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INSTALLATION, OPERATION AND SERVICE OF BRISTOL'S® METAMETER® TELEMETERING EQUIPMENT

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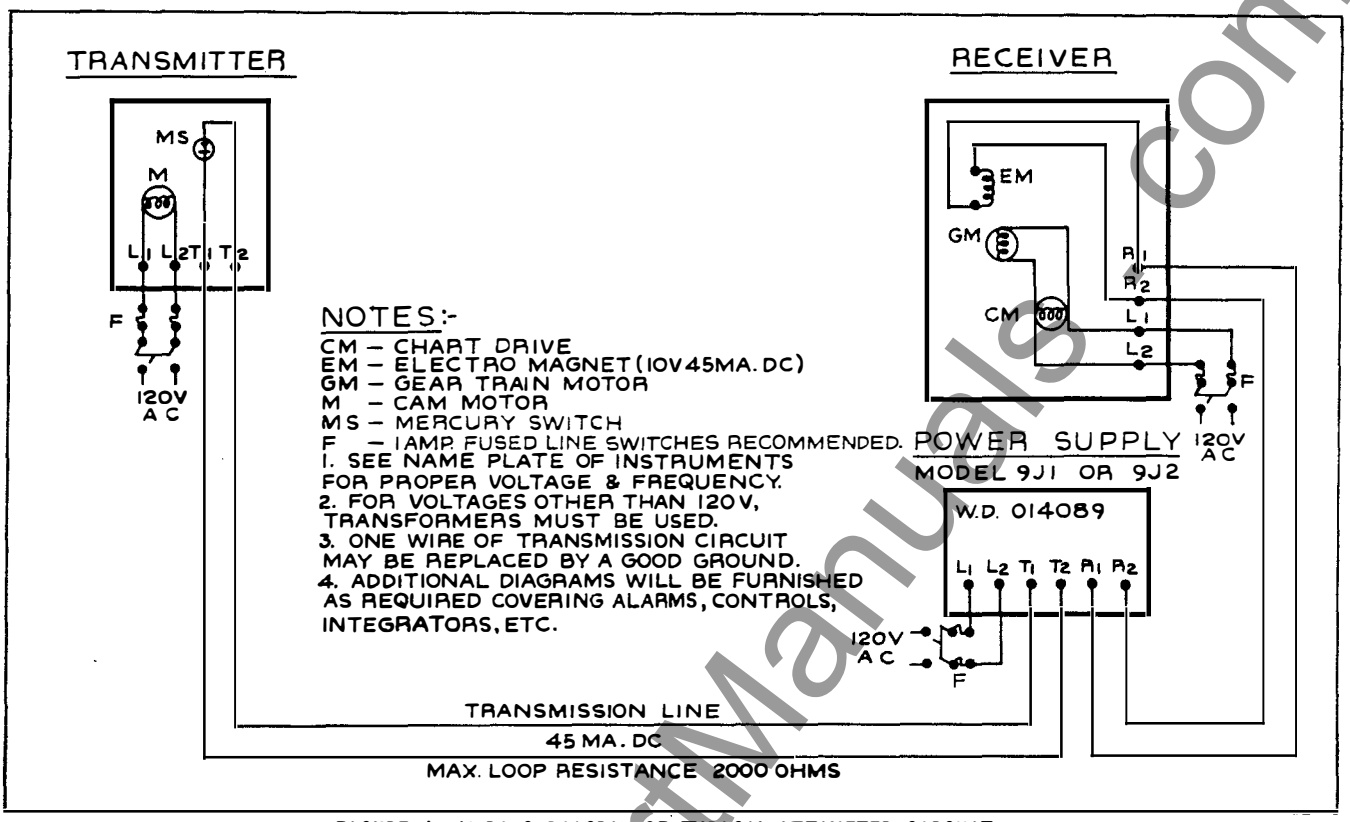

FIGURE 1 WIRING DIAGRAM OF TYPICAL METAMETER CIRCUIT

Note: This instruction covers only the installation, operation and service of Bristol's Metameter Telemetering Equipment. See separate instructions covering the measuring element, recording system, etc., as required.

PART I PRINCIPLES

The American Standards Association defines the word "telemetering" as "the indicating, recording or integrating of a quantity at a distance by electrical translating means". There are many types of telemetering systems available. The Bristol Company makes use of the impulse-duration type in its Metameter telemetering equipment. In this system, the value of the measured variable is transmitted as a function of time rather than as an electrical magnitude.

Figure 1 shows a typical Metameter circuit which includes one transmitter, one receiver and one direct-current power pack. The exact wiring diagram for your particular Metameter circuit is furnished with your instruction book. The number of this diagram is stamped on the name plate of the instruments and must be used for the actual wiring.

Metameter equipment may include more than one transmitter, more than one receiver, and such accessory equipment as power packs, relays, filter boxes, etc., as required.

A. The Metameter Transmitter

The Metameter transmitter contains the measuring element, transmitting unit and an indicating pointer.

The measuring element is linked to the cam follower and the indicating pointer; therefore any change in the value of the measured variable will change the position of the cam follower and indicating pointer.

Note: Ammeter, voltmeter and wattmeter transmitters do not have an indicating pointer and do not have a linkage between the cam follower and measuring element. The cam follower, in this case, is directly connected to the measuring element.

