INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE IM RECEIVER FOR HIGH RATE IMPULSE TELEMETERING

CAUTION Before putting receivers into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the receivers to check the calibration and electrical connections.

APPLICATION

The type IM receivers are operated by type IW transmitter in Load Dispatching systems where important load indications are to be transmitted between stations. The electrical quantities measured and transmitted are megawatts or megavars. The measurements are made by the transmitters at the tie lines, substations or generating stations and are transmitted to the dispatcher's office for the purpose of dispatching and load control. The measurements are transmitted in the form of impulses over carrier channels, pilot wires, or telephone lines and received on the type IM receivers. The purpose of the type IM receivers is to convert the impulses into d-c microampere and millivolt quantities so the transmitted measurements may be read on indicating meters and potentiometer recorders. Schematic connections between the transmitter and receiving units is shown in Fig. 1 and these connections illustrate, in a general way, the manner in which the units may be coordinated.

CONSTRUCTION AND OPERATION

The receiver consists of a reversing relay, a capacitor unit, a regulator tube, a filter, and drop coil all mounted in a single case. These circuits are used to convert the impulse rate from the transmitter into direct current microamperes. This current is used to operate direct current indicating instruments or is passed thru a resistance coil to give a suitable millivolt drop for operating a potentiometer type of recorder. The scales of these instruments are marked in terms of the quantity measured by the transmitter.

The operation of the receiver is illustrated in Figure 2. The reversing relay operates on each receiver impulse to alternately charge and discharge a 0.3 mfd. capacitor from a constant direct current supply. Every operation of the relay provides an impulse of current which flows always in the same direction through the circuit of the drop coil and indicating meter. The total quantity of current in a second is proportional to the impulse rate and is independent of the circuit resistance, provided this resistance is low enough so that the condenser can completely charge during the time the reversing relay contacts are closed. The direct current type of instruments used operates on the average value of current flowing.

The accuracy of this arrangement depends upon the fact that a condenser when charged from a direct voltage of constant value will hold a definite quantity of electricity. To maintain a constant d-c voltage from a station battery whose voltage may vary appreciably, a type 874 regulator tube is incorporated in the receiver circuit. The voltage across the tube remains constant at approximately 90 volts even though the battery voltage varies.

The current which flows through the .3 mfd. condenser is a pulsating quantity but its peak value is reduced by placing resistance directly in series with the reversing contacts. An additional smoothing action is

