strip, and an external float which varies the height of a grounded spring contact, which in turn increases or decreases the tension of the bimetal strip.

The receiver unit contains a similar heating coil and bimetal strip, linked to a pointer. The receiver unit is series connected to the ignition switch, and therefore, operates only when the ignition switch is turned on.

When the fuel tank is empty, the float of the tank unit is at the bottom of its movement and the two contacts are just touching. With the ignition switch turned on, current flows through the circuit and heat is generated in the heating coil, causing the bimetal strip to bend. Bending of the bimetal opens the contacts and the circuit is broken. The heating coil and bimetal then cools and the spring returns to its former position where contact is again made.

Since the heating coils of the two units are connected in series, a similar slight bending of the bimetal strip in the dash unit takes place, which is just sufficient to pull the pointer to the "Empty" position.

When the fuel tank is filled, the action of the float and eccentric shaft (some units have cams) raises the grounded contact against the insulated bimetal contact, bending the bimetal strip in the dash unit.

With the bimetal strip under tension, a greater amount of current is required to bend it sufficiently to break contact. A similar increased bending of the bimetal strip in the dash unit occurs and this action pulls the needle over the "Full" position on the dial. The cycle of opening and closing of the contacts is continuously repeated.

Because the bimetal strips heat and cool slowly, sudden changes of fuel level caused by the sloshing of gasoline in the tank are dampened and a steady reading of the average fuel level in the tank is indicated.

Service

Trouble in the units or circuits may cause the gauge to indicate "Empty" at all times or the pointer may constantly rest beyond the "Full" mark.

Gauge Does Not Indicate

When the dash unit does not indicate the fuel level with ignition switch turned on, check the dash unit and wire to the tank unit as follows:

1. With ignition switch turned off, connect a jumper wire from the tank unit terminal to a convenient ground.
2. Turn the ignition switch on momentarily. Then if the dash unit gives an indication, the tank unit is defective and must be replaced.
3. If the dash does not show any indication after completing step 2, ground the tank-to-dash wire at the dash unit terminal.
4. Turn ignition on momentarily. If the dash unit now indicates, then the wire to the tank unit is defective and must be repaired or replaced. However, if the dash unit fails to indicate, then the dash unit is defective.

CAUTION—In making tests, be sure to turn off the ignition switch before the pointer reaches the full end of the scale, otherwise damage to the dash unit will result. A defective tank unit or wiring may have damaged the dash unit. After installing a new dash unit, observe its action after turning on the ignition switch momentarily. If the pointer moves beyond the "Full" mark, then the

tank unit or wiring is defective and must be replaced.

In rare cases, a false indication of fuel level would be obtained if a leak developed in the tank unit float. If this condition is found, replace the complete tank unit.

Gauge Indicates Beyond "Full" Mark

When this condition occurs, regardless of the quantity of fuel in the tank, make the following tests to determine the source of the trouble. Before each test, be sure to turn on the ignition switch momentarily to energize the units.

1. If the tank unit is equipped with a radio condenser, disconnect the condenser. Then if the dash unit indicates correctly, the condenser is shorted and a new one should be installed.
2. The next step is to check the wiring between the gauges. Do this by disconnecting the existing wire and substitute a jumper wire between the gauges. If the dash unit now checks OK, it indicates that the wiring is defective.
3. If the wiring proved not to be the cause of the trouble, use a spare tank unit and operate the float by hand, first being sure to ground the tank unit housing. Now if the dash unit indicates correctly, the tank unit was the source of the trouble.
4. If the dash unit still fails to function properly after making the above tests, replace it with a new one.

Using Volt-Ammeter Test Set

If a volt-ammeter test set is available, perhaps it is quicker to test the dash gauge first.

1. Disconnect tank unit wire at dash gauge.
2. With ignition switch *off,* connect volt-ammeter test set and dash gauge as shown in Fig. 7A.
3. Turn rheostat knob to maximum resistance.
4. Turn ignition switch on.
5. Decrease resistance until voltmeter reads 1.5 volts. If the dash gauge is functioning properly, the fuel gauge will indicate about ½. If it does not, the gauge is defective.
6. If the dash gauge indicates properly according to the above test, then check out the radio condenser and dash-to-tank unit wiring as directed above. If these check out all right, obviously the tank unit is defective.

STEWART-WARNER FUEL GAUGE

Fig. 8.—This type gauge consists of an ammeter and rheostat. The ammeter, which is calibrated in gallons, is the dash unit and its readings are dependent on the amount of current passed to it by the float controlled rheostat—which is the tank unit. If the gauge fails to function properly, make the following tests:

1. Make sure that all wiring connections are tight and electrically secure; that the line from the tank unit to the dash unit is not grounded or open, and that the dash unit and tank unit are well grounded.
2. Disconnect the wire running from the tank to the dash unit at the tank terminal and ground it to the frame while the ignition is on. If the gauge now reads full and drops to empty when the wire is removed from the ground on the frame, the tank unit is faulty. If the dash unit behavior is not as just described when the wire is grounded to the frame and then removed, a defective dash unit is indicated.

