INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE 44 RECORDING INSTRUMENTS

CAUTION: Read all of the information in this leaflet before proceeding as directed below. Before putting type 44 recording instruments into service, remove all blocking which may have been inserted for the purpose of securing parts during shipment, and make sure that all moving parts operate freely.

GENERAL

Type 44 recording instruments should be installed where they will not be subjected to excessive vibration, dust, moisture or variations in temperature. In general, good indicating instrument practice should be followed with additional regard to the fact that temperatures below freezing will interfere with the flow of ink. Recorders when supplied with heaters will allow operation at temperatures down to -12 degrees Fahrenheit.

The insulation rating of type 44 recording instruments makes them suitable on circuits up to 800 volts.

Type 44 recording instruments are magnetically shielded against stray fields.

INSTALLATION

UNPACKING

Unpack carefully. Be sure that all small accessories, spare parts, etc., are found before discarding the packing material.

For list of accessories supplied with each recorder see page 7..

MOUNTING

Carefully observe the following directions and execute them in the order in which they are given:

a. For panel mounting drill the panel according to the drilling plans in this leaflet. When mounting, see that the instrument is level.
b. Mount the instrument upon the switchboard or other support, using a level to insure its being placed in a vertical position both parallel and perpendicular to the board.
c. Trace out all external electrical connections carefully and connect according to the proper diagram. All diagrams are made showing the connections as they appear from the rear unless specifically indicated otherwise.

INSERTING THE CHART

Refer to Figure 1.

Open the door by lifting the latch handle, and lower the chart mechanism by pulling forward on the chart-mechanism release lever. Tilt the chart mechanism forward by means of the tilting posts. If desired, the complete chart mechanism may be removed at this point, after first disconnecting the synchronous clock plug connector at the rear of the chart mechanism. With the chart mechanism in the forward position as shown in Figure 2, place the new roll of paper in the upper receptacle at the rear of the unit. Unroll a short length of the chart and feed it carefully under the chart roller and guards and over the driving-drum pins. Turn the chart time-setting thumb gear, and the drum will rotate through the friction clutch without driving the timing mechanism. Continue to roll the chart on the drum until the end of the chart extends about six inches below the recorder. Tilt the chart mechanism to the backward position. Remove the reroll spool by lifting the reroll spool release lever. The reroll spool will roll forward for easy removal. Thread the chart behind the chart mechanism and reroll spool release levers, and insert the loose end into the reroll spool slot. Wind a few turns on the spool, and return the spool to its operating position. Be sure the spool is engaged with the rewind gear. Place the hand under the reroll spool and rotate the spool in the unwinding direction one-quarter turn. *Then slowly release the spool, making certain that the chart is under tension from the reroll drive mechanism.*

CHART DRIVE AND REROLL MECHANISMS

Refer to figure 3.

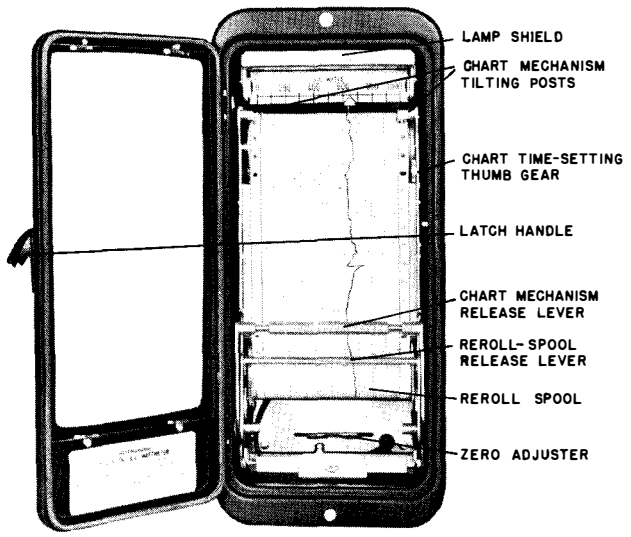

Fig. 1 - Type 44 Recording Wattmeter with door open.