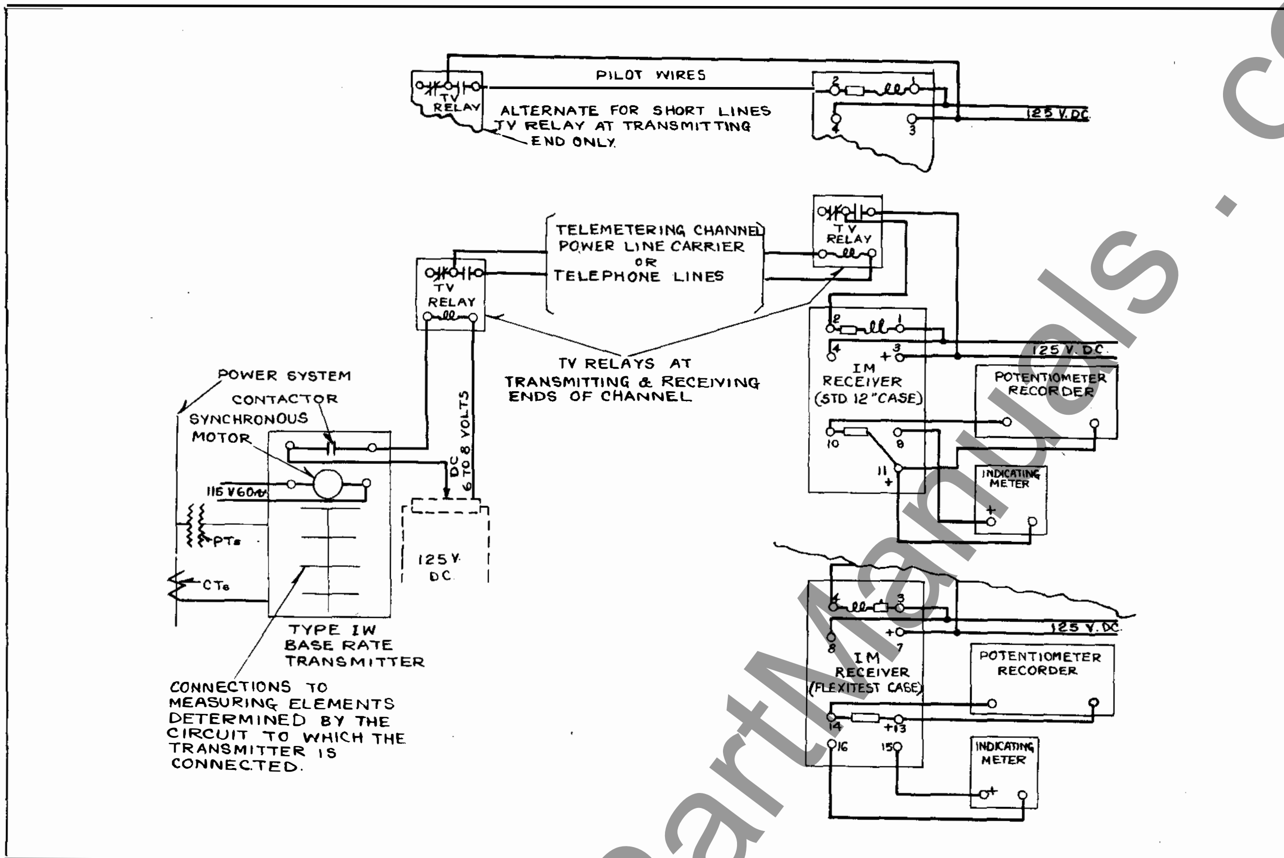


Fig. 1—Schematic Connections for a Typical High Rate Telemetering System.

obtained by passing the pulsations through a condenser reservoir. This reservoir reduces the peak of the pulsations to such a value that for any given impulse rate, within the operating range of the receiver, the d-c output is a steady current that follows an essential straight line characteristic over the operating range.

One complete cycle of the reversing relay is considered an impulse. During the cycle the charge in the condenser is changed from +90 volts to -90 volts and back again to +90 volts. This is equivalent or four charges at 90 volts. At an impulse rate of 200 impulses per minute, 360 microamperes pass through the 0.3 mfd. condenser and into the filter. It then passes through the circuits of the microammeter and drop coil.

CHARACTERISTICS

Scales and Impulse Rates

The following three classes of receiver

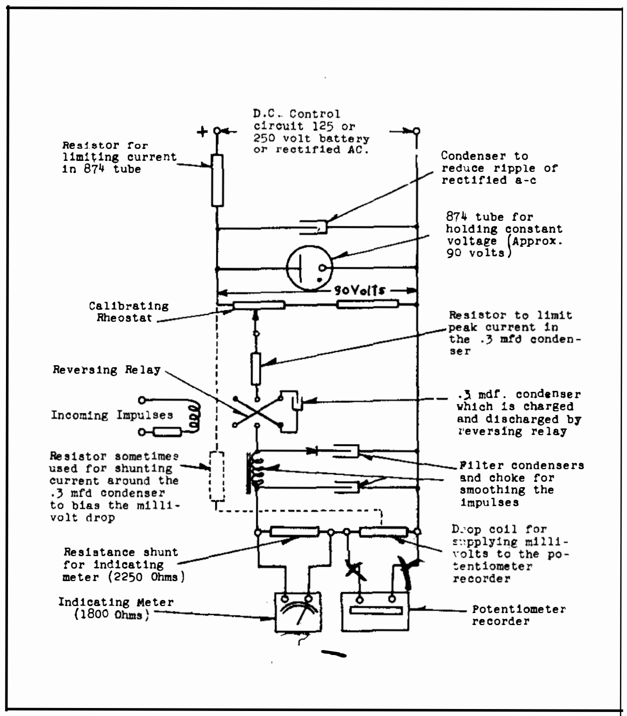
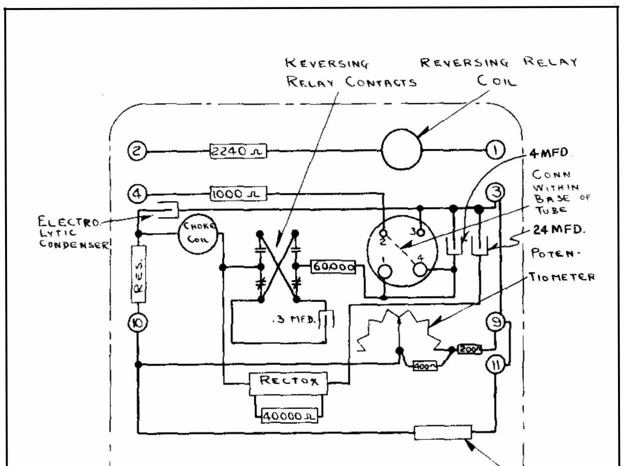


Fig. 2—Schematic Connections of the Type IM Receiver.