If the tank unit is faulty, be sure to have the ignition turned off before removing it from the tank.

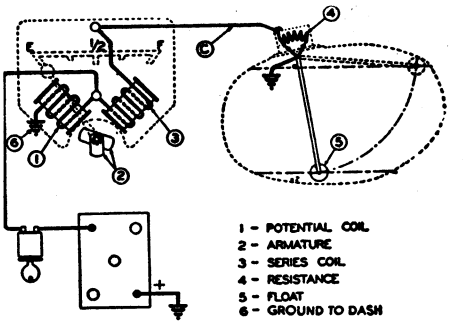

Fig. 8 STEWART-WARNER fuel gauge

AC TEMPERATURE GAUGES

Vapor Pressure Type

This type gauge consists of a metal case, enclosing a dial, a frame and mechanism assembly. Hermetically attached to the frame socket is a capillary tube (connector) and immersion bulb. The immersion bulb contains a liquid, such as ether, whose vapor pressure is proportional to the temperature.

The expanded gas is directed up the capillary tube, and into the curved bourdon tube (C shaped) which has one end fastened to the mechanism frame. The applied pressure has a straightening effect on the bourdon tube and results in its free end moving outward in proportion to the pressure. Since the free end is connected to the pointer by a linkage, the bourdon tube movement is transferred to an indication on the dial. Because the vapor pressure is constant for any given temperature, the dial is calibrated directly in degrees Fahrenheit.

Fig. 9 Removing vapor pressure bulb from engine block

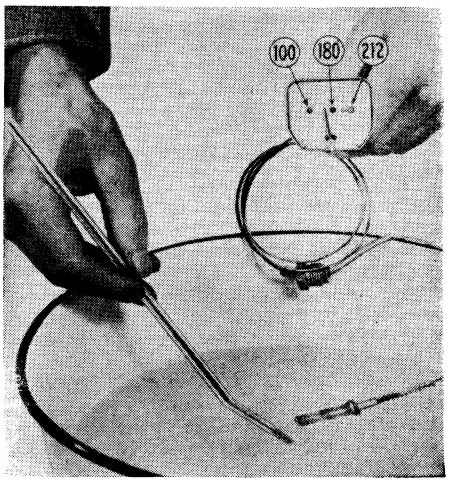

Fig. 10 Testing vapor pressure type temperature gauge

Service

Vapor pressure gauge troubles are of three kinds: (1) The pointer movement is sticky, jumpy or uneven. (2) The pointer does not move at all. (3) The pointer shows temperatures which are obviously incorrect.

Most automotive engines are designed to operate at temperatures between 160 and 180 degrees. Should temperature go consistently higher than normal operating temperatures, the engine may be overheating due to one or more of the following:

1. Broken or loose fan belt.
2. Collapsed radiator hose.
3. Frozen radiator.
4. Obstruction in front of radiator, such as dirt or insects.
5. Thermostat out of order.
6. Radiator pressure cap (if fitted) not operating properly.
7. Poor engine lubrication.
8. Low water level in radiator and cooling system.

After the cooling system is thoroughly checked, test the temperature gauge to make sure that nothing is wrong with it. The procedure is as follows:

1. Drain water from radiator.
2. Loosen plug which holds vapor pressure bulb in engine block.
3. Remove the vapor pressure bulb from the engine, Fig. 9.
4. Place the vapor pressure bulb in a pail of hot water, Fig. 10. Also place a thermometer which reads up to 200 degrees F. or higher, and which is reasonably accurate in the hot water. Leave them in about three minutes.
5. If the temperature gauge is okay, the pointer should register the same temperature as the thermometer.
6. If this test shows that the trouble is in the gauge itself, the entire gauge should be replaced with a new unit.

7. When reinstalling one of these gauges in the engine block, don't use a wrench with too long a handle, and don't turn the bulb down too hard. A water-tight fit is all that is needed.

AC Electric Type

This type gauge, Fig. 11, consists of a dash unit and engine unit. These two units are connected by a single wire and each unit is grounded in its respective location.

The indicating unit consists principally of two coils spaced 90 degrees apart with an armature and integral pointer at the intersection of the coil axis. An inertia dampener is provided on the armature assembly to prevent vibration of the pointer on rough roads. The dial has a scale graduated in degrees Fahrenheit.

The engine unit has no moving parts and is essentially an electrical resistor which changes resistance with changes in temperature. The unit has a high resistance value when cold and a low resistance value when hot.

The change in engine unit resistance modifies the strength of the indicating unit coils and causes proper indication of the pointer.

SERVICE—Electric temperature gauge troubles are of four kinds: (1) The pointer doesn't move when the ignition switch is turned on. (2) The pointer indicates a high temperature whether the engine is hot or cold. (3) The pointer does not show temperature accurately.