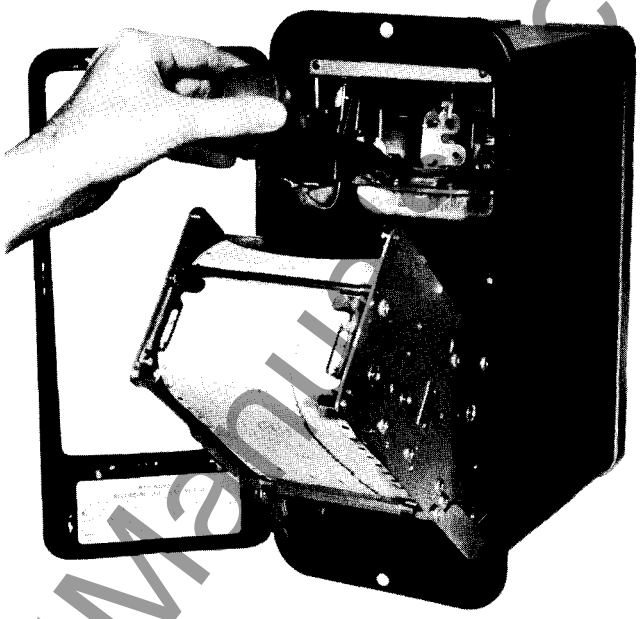

Fig. 2 - Type 44 Recording Instrument with chart mechanism in forward position and inkwell lowered for filling.

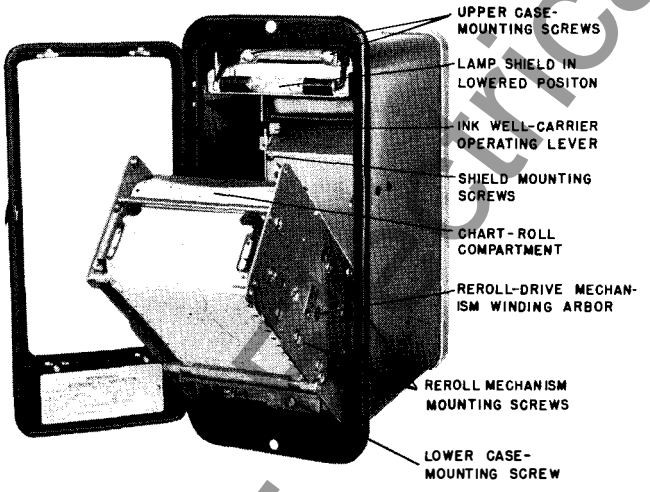

Fig. 3 - Type 44 Recording Instrument with lamp shield lowered for easy replacement of lamps.

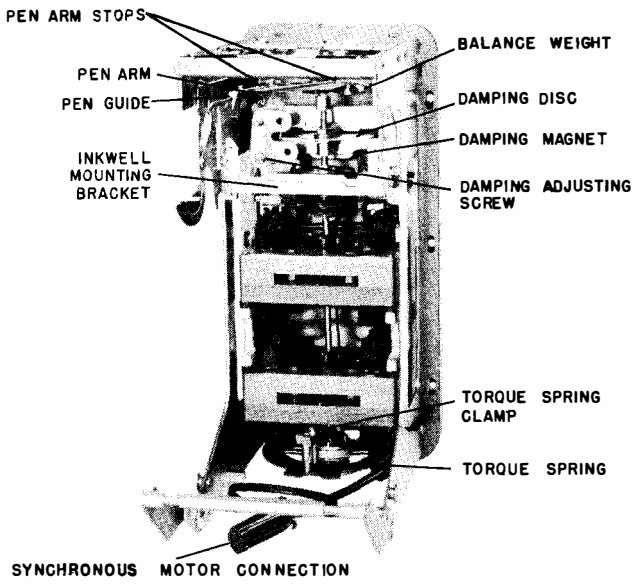

Fig. 4 - Type 44 Recording Instrument with case removed. View shows polyphase wattmeter and indicates parts common to all Type 44 instruments.

Three types of chart drives are available. These are;

1. Single speed synchronous-clock drive.
2. Two speed synchronous-clock drive.
3. Two speed hand-wound spring-clock drive.