Drop Coil Data

Drop Coil Resis.	Millivolt Drop	Micro-Amps.	Impulse Range
357.3	28.6-78.6	80 - 220	80 - 220
312.5	12.5-62.5	40 - 200	40 - 200

Fig. 3—Internal Schematic of the Type IM Receiver in the Standard Case With Zero Millivolt Bias at Zero Impulses and With Calibration Rheostat Directly Across Output Terminals.

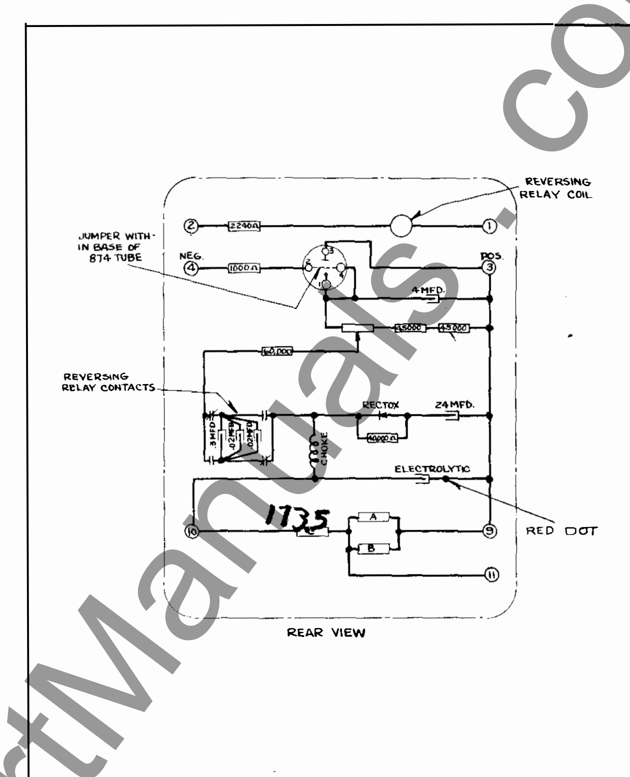


Fig. 4—Internal Schematic of the Type IM Receiver in the Standard Case with Zero Millivolt Bias at Zero Impulses.

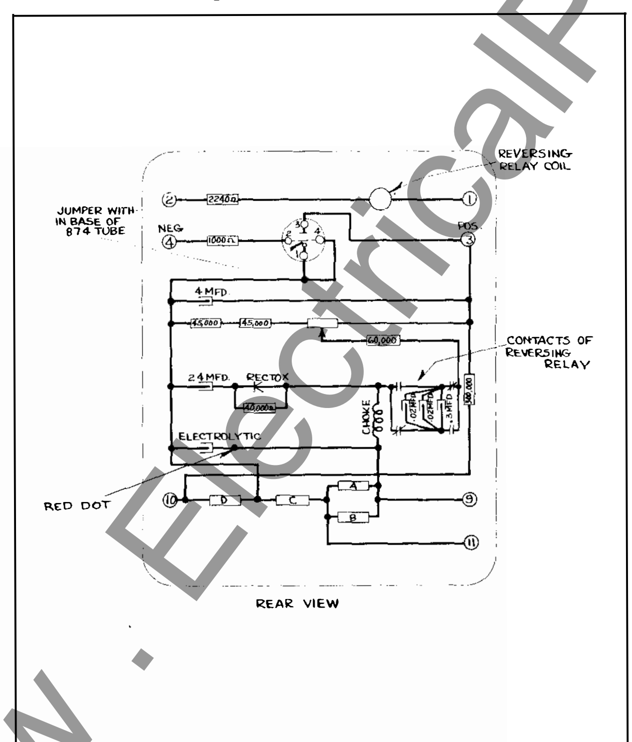


Fig. 5—Internal Schematic of the Type IM Receiver in the Standard Case with Negative Millivolt Bias at Zero Impulses.

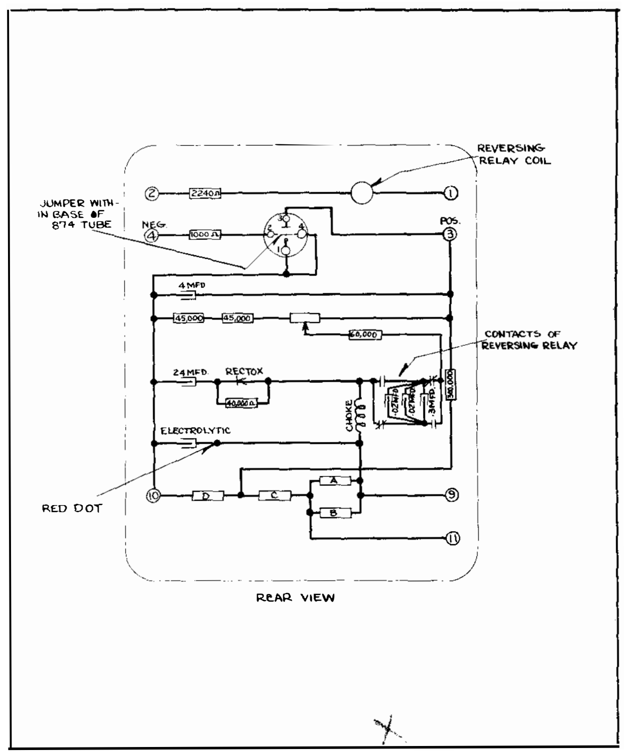


Fig. 6—Internal Schematic of the Type IM Receiver in the Standard Case with Positive Millivolt Bias at Zero Impulses.