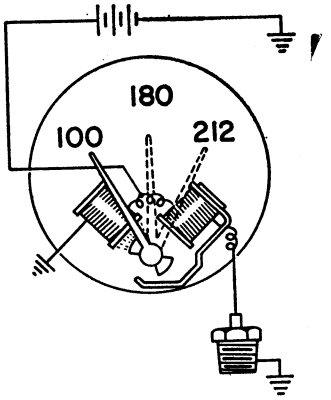

Fig. 11 AC electric temperature gauge wiring diagram

(4) The pointer indicates a low temperature whether the engine is hot or cold.

In addition to the above, any of the cooling system troubles listed under vapor pressure gauges can also affect the electrical unit.

Incorrect temperature readings are checked as follows:

1. Disconnect wire from binding post on end of engine unit.
2. Turn ignition switch on.
3. Hold end of wire away from all wires or other metal.
4. Check dash unit. The needle should point to the low mark or "100".
5. Touch the bare end of the wire to the engine block.
6. Check dash unit again. The needle should then point to over "212" or the high mark.
7. If the dash unit reads as described in steps 4 and 6, it indicates reasonable performance of the dash unit and the connecting wire. In this event, the engine unit should be checked as described below. But if the dash unit does not indicate properly, then first check the wire. If it is okay, replace the dash unit.
8. To check the engine unit, drain the water from the radiator.
9. Disconnect the wire which is attached to the engine unit, Fig. 12.
10. Loosen the engine unit and lift it out.
11. Reconnect the lead wire to the engine unit. Ground the threaded portion to a convenient point on the car with suitable wire and clamps.
12. Get a pail or other suitable receptacle and fill it with hot water. Also a thermometer having a reading of 200 degrees F. or higher which is known to be reasonably accurate. Place the threaded end of the engine unit part way down into the hot water. Place the thermometer in also. Leave them in the water for about three minutes. Do not let any water get above the threads on the engine unit as to do so may ruin the unit.
13. If the dash unit is okay, the pointer should indicate the same temperature as the thermometer. If the pointer does not indicate correctly, replace the engine unit.

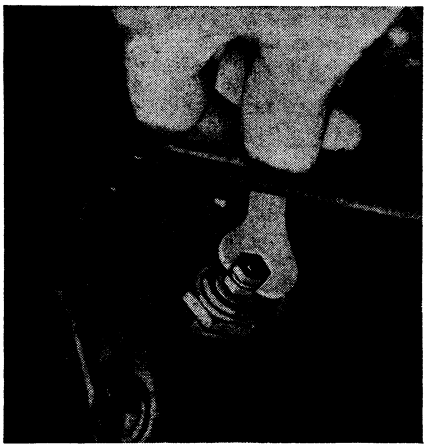

Fig. 12 Disconnecting wire from electric type temperature gauge

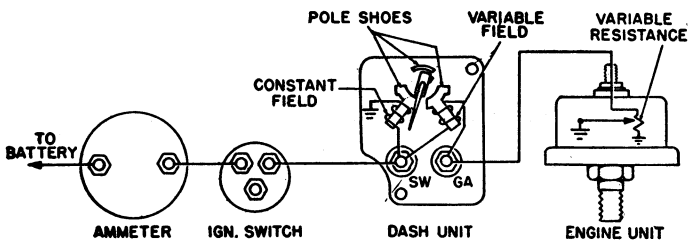

Fig. 13 AUTO-LITE electric temperature gauge wiring diagram

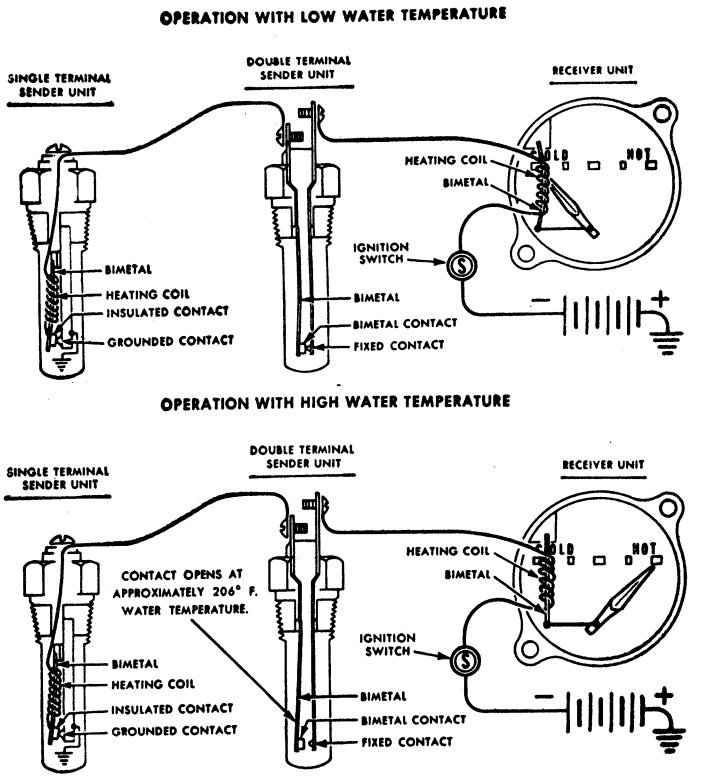

Fig. 14 FORD and KING-SEELEY temperature gauges. The diagrams show the installation on 1949 and later V8 engines in which two engine units are used, one in each cylinder head

AUTO-LITE TEMPERATURE GAUGES

Vapor Pressure Type

This type gauge operates and is serviced in the same manner as described for AC vapor pressure gauges.