The transmitting unit consists of a continuously rotating cam, a synchronous motor, a cam follower and a magnetic-type mercury-switch assembly. There are three different transmitting units available: a 2-second, 5-second and 15-second unit. The 15-second transmitting unit is standard on most transmitters, but a 5-second

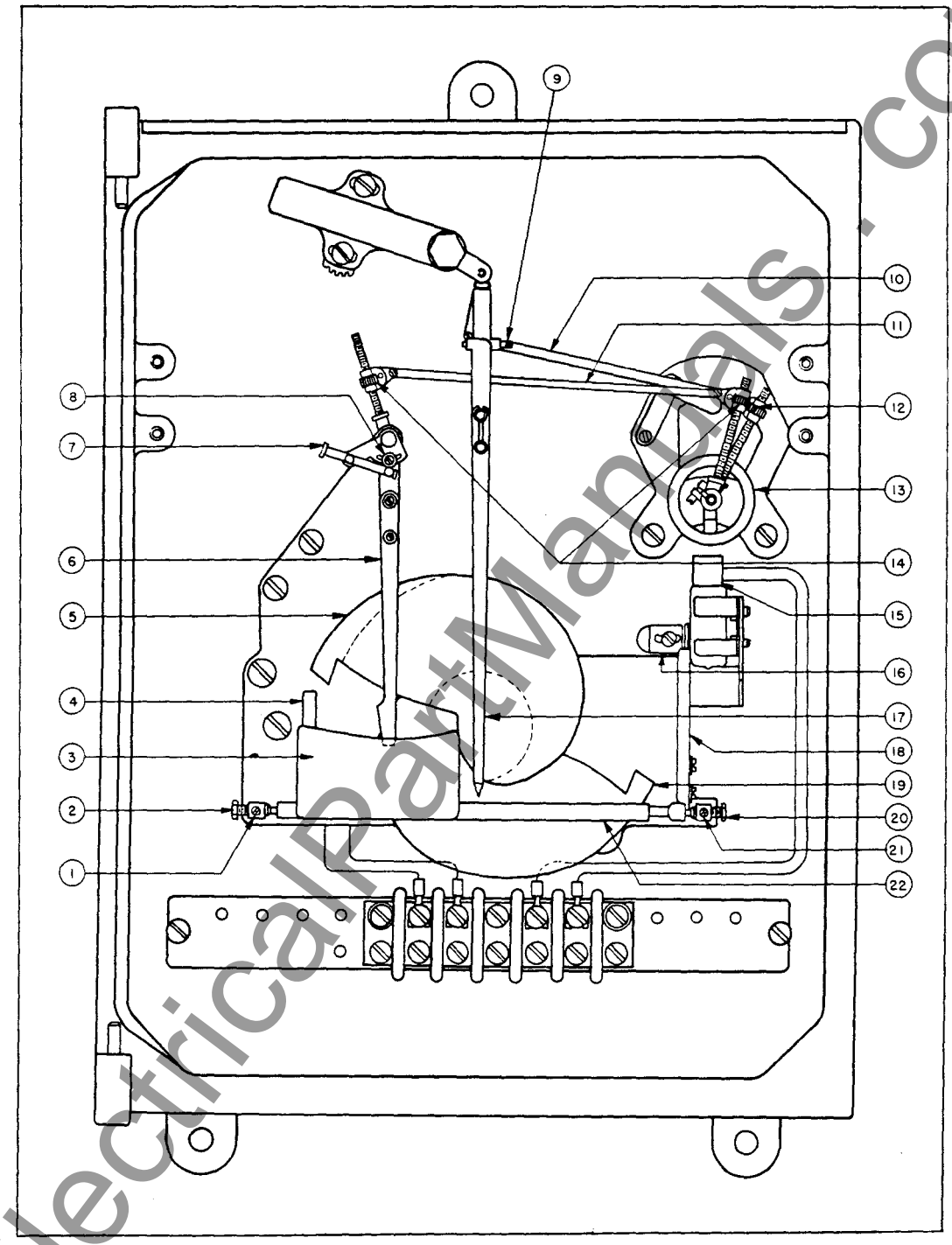

FIGURE 2 DETAILS OF TYPICAL METAMETER TRANSMITTER

CODE TO FIGURE 2

1. Locking Screw
2. Bearing Screw
3. Trip Plate
4. Fixed Arm
5. Cam
6. Cam Follower
7. Point Adjustment for Cam Follower
8. Locking Screw
9. Point Adjustment for Indicating Pointer
10. Link
11. Link
12. Span Adjustment for Indicating Pointer
13. Measuring Element
14. Span Adjustment for Cam Follower
15. Mercury Switch
16. Permanent Magnet
17. Indicating Pointer
18. Lever with Vane
19. Cam for Balance
20. Bearing Screw
21. Locking Screw
22. Shaft