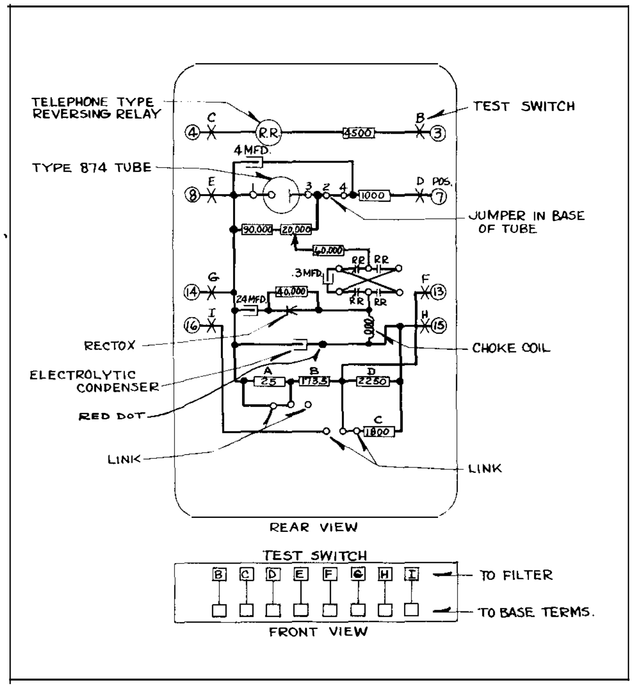


Fig. 7—Internal Schematic of the Type IM Receiver in the Type FT Case with Zero Millivolt Bias at Zero Impulses.

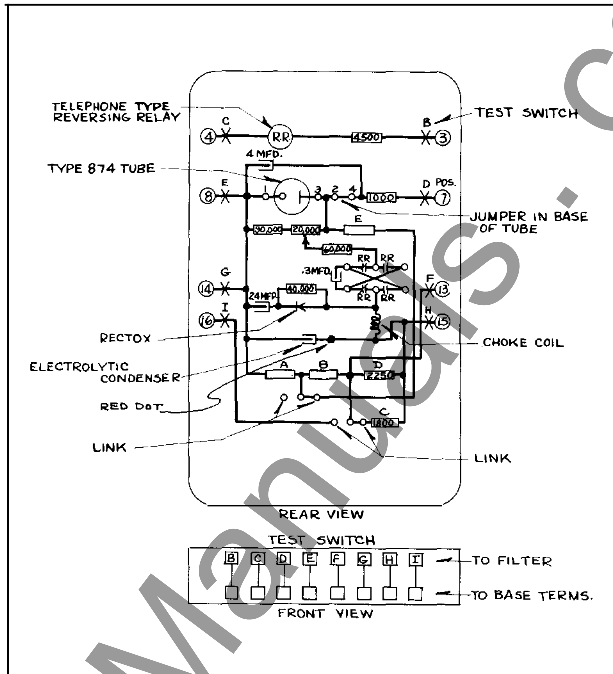


Fig. 8—Internal Schematic of the Type IM Receiver in the Type FT Case with Positive Millivolt Bias at Zero Impulses.

scales are available to cover practically all circuit conditions. They are:

1. Zero at the center of the scale using a base rate of 120 impulses per minute.

2. Zero at 1/4 scale using a base rate of 80 impulses per minute.

3. Zero at left end of the scale using a base rate of 80 impulses per minute.

The following tabulation gives the transmitter disc speeds, impulse rates, and the outputs of the receiving filters.