Electric Type

This type gauge, Fig. 13, includes two units. The dash unit has three magnetic poles, two of which have windings. One of these windings is connected to the ignition switch and to ground and creates a steady magnetic pull toward the low mark on the scale. The other winding is also connected to the ignition switch but it is grounded by the engine unit. It creates a magnetic pull toward the maximum temperature position, the strength of which is dependent upon the amount of resistance inserted in the circuit by the engine unit.

The engine unit is actuated thermally without moving parts. The resistance unit in the engine unit is made of special metal oxides in the form of a flat disc that changes resistance as its temperature varies. When it is hot, the resistance inserted in the variable field circuit is reduced and the pointer is attracted toward the "Hot" position.

The pointer on the dash unit is mounted on a magnetic vane which is attracted by the two lower magnetic poles and assumes a position between them depending upon the combined magnetic field. A counterweight is mounted on the pointer to bring the reading back to zero whenever the ignition is turned off.

SERVICE—The procedure for testing these gauges is the same as described for the AC electric temperature gauge.

KING-SEELEY & FORD TEMPERATURE GAUGES

These units, Fig. 14, consists of a sender unit located in the cylinder head and series connected to the receiver or dash unit. The illustrations show the two engine units, one for each cylinder head on some 1949 and later Ford V8 engines. When only one sender unit is used, as in the case with an "In-Line" engine the single terminal sender unit is used.

The single terminal sender unit consists of a heating coil formed around a bimetal strip, insulated from the grounded frame. A grounded contact is attached to the frame in alignment with the bimetal contact.

The double terminal sender unit is similar in outward appearance to the single terminal unit with two terminals provided to allow series connection between the receiver unit and the single terminal unit in the opposite cylinder head. As shown in illustration, this unit consists of a bimetal strip with a contact point, insulated from a supporting frame. The frame also supports a phosphor bronze spring with a contact point in alignment with a bimetal contact, both insulated from ground.

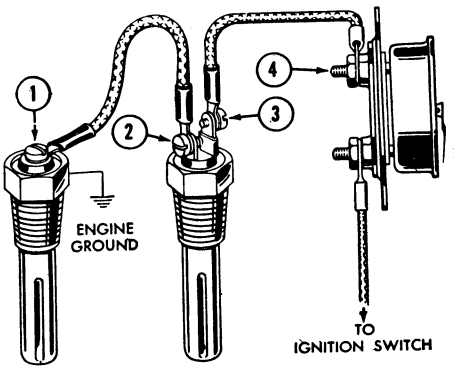

Fig. 15 FORD and KING-SEELEY. Showing check points for testing temperature gauges when two engine units are used

The bimetal assemblies of both sender units are sealed in their respective waterproof casings. The receiver and sender units are both calibrated at the factory and if either one become defective, it should be replaced with a new one.

Operation

The dash unit is connected to the ignition switch and to the series connected engine unit (or units). The dash unit will indicate water temperature only when the ignition switch is turned on. When the ignition is turned off, the pointer will register at the "Hot" position. This does not indicate that the cooling system is overheated but that the pointer is at its normal at rest position.

The dash unit, operated by a heater wire on a bimetal strip, is connected to a bulb in the cylinder head (or one bulb in each cylinder head as in Fig. 14). The bulbs have similar bimetal strips as the dash unit. When the ignition is turned on, current will pass through the dash unit and the engine unit (or units). The single terminal engine unit is normally grounded. However, as the current passes through the engine unit (or units), heat is generated in the single terminal engine unit bimetal, causing it to bend and open the contact to ground. Flow of current is then stopped, permitting the bimetal to cool and return to its normal, grounded position and the cycle is again repeated.

The same amount of current passes through the dash and engine units since they are connected in series with each other. This current also causes the bimetal in the dash unit to become heated and pull the pointer over to the left or right, depending on the temperature of the water. The cycle of opening and closing of the engine unit contact points is repeated continuously.

When the temperature of the water increases, the heat from the circulating water around the single terminal engine unit supplements the heat generated by the current passing through the units, reducing the amount of current necessary to cause the bimetal to draw away from the fixed contact. With less current flowing through the engine unit (or units), less current likewise flows through the dash unit and deflection or bending of the bimetal in the dash unit is lessened.