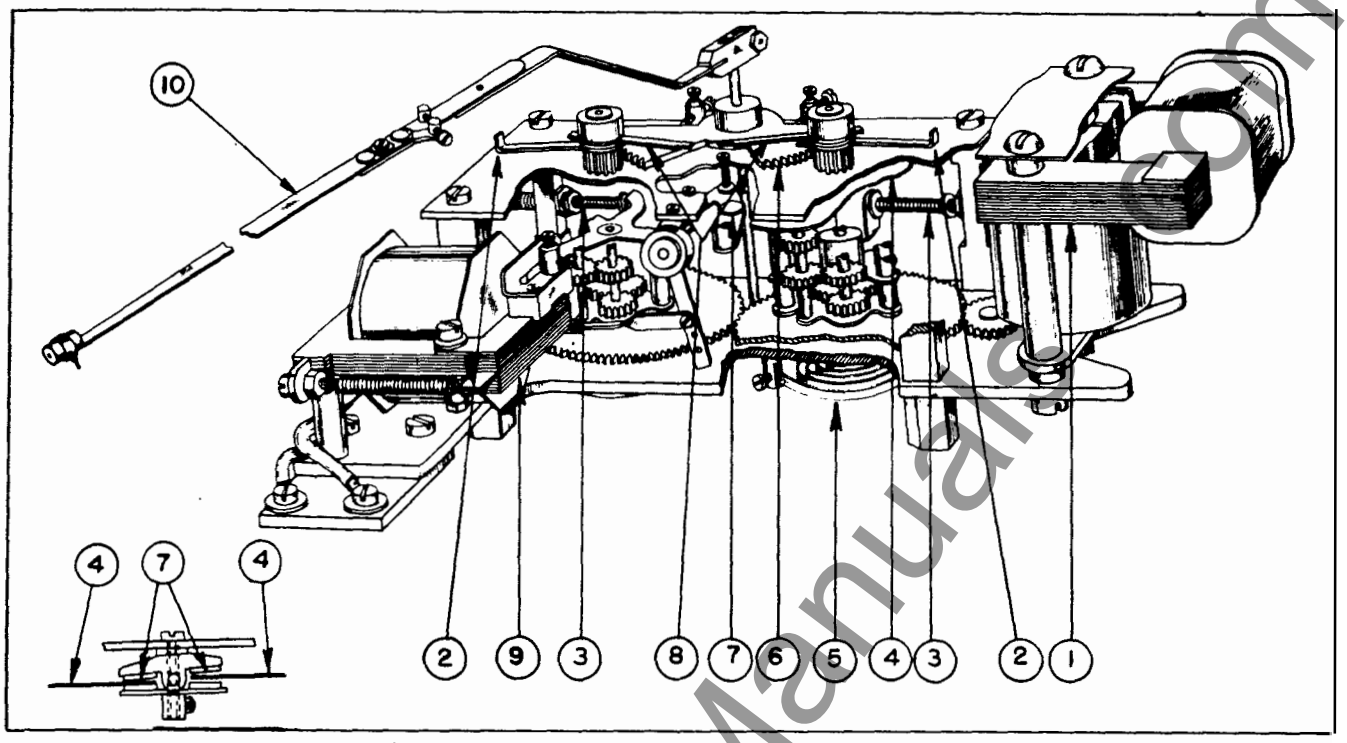

FIGURE 3 DETAILS OF MODEL M METAMETER RECEIVER MOVEMENT

CODE TO FIGURE 3

1. Synchronous Motor
2. Lever Arm
3. Differential Stop
4. Braking Disk
5. Hair Spring
6. Segment Gear
7. Brake Shoe
8. Lever Arm
9. Electromagnet

unit is standard in a Metameter transmitter used with Bristol's Multiplexing Equipment. The cam rotates continuously in a counterclockwise direction, making a complete revolution once every 2 seconds in a 2-second unit, once every 5 seconds in a 5-second unit and once every 15 seconds in a 15-second unit. The cam contour will vary with the type of chart record required. For example, a flowmeter transmitter will use a square-root cam when a linear chart is required in the receiver and a linear cam when a law-of-squares chart is required.

1. Description of Operation. Transmitters with linear cams have a fixed arm mounted on the trip plate in such a way that a shoe mounted on the back of the arm will slide up on the surface of the cam when the leading edge of the rotating cam reaches it. As the shoe on the fixed arm slides onto the cam, the trip plate is displaced. A second shoe mounted on the back of the cam follower glides up on the cam an instant after the shoe on the fixed arm does and keeps the trip plate displaced even after the shoe of the fixed arm has dropped off the trailing edge of the cam. When the cam follower drops off the cam, the trip plate returns to its original position.

When the trip plate is displaced, a vane mounted on an arm attached to the right end of the trip-plate shaft is also displaced. When the cam follower is off the cam, the vane is between the permanent magnet and mercury switch, and the circuit thru the mercury switch is made. When the cam follower is on the cam, the vane moves out from between the permanent magnet and mercury switch, and the circuit thru the mercury switch is broken. The circuit thru the mercury switch, then, is made and broken once for each revolution of the cam. The ratio of the time the circuit is made to the time the circuit is broken is determined by the angular position of the cam follower and the design of the cam. Because the cam follower is linked to the measuring element, any change in the value of the measured variable will change the angular position of the cam follower and, therefore, the duration of the electrical impulses to the receiver.

On older models with square-root cams.