ZERO AT CENTER OF SCALE

Scale Deflection	Left End	Center	Right End
Disc RPM	-25	0	+25
Imp. per min.	40	120	200
Microamp. output	40	120	200
Millivolt Drop 1	12.5	37.5	62.5

ZERO AT 1/4 SCALE

Scale Deflection	Left End	1/4 Scale	Right End
Disc. RPM	-8-1/3	0	+25
Imp. per min.	40	80	200
Microamp. putput	40	80	200
Millivolt Drop	12.5	25	62.5

ZERO AT LEFT END OF SCALE

Scale Deflection	Left End	Right End
Disc RPM	0	+25
Imp. per min.	80	220
Microamp. output	80	220
Millivolt Drop	28.6	78.6

The potentiometer recorder must have a scale span of 50 millivolts with left end and right end values corresponding to the data given above. The dial is usually marked in megawatts. The "drop coil" is a resistor for providing the millivolt drop for the potentiometer recorder. A millivolt meter cannot be used across this coil as it will shunt a part of the current, (thus a potentiometer must be used to measure the drop.) The value of the resistance between these terminals as viewed from the galvanometer is 173.5 ohms for the 40-120-200 impulse range, and 198.5 ohms for the 80-220 impulse range.

The indicating meter must be a d-c microammeter with suppressed spring. The microampere values to which the meter is calibrated must be numerically equal to the impulse rate. The resistance of the meter must be 1800 ohms but if it is not it should be padded until it is 1800. If several microammeters are to be placed in series, their combined resistance must be 1800 ohms.

Totalizing Several Load Indications With Type IM Receivers

Several load indications can be totalized at the Dispatcher's Office by connecting the millivolt outputs of the several type IM receivers in series to obtain a totalized millivolt quantity for operating the potentiometer recorder. To do this the following points must be observed.

(1) A separate 125 volt d-c control circuit must be used for each type IM.

(2) The millivolt output per megawatt must be the same for each type IM even though the power circuits being metered are not of the same capacity, and this will necessitate special calibration of either the transmitters or receivers. If the circuit conditions are carefully studied, it will usually be found that some of the equipment can be given standard calibration.

(3) The recorder will probably need a span greater than 50 millivolts to take care of the totalized measurement. Also the zero point on the scale will have a millivolt value equal to the sum of the base millivolts of the several Type IM receivers.

If one of the type IM is removed from the circuit, its base millivolts is likewise removed, thus changing the zero point of the recorder, hence it is necessary that the recorder be provided with a special means for inserting an equivalent millivolt drop back in its circuit.

The following example is given to show in a general way some of the things that may be involved in totalization. Assume a certain installation has three circuits to be totalized by connecting the millivolt outputs of the type IM receivers in series and recording the total measurement on a potentiometer recorder. The rating of the three circuits is:

40----0----40----Megawatts
60----0----60----Megawatts
80----0----80----Megawatts

Assume that a study of circuit loads indicated that a recorder having a scale of 160----0----160 Megawatts with a 100 millivolt span would be satisfactory. This would mean that the millivolt values would be 62.5-112.5-162.5. The 112-1/2 millivolt point is the sum of the three base values. The millivolts per megawatt is 5/16. Obviously each type IM receiver of the above combination must deliver 5/16 millivolt per megawatt regardless of the capacity of the circuit it is metering. To accomplish this, either the receivers or transmitters must be given special calibration.

Transmitters with special impulse rates may be used to operate standard receivers, usually at reduced impulse ranges or receivers with special millivolt calibration may be operated from transmitters having standard impulse rates. This following tabulation has been made using 5/16 millivolt per megawatt to show the millivolts that any of the three IM receivers must deliver at any load.

Megawatts	-80	-60	-40	0	+40	+60	+80
Millivolts	12.5	18.75	25	37.5	50	56.25	62.5

The above tabulation may be used as a reference to determine the calibration data below:

Circuit #1

Standard transmitter, special receiver.

40-----0-----40 MW
40----120----200 IPM
25----37.5---50 MV

or Special transmitter, and standard receiver.

40-----0-----40 MW
80----120----160 IPM
25----37.5---50 MV

Circuit #2

Standard transmitter and special receiver.

60-----0-----60 MW
40----120----200 IPM
18.75----37.5---56.25 MV

or Special transmitter and standard receiver.

60-----0-----60 MW
60----120----180 IPM
18.75----37.5---56.25 MV

Circuit #3

Standard transmitter and standard receiver are required for this circuit.

80-----0-----80 MV
40----120----200 IPM
12-1/2---27-1/2--62-1/2 MV

Type 874 Regulator Tube

This tube will hold a constant voltage of approximately 90 volts of the receiver for battery voltage variations between 120 and 140 volts. The tube characteristics are:

Starting supply voltage 125 d-c volts
Operating voltage 90 d-c volts
Current (operating) 10 to 50 milliamperes
Current continuous 50 milliamperes
Pin 1 Cathode (Cyclinder of electrode)
Pin 3 Anode (Center of electrode)
Pins 2 and 4 are connected together by a jumper within the base.

The nominal control voltage for energizing the circuit of the 874 tube is 125 volts d.c. The current through the tube is limited to about 35 milliamperes by series resistor of 1000 ohms, mounted inside the case. An external resistor of 4000 ohms must be used to absorb the additional 125 volts for 250 volt control circuits.