Service

When the dash unit does not register with the ignition switch turned on, check the engine unit (or units) and wires as follows:

1. With the ignition switch turned off, short out the single terminal engine unit by clipping one end of a jumper wire to its terminal and the other end to ground.
2. Turn ignition switch on momentarily. If the dash unit now gives an indication, then the single terminal engine unit is defective and must be replaced.
3. On Ford V8 engines using two engine units, check the double terminal engine unit as follows: If the dash unit does not register as in step 2, ground terminal "2" of the double terminal engine unit to which the wire connecting the single terminal unit is attached, Fig. 15. Turn the ignition switch on momentarily and observe if the dash unit registers. If it does, then the wire connecting the two engine units is defective.
4. If the dash unit does not register as in step 3, move the clip of the ground wire to terminal "3" of the double terminal engine unit. Turn the ignition switch on momentarily. If the dash unit now registers, then the double terminal engine unit is defective and must be replaced.
5. If the dash unit does not register as in step 4, ground terminal "4" at the dash unit, Fig. 15. If the dash unit registers, then the wire connecting the double terminal engine unit to the dash unit is defective. If the dash unit is still inoperative after the preceding tests, replace the dash unit.

WARNING—In making the above tests, turn off the ignition before the pointer reaches the end of the scale, otherwise the dash unit will become damaged or burned out.

AC OIL PRESSURE GAUGES

Pressure Expansion Type

This type gauge is similar in principle to the vapor-pressure type of water temperature gauge previously described. In this unit, however, oil under pressure passes from the engine unit up the connecting tube to the dash unit. As the pressure builds up it has a tendency to straighten out the C-shaped bourdon tube in the dash unit and thus move the pointer attached to the free end of the tube.

As with the water temperature gauges, engine factors should be considered when checking oil gauge operation. Engine oil should be brought to normal temperature. Pressure at idling speed will vary from 3 to 15 lbs., depending on the make of truck. Above 30 mph engine speed the gauge should show between ½ and ¾ distance across the dial.

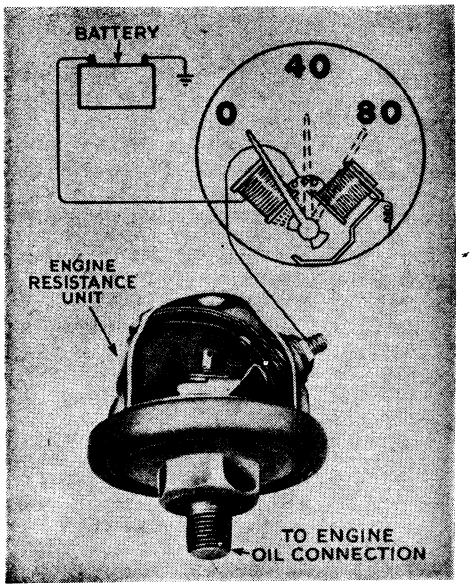

Fig. 16. AC electric oil pressure gauge

If the gauge is jumpy, sticky or uneven in its operation it must be replaced. If it is suspected of being off its calibration, another gauge known to be accurate can be connected to the oil line and checked. If the new gauge indicates correctly, it proves that the old gauge is defective.

Occasionally the operation of the unit can be improved by using a fine wire to clear any accumulation of oxide that may plug the small hole in the oil gauge connection.

Also check the oil line from engine to gauge for leaks. Loosen the nut but do not remove the oil line at the engine block while the engine is running. If oil runs out, the trouble is in either the oil line or dash unit.

Electrical Type

This gauge, Fig. 16, consists of a dash and engine unit connected by a single wire. Each unit is grounded in its respective location.

The indicating unit consists principally of two coils spaced 90 degrees apart with an armature and integral pointer at the intersection of the coil axis. An inertia dampener is provided on the armature to prevent vibration of the pointer on rough roads. The dial has a scale graduated in pounds per square inch.

The engine unit consists of a housing enclosing a diaphragm and linkage which moves a contact over a resistance proportional to oil pressure. The change in engine unit resistance modifies the strength of the indicating unit coils and causes proper indication of the pointer.

Service

Electrical oil pressure gauges are subject to five kinds of troubles:

1. The pointer will not move when the ignition switch is on. Probable causes are (a) defective dash unit, (b) break or poor connection between battery and dash unit, (c) dash unit not grounded.
2. The pointer indicates "high" all the time: Probable causes are (a) defective engine unit, (b) break in dash to engine unit wire, (c) engine unit improperly grounded.
3. The pointer indicates "low" all the time: Probable cause is a short to ground at engine unit terminal or in dash-to-engine unit wire.
4. The pointer never indicates low and is always too high: Probable causes are (a) loose or dirty connections, (b) defective dash unit, (c) defective engine unit.
5. The pointer never indicates high and is always too low: Probable causes are (a) partial ground at engine unit terminal or in dash-to-engine unit wire, (b) defective dash unit, (c) defective engine unit.