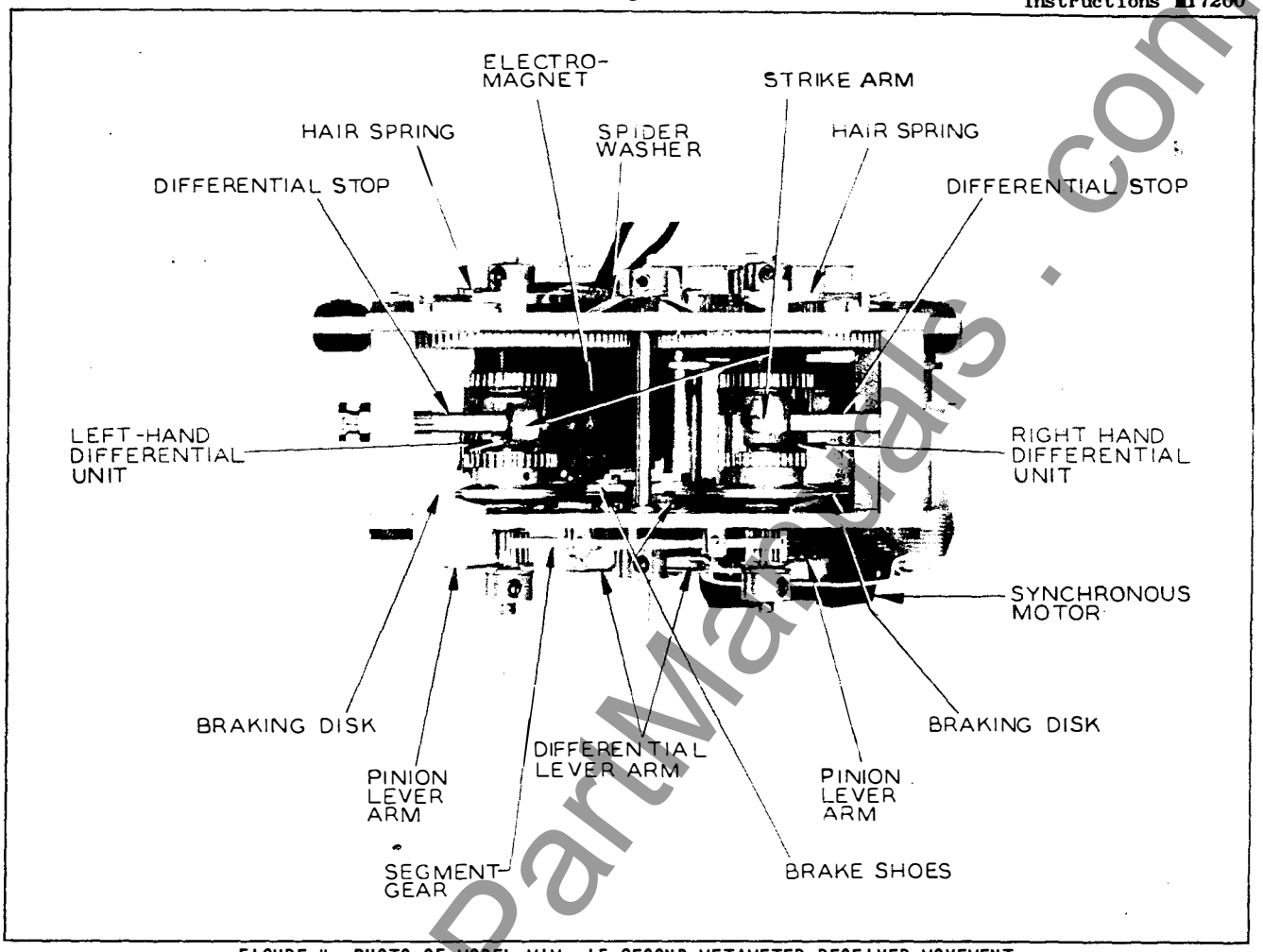

FIGURE 4 PHOTO OF MODEL MIM, 15-SECOND METAMETER RECEIVER MOVEMENT

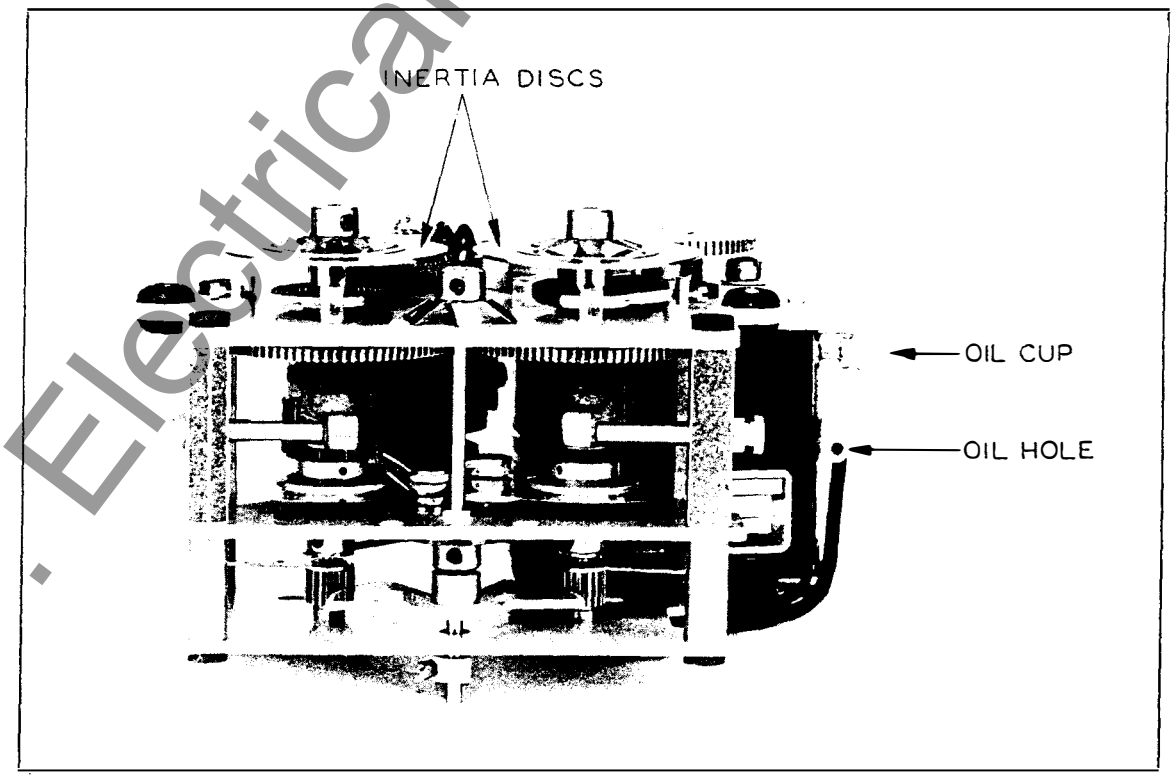

FIGURE 5 PHOTO OF MODEL MIM, 2-SECOND METAMETER RECEIVER MOVEMENT

there was no fixed arm and the cam follower displaced the trip plate directly.

B. The Metameter Receiver

The metameter receiver contains the receiving mechanism, the necessary recording or indicating components and may contain such accessory items as alarm contacts, controls, integrators, etc., as ordered. Separate instructions will be furnished as required covering these attachments. **Note:** Some case styles will not permit the use of controls or alarms because of their space limitations.

1. Description of Operation. The receiver mechanism consists essentially of two differential units which are driven continuously by a constant-speed motor. Hairsprings attached to the shafts of the differential units tend to hold the free ends of the differential units against fixed stops. The free ends of the differential units drive their respective braking discs according to whether the electromagnet is energized or deenergized.