Reversing Relay

The relay operating current should be between 15 to 35 milliamperes. The relay coil resistance is 1500 ohms. The series resistor in the standard case relays is 2240 ohms, and in the Flexitest Case is 4500 ohms with a mid tap. The control voltage is usually 125 d-c but for lower voltages and high resistance lines, the series resistor may be shorted out.

RELAYS IN TYPE FT CASE

The type FT Cases are dust-proof enclosures combining receiver elements and knife-blade test switches in the same case. This combination provides a compact flexible assembly easy to maintain, inspect, test and adjust. There are three main units of the type FT case: the case, cover and chassis. The case is an all welded steel housing containing the hinge half of the knife-blade test switches and the terminals for external connections. The cover is a drawn steel frame with a clear window which fits over the front of the case with the switches closed. The chassis is a frame that supports the receiver elements and the contact jaw half of the test switches. This slides in and out of the case. The electrical connections between the base and chassis are completed through the closed knife-blades.

Removing Chassis

To remove the chassis, first remove the cover by unscrewing the captive nuts at the corners. There are two cover nuts on the S size case and four on the L and M size cases. This exposes the receiver elements and all the test switches for inspection and testing. The next step is to open the test switches. In opening the test switches they should be moved all the way back against the stops.

With all the switches fully opened, grasp the two cam action latch arms and pull outward. This releases the chassis from the case. Using the latch arms as handles, pull the chassis out of the case. The chassis can be set on a test bench in a normal upright position as well as on its top, back or sides for easy inspection, maintenance and test.

After removing the chassis a duplicate chassis may be inserted in the case or the blade portion of the switches can be closed and the cover put in place without the chassis.

When the chassis is to be put back in the case, the above procedure is to be followed in the reversed order.

Electrical Circuits

Each terminal in the base connects thru a test switch to the receiver elements in the chassis as shown on the internal schematic diagrams. The receiver terminal is identified by numbers marked on both the inside and outside of the base. The test switch positions are identified by letters marked on the top and bottom surface of the moulded blocks These letters can be seen when the chassis is removed from the case.

The potential and control circuits thru the receiver are disconnected from the external circuit by opening the associated test switches.

Testing

The receiver can be tested in service, in the case but with the external circuits isolated or out of the case as follows:

Testing In Service

Voltages between the potential circuits can be measured conveniently by clamping #2 clip leads on the projecting clip lead lug on the contact jaw.

Testing In Case

With all blades in the full open position, the ten circuit test plug can be inserted in the contact jaws. This connects the receiver elements to a set of binding posts and completely isolates the receiver circuits from the external connections by means of an insulating barrier on the plug. The external test circuits are connected to these binding posts. The plug is inserted in the bottom test jaws with the binding posts up.

The external test circuits may be made to the receiver elements by #2 test clip leads instead of the test plug.

Testing Out of Case

With the chassis removed from the base, receiver elements may be tested by using the ten circuit test plug or by #2 test clip leads as described above. The factory calibration is made with the chassis in the case and removing the chassis from the case will change the calibration values by a small percentage. It is recommended that the receiver be checked in position.

INSTALLATION

The receivers should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the receiver vertically by means of the two mounting studs. Either of these studs may be utilized for grounding the receiver. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the receiver for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nuts with a wrench.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this receiver have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the receiver taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods,

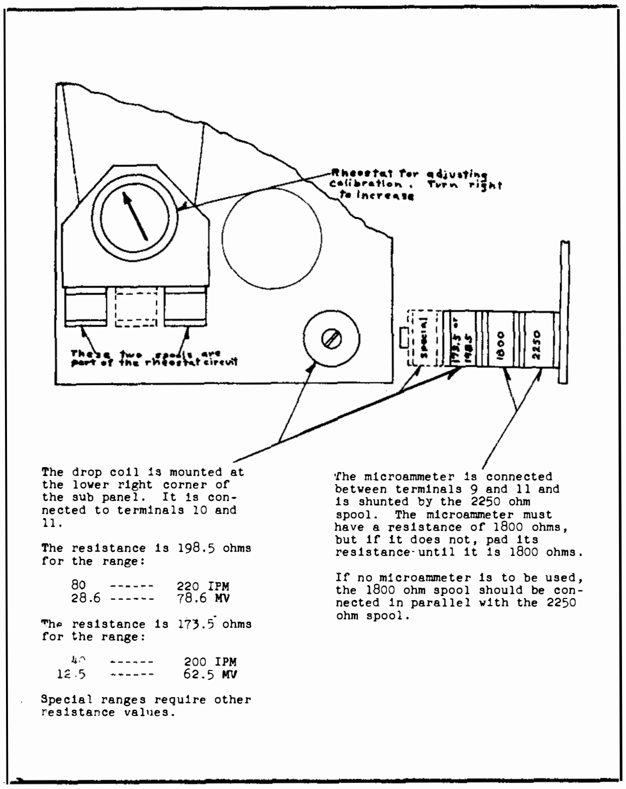


Fig. 9—Calibration Adjustments of the Type IM Receiver in the Standard Case.