To locate the trouble, use the same testing apparatus pictured in Fig. 2 for testing AC fuel gauges, and proceed as follows:

1. Turn off ignition switch.
2. Disconnect one of the battery cables.
3. Disconnect the wire from the oil gauge dash unit which runs to the engine unit.
4. Using the spring clip, connect the colored tester wire to the binding post from which the wire was removed.
5. Connect the black tester wire to the flange of the tester and to any convenient ground—such as the unpainted part of the instrument panel.
6. Turn on the ignition switch.
7. Connect the battery cable. Move the arm of the tester back and forth slowly, Fig. 2. If the dash unit is okay, the pointer will move from the low mark to the high mark freely. If the pointer doesn't move, the dash unit is defective and a new one should be installed.
8. If the dash unit proves to be okay, the next step is to test the wiring between the dash and engine unit. This also can be done with the tester as follows:
9. Turn the ignition switch off and disconnect one battery cable.
10. Follow the wire from the dash to the engine unit, and disconnect the wire at the engine unit.
11. Attach the colored tester wire to the end of the wire which runs to the dash unit. Attach the black tester wire to any convenient ground, such as an unpainted part of the engine.
12. Connect the battery cable. Move the arm of the tester back and forth. If the wiring is okay, the pointer on the dash unit will move from the low mark to the high mark freely. If the pointer doesn't move, or only moves part away, the trouble is in the wire from the dash to engine unit. Repair or replace the wire.
13. If the pointer does move correctly, then the trouble is in the engine unit. If the connection at the engine unit is clean, then a new engine unit must be installed.

AUTO-LITE OIL PRESSURE GAUGES

Pressure Expansion Type

This type gauge is similar to the one described for AC and service is performed in the same manner.

Electric Type

This type gauge, Fig. 17, consists of a dash and engine unit. The dash unit has three magnetic poles, two of which have windings. One of these windings is connected to the ignition switch and to ground and creates a steady magnetic pull towards the "zero" position when the ignition switch is turned on. The other winding is also connected to the ignition switch but is grounded by the engine unit. It creates a magnetic pull toward the maximum pressure position, the strength of which is dependent upon the amount of resistance inserted in the circuit by the engine unit.

The engine unit has a resistance with a sliding contact which is actuated by the oil pressure. When pressure is applied to the diaphragm in the engine unit, resistance is shorted out.

The pointer is mounted on a magnetic vane which is attracted by the two lower magnetic poles and assumes a position between them depending upon the combined magnetic field. A counterweight is mounted on the pointer to bring the reading back to zero whenever the ignition is turned off.

Service

To test a gauge which does not give true indications of the oil pressure, make sure electricity is reaching the dash unit. This can be checked as follows: With ignition switch turned on, connect a test lamp from the "SW" terminal on the dash unit to a ground. If the lamp does not light it indicates no current is reaching the gauge, and the ignition switch, ammeter and wiring should be thoroughly inspected.

If current is reaching the gauge, dis-

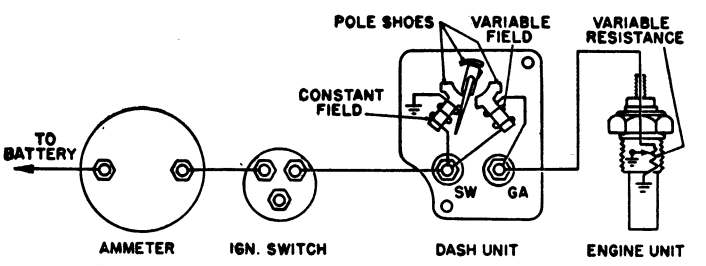

Fig. 17 AUTO-LITE electric oil pressure gauge wiring diagram

connect the lead from the engine unit and again turn on the ignition. The pointer should stay against the left stop pin (no pressure side). Ground the engine unit lead and the pointer should stay against the right stop pin (high pressure side).

If the test results are not as described above, the source of the trouble may be found by following the same procedure outlined for AC electric oil pressure gauge, but using an Auto-Lite fuel gauge tank unit.

KING-SEELEY & FORD OIL PRESSURE GAUGES

These gauges, Fig. 18, consist of a dash unit and engine unit. The dash unit is connected to the ignition switch and in series with the engine unit. When the ignition switch is turned off, the pointer will rest at the extreme left position.

The engine unit contains a diaphragm which is deflected in proportion to the pressure of the oil in the line. When the diaphragm is deflected, an electrical circuit is closed, allowing current to flow through a heating coil wound around a bimetal strip. Heat, generated in this coil, deflects the bimetal to the point where the contact is opened. The bimetal then cools and returns to its original position, which again closes the electrical circuit. This cycle of opening and closing is repeated continuously.

The dash unit contains a similar heating coil formed around a bimetal, connected in series with the coil in the engine unit. As heating takes place in the engine unit, heating also takes place in the dash unit, causing the bimetal strip in each unit to deflect simultaneously.

The pointer indicator is linked to the bimetal strip and oil pressure is indicated by the amount of deflection actuating the pointer.

Increased oil pressure causes greater deflection of the diaphragm in the engine unit, therefore a greater amount of current is required to open the heating coil circuit. This increased current is transmitted to the dash unit, causing a corresponding increased bending of the dash unit bimetal and resultant indication of increased oil pressure.

The heating coil in the engine unit is shunted by a calibrating resistor at the time of assembly to assure accuracy of the unit.