The armature of the electromagnet has two brake shoes. One brake shoe engages one braking disc when the magnet is deenergized, and the other shoe engages the other braking disc when the magnet is energized. On the Model M (see Figure 2) the brake shoes are mounted on a separate bracket which is linked to the armature.

Attached to each differential shaft is a lever arm which may engage the lever arm fixed to a loosely mounted pinion. Both pinions mesh with a common segment gear. The shaft of the segment gear is connected, thru linkage, to the indica ing pointer or pen arm.

One of the differential units with : lever will rotate thru an angle propo tional to the time the magnet is energi or deenergized. If the lever arm engag its associated arm, the pen or point will move to a new position. At t termination of an impulse the release the locked disc and the engagement of t free disc take place simultaneously. Th the lever arm and its corresponding di ferential unit (which was advanced) wi be reset to the stop under influence the hairspring. The instant the diffe ential unit starts to return to its sto the other lever arm and differential un will begin to move.

If successive impulses, correspondi to a steady value of the measured quanti are of interchanging value, each of t lever arms will just reach its associat arm when it will be reset to its st without moving its associated arm. If t relative duration of "on" and "off" i pulses should vary, the relative advance of the two associated arms will be alter and the pen or pointer will move to a n position corresponding to the new valu of the measured variable.

The 2-second receiver mechanism (se Figure 5) differs slightly from the 5 second and 15-second mechanisms in tha it has inertia discs on the differentia shafts in order to prevent the bounc when the differential units return t their respective stops.

PART II INSTALLATION

A. The Metameter Transmitter

See separate instructions furnished covering the mounting of the case and installation of the measuring system.

After mounting the transmitter, remove any rubber bands or thread used to keep parts in place during shipment. **Do not** disturb any adjustments. **Do not manipulate the cam follower or cam by hand.**

When installing float-and-pulley-type liquid-level gauges or mechanical-motion transmitters, make sure that the cam follower is never moved outside its range because this will damage the instrument mechanism.

On wattmeter transmitters a specia transparent protection plate is mount in front of the transmitting unit. Th plate must be removed in order to remo the shipping device (rubber band thread) holding the lifter plate do during shipment. Use extreme cautio when removing the shipping device so a not to disturb or damage the cam followe the cam follower in a wattmeter has be extremely light and fragile because is mounted directly on the wattmeter mov ment. Be sure to replace the transparen protection plate after removing the shi ping device.

1. Wiring. See wiring diagram diagrams furnished with your Metamet equipment. The correct wiring-diagr

number is stamped on the name plate of each instrument. Check name plate of instrument for proper line voltage and frequency.

Connect a 120 volt a-c supply to terminals marked L_1 and L_2. The cam should now start revolving. Where the supply voltage is 220 volts or higher, a suitable step-down transformer must be used. This transformer should be mounted outside the instrument.

Connect the two transmission wires to terminals marked T_1 and T_2. Because the mercury switch is in series with the transmission wires, it makes no difference which wire is connected to T_1 or T_2.

2. Mercury Switch. There is a possibility that, after shipment, a small amount of mercury might stick to the sides of the glass tube with the result that not enough mercury will be left in the bottom of the tube to make electric contact. Therefore, after the transmitter has been installed, it is advisable to lightly tap one of the clips holding the mercury switch in order to shake loose any drops of mercury sticking to the sides of the glass tube.

B. The Metameter Receiver

See separate instructions furnished covering the mounting of the case.

After mounting the receiver, remove any rubber bands or thread used to keep parts in place during shipment.

1. Wiring. See wiring diagram or diagrams furnished with your Metameter equipment. The correct wiring-diagram number is stamped on the name plate of each instrument. Check name plate of instrument for proper line voltage and frequency.

Connect a 120-volt a-c supply to terminals marked L_1 and L_2. Where the supply voltage is 220 volts or higher, a suitable step-down transformer must be used. This transformer should be mounted outside the instrument.

When a receiver is equipped with an integrator, alarm contacts, electric control, etc., a separate diagram will be furnished to cover its wiring.

C. Power Supply

The D-C Power Supply is always furnished as part of the Metameter System unless user specifies that he has his d-c supply.

1. Part 66768. This power supp is for use on a 120 volt, 50 or 60 cy a-c supply. It must be mounted with vacuum tube in an upright position.

The variable resistor in the pow supply should be adjusted to limit current in the circuit to the receiv magnet to approximately 45 milliamper d-c. This requires that a d-c mill ammeter be wired in series with the pow supply.

See your particular wiring diagr for the exact wiring to the power supp

2. Model 9J1, Part 96200. Th power supply is for use on 120 volt, cycles supply and is the present standa replacing part 66768.

Mount power supply with termin block horizontal.

Adjustment is made as follows: press pushbutton and adjust rheost until ammeter shows proper current called for on wiring diagram. (Standa current requirement is 45 milliamperes

3. Model 9J2, Part 96201. Same 9J1 above except for use on 120 vol 25 cycle supply.

D. The Transmission Circuit

The transmission circuit is usual made up of two wires or one wire and good ground. These wires are eith supplied by the customer or leased f the telephone or telegraph company. circuits may include such items as int mediate repeaters, carrier, superviso microwave or multiplexing equipmer

The variable resistor (located power supply) has been adjusted at factory so as to limit the current to electromagnet to approximately 45 mil amperes d-c. (The standard magnet rated at 10 volts, 45 milliamperes Two other magnets have been used to m special requirements. One is rated at volts, 24 milliamperes d-c and the ot at 100 volts, 20 milliamperes d-c.) adjustment of the resistor is based on loop resistance specified on the c tomer's order or calculated from the ki size and length of the transmission wir