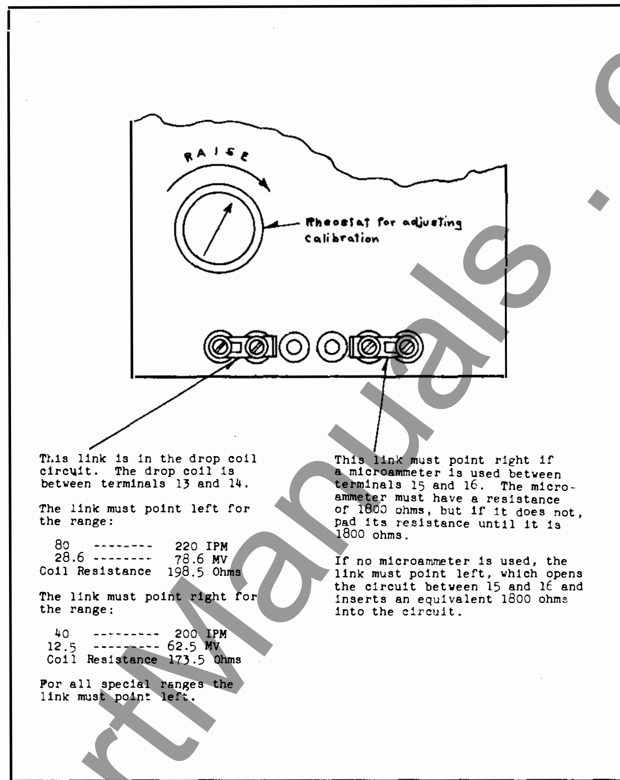


Fig. 10—Calibration Adjustments of the Type IM Receiver in the Type FT Case.

the instructions below should be followed.

Reversing Relay

It is necessary that the relay positively operate its contacts when the coil is energized or de-energized within the wide limits of control voltage, line resistance, and impulse rates. It has a large factor of safety, but the line resistance should not be so high or the voltage so low as to permit the operating current to drop below 15 milliamperes Also, the current should not be permitted to exceed 35 milliamperes, otherwise excessive pounding of the relay will cause undue wear of its parts. For any given impulse rate the energized and de-energized periods are nearly equal. Unequal operating periods generally indicate trouble in the timing of auxiliary and repeating relays which may be in the telemetering channel. All relays should be set so that their "on" and "off" periods are approximately equally spaced.

The contact pile up is equivalent to a double pole, double throw switch and wired into the filter as a reversing switch. The moving contact must not touch both of its stationary contacts at the same time. This bridging shorts the .3 mfd. condenser and causes erratic readings, and "spikes" on the recorder chart. Both moving contacts must operate simultaneously so that they both break or both make at the same instant. If they do not, there is a possibility of encountering a condition similar to that of bridging and shorting the condenser. The moving contact springs should have a definite downward pressure on their insulating bushings when the relay is in the de-energized position. These adjustments are by no means critical but reasonable care should be taken in bending the springs. The total travel of the moving contact should be adjusted to .028 inch. The follow, that is the amount the stationary contact follows before breaking, or if making the amount it follows after contact is made, should be .008 inch.

The armature travel is approximately one half of the contact travel because of the lever ratio of the armature. Adjustments can be checked with a thickness gage between the relay core and the residual pin of the armature. With the relay in the de-energized position the gap between the core and the pin should be .014 inch. When the lower contacts start to break, the gap should be .010 inch and when the upper contacts make the gap should be .004 inch. The residual pin is fixed and cannot be adjusted. The armature stroke which is the gap between the core and the residual pin can be adjusted by loosening the screw which holds the armature bearing, and shifting until the desired stroke is obtained. When tightening the screw, align the armature so that is seats squarely on the core.

Type 874 Regulator Tube

The applied voltage must be high enough to fire the tube. When properly operating it will show a slight purple glow and the voltage across its terminals will be approximately 90 volts, but if it fails to fire, the voltage will be nearly the same as the battery voltage. A convenient place to measure this voltage is across the two terminals of the 4 mfd. section of the condenser which is just below the tube socket.

The tube should maintain approximately 90 volts on the receiver circuits for battery voltage between 120 to 140 volts.