Service

If the oil pressure gauge is not functioning properly, make the following tests in the order given until the source of trouble is found. If the dash unit pointer indicates oil pressure upon turning on the ignition switch (engine not running) contacts in the engine unit may be frozen, the wire from the dash-to-engine unit may be shorted to ground, or the dash unit may be defective. If this condition existed for any length of time, it is probable that the dash unit is damaged. To check the gauge, proceed as follows:

1. Check for loose connections at the terminals of the dash and engine units and connections at the ignition switch. Inspect condition of wire from dash-to-engine units and wire from dash unit to ignition switch.
2. Remove wire from engine unit terminal. If pointer of dash unit now remains at zero position (ignition switch turned on momentarily and engine not running) then the engine unit is defective and must be replaced.
3. If the pointer still registers after completing step 1, remove the dash-to-engine unit wire at the dash unit and observe the pointer when the ignition is momentarily turned on (do not start engine). If dash unit does not register now, then the wire between the two units is grounded and must be repaired or replaced.
4. If pointer still registers after completing step 2, then the dash unit is defective and must be replaced. After installing new dash unit, check its action to make sure engine unit and wiring are satisfactory.

If dash unit does not indicate oil pressure with ignition on and engine running, connections and wiring appearing satisfactory, test as follows:

1. With ignition switch turned off, short out the engine unit at the terminal. Use a jumper wire with clips for this purpose. Clip one end to the terminal screw of the engine unit and the other end to engine ground.
2. Turn ignition on momentarily. If dash unit now registers, then the engine unit is defective and must be replaced.

WARNING—Turn ignition off before pointer of dash unit reaches the highest pressure mark on the scale. In this test the full voltage of the battery is placed on the dash unit and if allowed to remain for a longer period of time, the unit will burn out.

3. If the dash unit fails to register with the engine unit shorted out as in step 2, either the dash unit or the wire running to the engine unit is defective. Turn ignition switch off and check the wire by clipping one end of the jumper wire to the dash unit terminal and the other end to ground.

CAUTION—Be sure grounding wire is

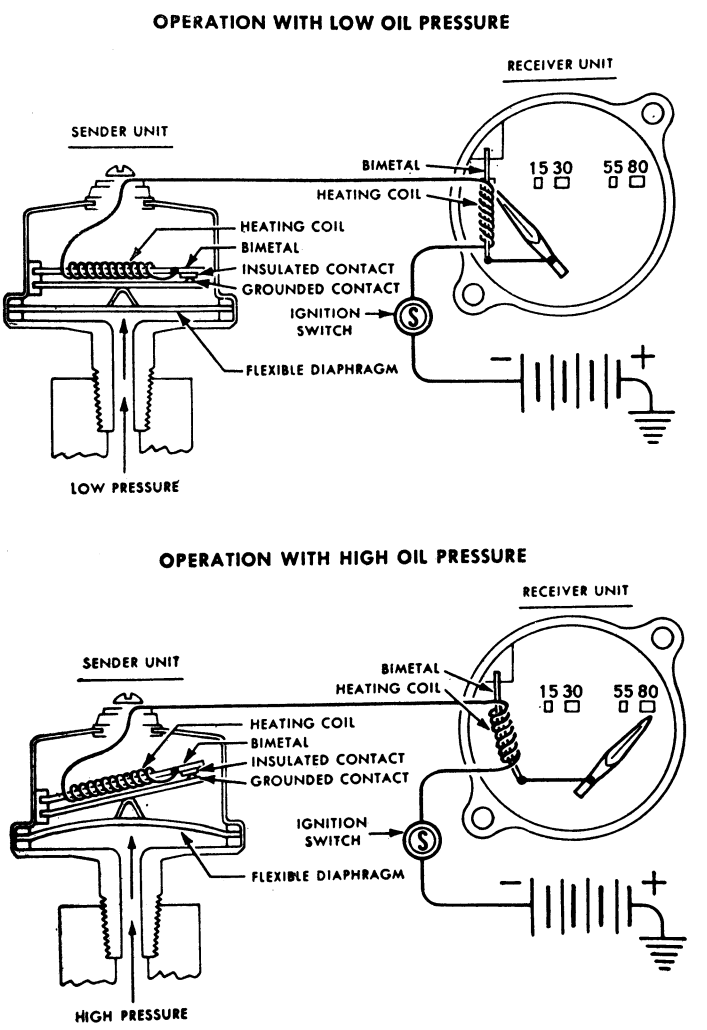

Fig. 18 FORD and KING-SEELEY electric oil pressure gauge

not connected to ignition side of dash unit.

4. Turn ignition on momentarily. If dash unit fails to register, then the dash unit is defective.
5. A defective engine unit or wiring may have damaged the dash unit. After installing a new dash unit, observe its action after turning ignition on momentarily. If the indicator moves beyond the point of normal oil pressure, the engine unit or wiring is defective and must be checked.

AMMETERS

Automotive ammeters indicate direction of current flow (charge or discharge) and the relative amount of current flow. The center point of the dial, Fig. 19, is the point of zero current flow and the two extremes of pointer travel indicate maximum charge and discharge. Therefore, the indicator must not be read for the amount of current charge or discharge but only for charge condition of the generating system.