The loop resistance is the to resistance of the two transmission wir

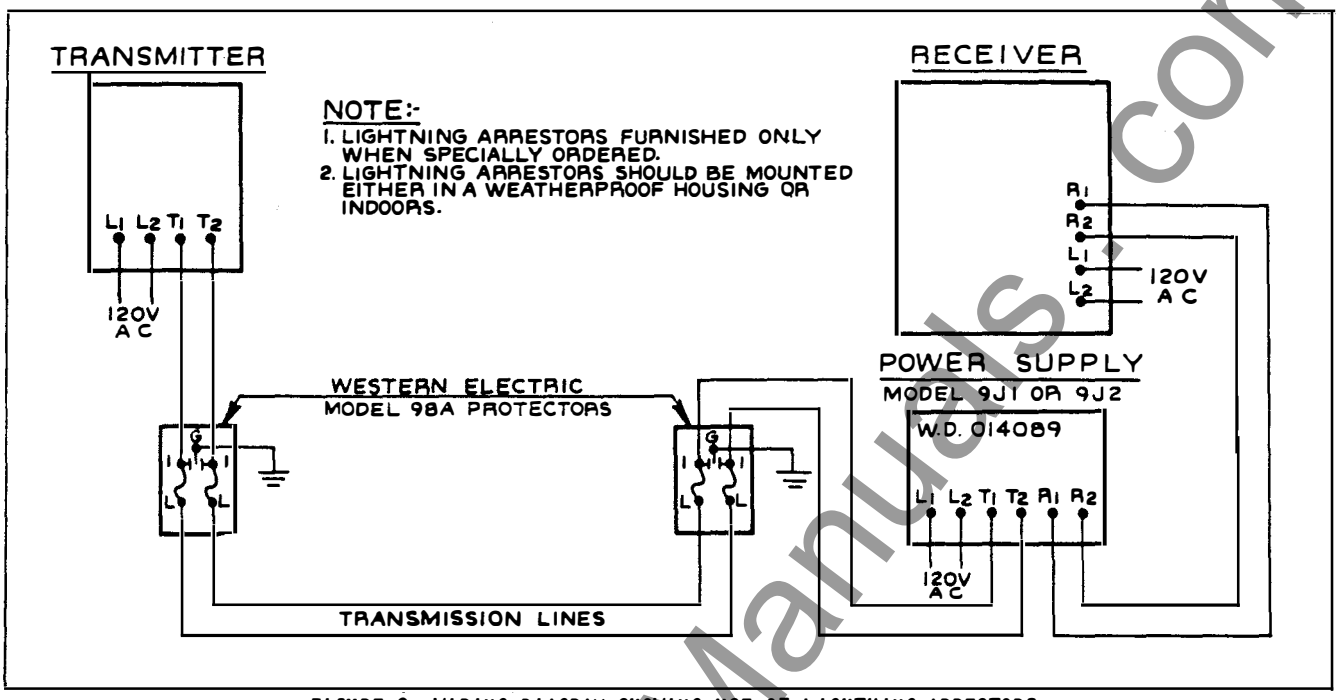

FIGURE 6 WIRING DIAGRAM SHOWING USE OF LIGHTNING ARRESTORS

If a circuit consists of a single wire and ground return, the loop resistance is figured as the resistance of a single conductor, the ground being considered as zero resistance.

If the resistance of the transmission wires should differ considerably from that allowed for by The Bristol Company, it may be necessary to readjust the variable resistor in the power supply.

E. Lightning Protection

The danger from lightning is quite serious in some locations, especially where the transmission line is open wiring. Therefore, it is advisable to provide lightning protection such as Western Electric Model 98A Protectors. See Figure 6.

Transmission lines leased from the telephone company usually carry protective equipment; therefore no further protection is necessary.

F. Special Equipment

Additional equipment, such as relay boxes, filters, repeating coils, etc., may be furnished with your Metameter equipment, depending on the system's requirements. See special diagram furnished, covering the wiring and approximate location of this special equipment.

PART III OPERATION

A. Starting the Metameter Equipment

With transmission and power connections properly made and with the measuring system properly installed and operating, turn on power-supply switches. Instruments will then start to indicate or record the value of the measured variable.

See separate instructions covering the operation of the measuring system, recording, controlling, etc., as required.

B. Stopping the Metameter Equipment

If it is necessary to stop the transmitter cam at any time, do not stop it with the shoe of the cam follower resting on the surface of the cam. Always permit the cam to continue rotating until the cam follower is free to move over the whole range without interference by the cam.

The receiver may be stopped at any time.

C. Zero Adjustment

1. On Metameter Transmitters. The indicating pointer and cam follower should read zero when the measuring element is at zero (or low end of scale). If they do not, adjust point adjustments (Items 9 and 7 in Figure 2).

2. On Metameter Receivers. The recording pen should read zero when the measuring element is at zero (or low end of scale). If it does not, adjust point adjustment on pen arm.

PART IV SERVICE

A. Routine Maintenance

1. Lubrication

a. Metameter transmitter cam. The front surface of the transmitter cam should be oiled once every 90 days of service with #20 or #30 SAE motor oil. Before oiling, clean cam with a soft cloth soaked in carbon tetrachloride, benzine or gasoline. Wipe surface dry; then apply oil to the cam with a finger while the cam is rotating. Only a light film of oil is required.

b. Metameter transmitter bearings. Oil the two trip-plate-shaft bearings every 90 days of service with light clock oil. Apply the oil sparingly with a toothpick. Before oiling, clean bearings with a camel's-hair brush soaked in benzine or carbon tetrachloride. Let dry before oiling. Under ordinary service no lubrication is required by bearings in the linkage between the measuring element and indicating-pointer mounting and cam-follower mounting.

c. Receiver Mechanism. All shaft bearings and the hub of the idler gear between motor pinion and differential-gear assembly should be lubricated every 90 days of service with light machine oil. Before oiling, clean with a camel's-hair brush soaked in carbon tetrachloride, benzine or gasoline. Let dry before oiling. Apply oil sparingly with a toothpick. It is generally unnecessary to oil the gear teeth unless corrosion gives trouble. If any gear becomes sticky with dust and oil, clean with a camel's-hair brush soaked in carbon tetrachloride, benzine or gasoline.