Calibration

A small rheostat mounted inside the receiver case is to be used for adjusting the millivolts and microamperes to their correct values. This is the only field adjustment that needs to be made. The resistance values of the drop coil circuit have been chosen so that when the millivolts are correct the microamperes will also be correct. Refer to Figs. 9 and 10. The rheostat with its series resistor is connected directly across the 90 volts at the 874 tube and is used to vary the voltage to the .3 mfd. condenser. Some of the earlier receivers which were mounted in the standard case had the rheostat mounted directly across the output terminals and calibration was obtained by varying the amount of shunted output current.

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

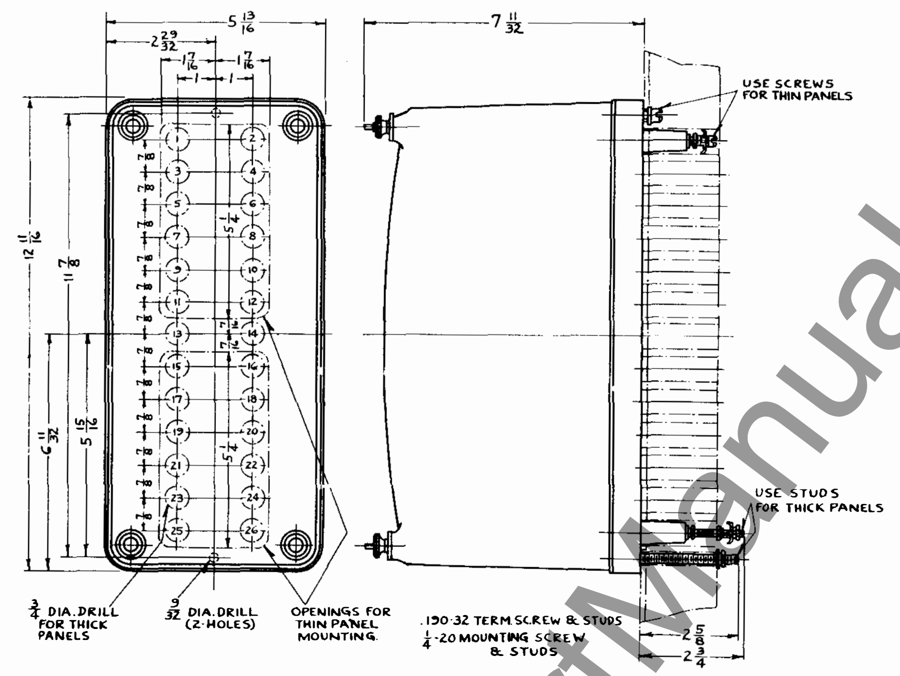


Fig. 11—Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

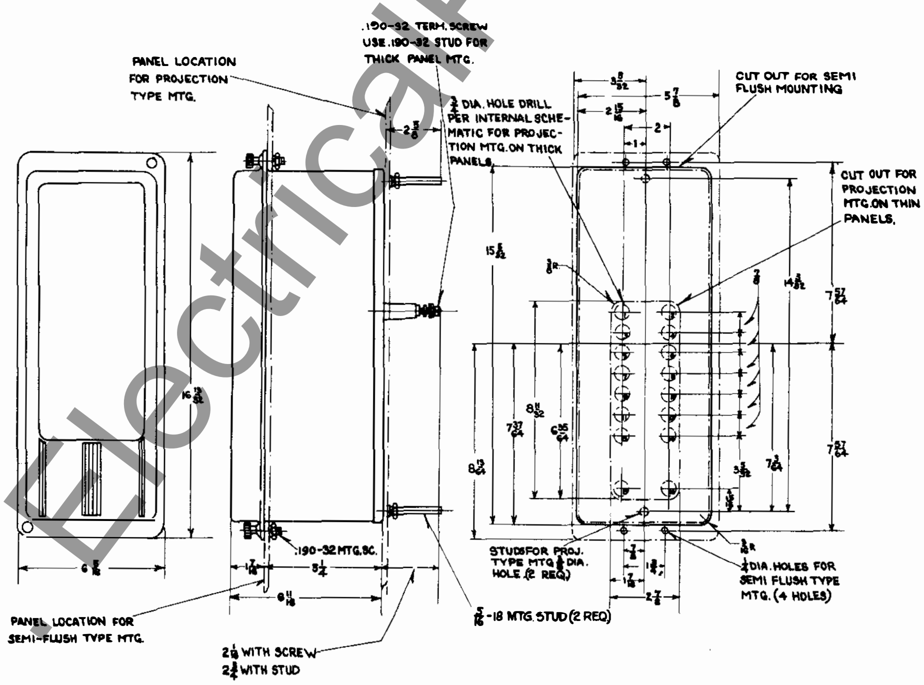


Fig. 12—Outline and Drilling Plan for the M10 Projection or Semi-Flush Type FT Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

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