The typical ammeter consists of a frame to which is attached a permanent magnet. The frame also supports an armature and pointer assembly. When no current flows through the ammeter, the magnet holds the pointer armature so that the pointer stands in the center of the dial. When current passes in either direction through the ammeter, the resulting field attracts the armature away from the affect of the permanent magnet, thus giving a reading proportional to the current strength.

Service

When the ammeter apparently fails to register correctly, there may be trouble in the wiring which connects the ammeter to the generator and battery, or in the generator and battery themselves. There are only a few simple things to check in order to find the cause:

1. Loose connections on the back of the ammeter.
2. Loose connections at the back of the ignition switch, or at the battery. (Ammeters are not grounded to the instrument panel.)
3. Spots on the wiring where the insulation has been chafed, burned or broken.

To check the connections, first tighten the two binding posts on the back of the ammeter. Then, following each wire from the ammeter, tighten all connections on the ignition switch, battery and generator. Chafed, burned or broken insulation can be found by following each ammeter wire from end to end.

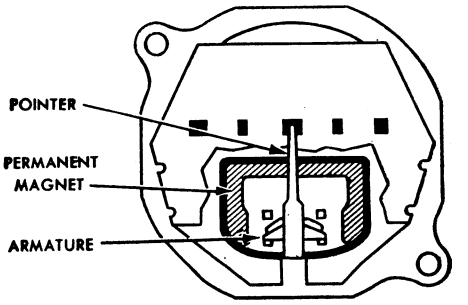

Fig. 19 Drawing of a typical ammeter or battery charge indicator

After checking and repairing the wiring, tighten all connections and turn the ignition switch on. The pointer should point to the discharge side of the dial slightly. Start the engine and speed it up to about 30 mph. The pointer should then move to the charge side of the dial and its movement should be smooth.

If the pointer does not behave correctly the ammeter itself is out of order and must be replaced with a new one.

SPEEDOMETERS

The following material covers only that service on speedometers which is feasible to perform by the average service man. Repairs on the units themselves are not included as they require special tools and extreme care when making repairs and adjustments and only an experienced speedometer mechanic should attempt such servicing.

The speedometer has two main parts —the indicating head and the speedometer drive cable. When the speedometer fails to indicate speed or mileage, the cable or cable housing is probably broken.

Speedometer Cable

Most cables are broken due to lack of lubrication, or a sharp bend or kink in the housing.

A cable might break because the speedometer head mechanism binds. If such is the case, the speedometer head should be repaired or replaced before a new cable or housing is installed.

A "jumpy" pointer condition, together with a sort of scraping noise, is due, in most instances, to a dry or kinked speedometer cable. The kinked cable rubs on the housing and winds up, slowing down the pointer. The cable then unwinds and the pointer "jumps."

To check for kinks, remove the cable, lay it on a flat surface and twist one end with the fingers. If it turns over smoothly the cable is not kinked. But if part of the cable flops over as it is twisted, the cable is kinked and should be replaced.

Lubrication

The speedometer cable should be lubricated with special cable lubricant every 10,000 miles. At the same time, put a few drops of the lubricant on the wick in the speedometer head.

Fill the ferrule on the upper end of the housing with the cable lubricant. Insert the cable in the housing, starting at the upper end. Turn the cable around carefully while feeding it into the housing. Repeat filling the ferrule except for the last six inches of cable. Too much lubricant at this point may cause the lubricant to work into the indicating head.

Installing Cable

During installation, if the cable sticks when inserted in the housing and will not go through, the housing is damaged inside or kinked. Be sure to check the housing from one end to the other. Straighten any sharp bends by relocating clamps or elbows. Replace housing if it is badly kinked or broken. Position the cable and housing so that they lead into the head as straight as possible.

Check the new cable for kinks before installing it. Use wide, sweeping, gradual curves where the cable comes out of the transmission and connects to the head so the cable will not be damaged during its installation.

Arrange the housing so it does not lean against the cylinder head because heat from the engine may dry out the lubricant.

If inspection indicates that the cable and housing are in good condition, yet pointer action is erratic, check the speedometer head for possible binding.

The speedometer drive pinion should also be checked. If the pinion is dry or its teeth are stripped, the speedometer may not register properly.

The transmission mainshaft nut must be tight or the speedometer drive gear may slip on the mainshaft and cause slow speed readings.

FUEL PUMPS

AC FUEL PUMPS

Using Fig. 1 as an example, all AC mechanical fuel pumps operate as follows:

1. The cam on the engine camshaft forces the rocker arm outward, which, through the linkage and pull rod, moves the diaphragm on its down stroke.
2. The downward movement of the diaphragm creates a vacuum in the fuel chamber of the pump which sucks fuel from the gasoline tank.
3. The diaphragm spring then pushes the diaphragm upward on a pressure stroke, which forces the contents of the fuel chamber into the carburetor bowl.
4. The flow of fuel from the pump is controlled by the carburetor float. The float opens and closes the float needle valve which builds up or re-