On a 2-second movement a Holtzer-Cabot motor is used. This motor should be oiled once a month with Gulf electric motor oil. There is an oil cup for the front bearing and an oil hole for the rear bearing. Wipe excess oil from overflow hole at rear bearing.

2. Mercury Switch. After shipment or long service, a portion of the mercury may stick to the sides of the glass tube with the result that not enough mercury will be left in the bottom of the tube to make electric contact. To dislodge the mercury, gently tap the clips holding the glass tube.

a. Replacing Mercury Switch. To replace a mercury switch, proceed as follows: 1. Disconnect switch lead wires from terminal block. 2. Gently break the sealing cement holding the two clips to the switch. 3. Remove mercury switch and slip a new one into the clips. Adjust switch so that the moving steel contact inside the switch is exactly opposite the poles of the permanent magnet. 4. Connect switch leads to terminal block. Test for correct action of the mercury switch by raising and lowering trip plate with the fingers. Movement of the steel contact inside the switch can be both seen and heard. 5. After switch has been correctly positioned and tested, cement it in place with Duco cement or white shellac.

3. Spark Suppression. Excessive sparking in the mercury switch in the transmitter will eventually cause failure of the transmission circuit. Therefore, it is necessary to check the mercury

switch after the initial installation and occasionally thereafter.

Sparking causes the mercury to become vaporized and deposited on the sides of the glass enclosure, thus diminishing the amount of mercury normally contained in the pool at the bottom of the glass enclosure. This process will continue to a point where the pool of mercury is so small that the moving contact, when properly actuated, does not make electrical contact.

Because actual line conditions vary widely, it is always best practice to determine the suppression constants directly on the line that the instrument is to be used with. Determination of the suppression constant is quite simple and is accomplished by observing at what instant the spark occurs at the switch. If the spark occurs when the switch is made, the line is predominantly capacitive. Correction in this case is made by inserting an inductance in series with the switch at the transmitter. The value of the inductance is not critical, and it is advisable that the standard sizes 10-, 30- and 80-millihenry chokes, obtainable in most radio stores, be tried. These chokes may be ordered from The Bristol Company under the following part numbers:

10-millihenry choke - Part No. 92338
30-millihenry choke - Part No. 92339
80-millihenry choke - Part No. 92340

Proper suppression will be indicated by a substantial reduction in sparking on the make and possibly a small spark evident on the break.

If the spark occurs at the instant the switch is broken, the transmission line can be considered to be predominantly inductive. Compensation in this case is provided by connecting a capacitor and resistor in series across the switch. Bristol's standard spark suppressor (0.25-mfd. condenser in series with a 1250-ohm resistor) should be sufficient to handle practically all cases of this sort. The Bristol Company will supply each transmitter with this spark suppressor only when the transmission line is known to be predominantly inductive.

4. Cleaning Brake Shoes of Receiver Mechanism. With receiver and transmission power off, insert a narrow strip of stiff paper wet with carbon tetrachloride, benzine or gasoline between brake discs and brake shoes. Clamp brake down by moving electromagnet armature with fingers. Pull paper out, while armature is clamped down, to wipe dirt off brake shoes. Clean all four brake shoes in this manner.

B. Trouble-shooting Tips

Because of the wide variety of Metameter circuits available, it is impossible to list a group of trouble-shooting tips that would apply to all systems. The following list of trouble-shooting tips is based on the typical circuit shown in Figure 1 and should serve as a guide in locating troubles in the majority of Metameter circuits.

While the source of trouble can be anywhere in the Metameter circuit, signs of trouble will usually appear as faulty readings on the receiver. In this discussion it is assumed that you have first checked to see that the measuring element (pressure element, flowmeter, wattmeter, etc.,) is working correctly and indicating the correct values on the transmitter scale, and that the correct power supply is available at all instruments.

1. Symptom: Receiver pen or pointer does not read zero when transmitter reads zero. **Fault:** Pen or pointer requires zero adjustment.

2. Symptom: Receiver pen or pointer goes off top of chart or scale and stays there. **Possible faults:**

a. Failure of the mercury switch in transmitter to open because of power failure at the transmitter while the cam follower is **off** the cam or failure of the vane to move out far enough from between the permanent magnet and mercury switch.

b. Short circuit in transmission line between transmitter and power pack.

c. Failure of the electromagnet in the receiver to become deenergized because of excessive current leakage in transmission wires between transmitter and power pack.

d. Failure of armature to drop away from electromagnet in the receiver because of mechanical reasons.

e. Binding of the receiver differential unit which is nearest the motor (right-hand unit).

Fault a can be checked by a visual inspection of the transmitter. As mentioned previously, the circuit thru the

mercury switch should be made and broken once for each revolution of the cam. If the vane does not move out far enough from between the magnet and mercury switch to open the circuit when the cam follower is on the cam, the vane may be readjusted by loosening the setscrew in its hub and shifting the position of the vane lever arm as required.

Fault b can be checked by disconnecting the instruments (including power packs) from the transmission line and connecting an ohmmeter across either end of the transmission line. If the ohmmeter reads some value between zero and the actual loop resistance of the line, it indicates a short circuit somewhere in the transmission line.

Fault c can be checked by inserting a milliammeter in series with the transmission line and disconnecting the transmission line at the transmitter. A current of more than 15 milliamperes will indicate excessive leakage. However in the Type D system (a-c, d-c system) and in long transmission lines using sensitive relays, a current of more than 4 milliamperes will indicate excessive leakage.

Fault d can be due to improper adjustment of helical spring located on electromagnet in receiver. This spring should be exerting sufficient force on the moving armature of the electromagnet to pull it free of the electromagnet pole during periods of no current flow in the transmission circuit.

Fault e refers to the differential unit (right-hand unit) which is nearest the motor. If, while the electromagnet is deenergized, the right-hand differential unit is moved by hand in a counterclockwise direction and then released, the differential unit should immediately be returned by its hairspring to a position in which its strike arm is against its stop. If the differential unit does not return to its stop but sticks short of its stop, friction should be looked for. This can usually be traced to foreign matter deposited on the surface of the gears. If this is the case, clean the gears with a camel's-hair brush soaked in benzine or gasoline.

3. Symptom: Receiver pen or pointer goes off bottom of chart or scale and stays there. **Possible faults:**

a. Failure of the mercury switch in the transmitter to close because of power failure at the transmitter while the cam follower is on the cam, because of the failure of the vane to move far enough in between the permanent magnet and mercury switch, or because some of the mercury has vaporized on the wall of the mercury switch.

b. Open circuit anywhere in the transmission line.

c. Short circuit in the transmission line between power pack and receiver.

d. Failure of power pack to supply proper voltage because of vacuum-tube failure, blown fuses, burned-out resistor or power failure, etc.

e. Failure of armature to pull into electromagnet pole in the receiver because of mechanical reasons.

f. Binding of the receiver differential unit which is nearest magnet (left-hand unit).

Fault a can be checked by a visual inspection of the transmitter. If the vane does not move in far enough between the permanent magnet and mercury switch to close the circuit when the cam follower is off the cam, the vane may be readjusted by loosening the setscrew in its hub and shifting the vane lever arm as required. If the mercury appears to have vaporized on the wall of the mercury switch, tap the clips holding the mercury switch in order to dislodge the drops of mercury.

Fault b can be checked by the use of a Murray or a Varley loop circuit to detect an open in transmission line. If transmission line is leased from a telephone or telegraph company, it is their responsibility to repair this trouble.

Fault c can usually be checked by a visual inspection of the wires connecting the power pack and receiver because most power packs are mounted next to their receivers. If there is a considerable distance between power pack and receiver, then an ohmmeter can be connected across either end of the transmission line after the Metameter equipment has been disconnected from both ends of the transmission line. If the ohmmeter reads some value between zero and the actual loop resistance of the line, it indicates a short circuit somewhere in the transmission line.

Fault d can be checked by inserting a milliammeter in series with the transmission line. If the standard magnet (10 volts, 45 milliamperes d.c.) is used

in the receiver, a current of from 45 to 55 milliamperes should be flowing. If a sensitive relay is in the circuit, the current should be between 12 and 15 milliamperes. Be sure to check with your wiring diagram for all current requirements. If the current is not the same as that called for by the wiring diagram, readjust resistor in power pack until it is the same.

Fault e can be due to improper adjustment of helical spring located on electromagnet in receiver. If the armature fails to pull in when the electromagnet is energized, it could mean that the spring tension is excessive. The spring should be exerting only enough force on the armature to pull it free of the electromagnet pole when the electromagnet is deenergized.

Fault f refers to the differential unit (left-hand unit) which is nearest the magnet. If, while the electromagnet is energized, the left-hand differential unit is moved by hand in a clockwise direction and then released, the differential unit should immediately be returned by its hairspring to a position in which its strike arm is against its stop. If If the differential unit does not return to its stop but sticks short of its stop, friction should be looked for. This can usually be traced to foreign matter deposited on the surface of the gears. If this is the case, clean the gears with a camel's-hair brush soaked in benzine or gasoline.

4. Symptom: Receiver pen or pointer runs up and down scale erratically with no change in transmitter reading. **Possible faults:**

a. Loose connection in transmission circuit.

b. Friction in the receiver differential units due to dirt or foreign matter.

c. Sticking brake discs in receiver.

d. Insufficient tension of spider washer located at the back end of shaft in receiver to which segment gear is attached.

e. Friction in receiver magnet assembly.

f. Insufficient power to operate electromagnet in receiver effectively.

g. Friction between segment gear and pinions located on the shafts of the receiver differential units.

Most of these faults can be checked by a visual inspection of the receiver mechanism.

5. Symptom: Receiver pen or pointer fails to move up or down scale even though primary measurement is changing. **Possible faults:**

a. Failure of power supply to the receiver.

b. Sufficient foreign matter on the gears which drive the differential units of receiver to stop the motor.

c. Damaged motor gear train in receiver.

d. Slippage of brake mechanism due to improper adjustment of linkage of the magnet assembly. The linkage is that which connects the armature of electromagnet with shaft of brake. This applies only to the Model M receiver movement.

Most of these faults can be checked by a visual inspection of the receiver mechanism.

6. Symptom: Receiver pen or pointer moves up and down scale slightly each revolution of the cam, resulting in a wide record. **Possible faults:**

a. Differential stops of receiver movement require adjustment.

b. Frequency of the a-c power supply to transmitter drops below frequency of power supply to receiver.

If the differential stops of the receiver movement need adjustment, proceed as follows:

With receiver mechanism in full operation, loosen the lock screws holding stops in position. These lock screws are located in the split posts that hold the stops and stop adjusting screws. When these lock screws are loosened, turn stop adjusting screw slightly in a clockwise direction until pen stops oscillating. Retighten lock screws after adjustment has been made. Do not overdo this adjustment as the accuracy and sensitivity of the receiver may be disturbed.

C. Repairs, Correspondence and Shipping

Send all correspondence and orders to the nearest Branch Office. Send all parts for repair or exchange to the Branch or Main Factories only, not to the Branch Offices. Addresses will be found on the last page of all instructions books.

Be sure to identify your shipment fully, including your exact return address model and serial number of instrument, your order number, etc.