Single speed drives provide chart speeds of 3/4, 1-1/2, 3, 6, and 12 inches-per-hour. These speeds are made possible by using appropriate sets of change gears as listed on page 7. When mounting the change gears, care should be taken to seat them properly on their respective shafts. Each gear has a slotted hub and the slot must be aligned with the shaft pin.

Two speed drives provide chart speeds of 3/4, 1½, 3, 6 and 12 inches-per-hour and inches-per-minute. Speed is changed by shifting a lever located at the left of the chart mechanism face plate. When operating at inches-per-hour speeds and inches-per-minute speeds *not in excess* of 3" per minute, the reroll mechanism can be either in the automatic or manual rewind position. When operating at 6 or 12 inches-per-minute chart speed, the reroll drive mechanism must be in the manual rewind position. Refer to information on chart mechanism side plate for position locations. Changing the position of the reroll mechanism is accomplished by loosening the three mounting screws, Figure 3, which hold the reroll mechanism in place and shifting the reroll mechanism until the dowel pin is located in the proper hole in the side plate. Both dowel pins must be in holes before tightening the mounting screws.

Standard switchboard recorders are furnished with 3 inches-per-hour change gears. Portable recorders are furnished with a complete set of change gears. These gears are stored directly below the reroll spool. Instructions for selecting chart speeds are given on the chart mechanism side plate.

Synchronous motor clocks may be stopped by disconnecting the line cord at the synchronous motor.

Hand wound clocks will run for eight days on one winding at the inches-per-hour speeds and for three hours at the inches-per-minute speeds. Reroll mechanism must *always* be in manual rewind position when using hand wound clock drives.

INSERTING THE PEN AND INKWELL

Pull forward on the inkwell lowering lever shown in figure 3. The inkwell carrier will come into view. Place the inkwell on this carrier as shown in figure 2.

Grasp the front end of the pen and place the pen in position under the pen guide and in line with the pen arm. Push the pen up gently on the pen guide and move the pen backward until the pen knife edges seat in the bearings.

FILLING THE PEN AND INKWELL

Fill the inkwell to within about 1/16 of an inch of the top of the lower opening, using the inkwell filler for this purpose. Move the inkwell operating lever to raise the inkwell to its operating position (shown in figure 3). Fill the pen by means of the rubber pen starter. The pen is of the capillary tube type and therefore must be primed before it will start recording. With the pen tube full of ink, the pen should be balanced so that the pen tip rests lightly but definitely on the paper. If the point rests too heavily on the paper, excessive friction will result, decreasing the accuracy of the recording; while if the point rests too lightly, an unsatisfactory record will result. The adjustment for pen tip pressure is readily made, when required, by adjusting the position of the helical balance weight at the rear of the pen.

Caution:— When shipping or transporting a recorder remove all ink from the well to avoid spilling ink on the mechanism. See "Preparation for Shipping" paragraph.

SETTING ZERO

After the chart mechanism is restored to its normal position, the zero can be set with power off or with the instrument disconnected. Set the pen to zero on the chart by moving the zero adjuster shown in figure 1. See that the moving element returns freely to zero when deflected up scale by hand.

If the connections have been opened for adjusting zero, reconnect the instrument to the circuit. (Remember that connections to current transformers must never be opened while current is flowing.)

ADJUSTING FOR TIME

The paper chart is driven by the chart driving mechanism through a friction clutch drive. To set the chart for the right time, turn the chart forward

to the correct time by means of the chart time-setting thumb gear.

If it is desired to turn the chart backward for more than a few inches, it will be necessary to tilt the chart mechanism forward again and rewind some of the chart upon the paper supply roll.

The date of the starting may be marked in pencil on the chart, together with any other useful notations.

MAINTENANCE

Type 44 recording instruments are designed to require a minimum of maintenance. The required maintenance is simple and convenient to perform.

INK AND INKING SYSTEM

The ink supplied has been specifically developed for this instrument and should always be used.

If the recorder has been out of service for sometime, the ink-well should be thoroughly washed with water or alcohol and refilled with fresh ink. If the recorder is to be taken out of service for any appreciable time, the pen and inkwell should first be thoroughly flushed out and cleaned with water or alcohol.

It is recommended that the inkwell be flushed with water or alcohol once a month or oftener, depending upon service conditions.

To assure reliable recording, it is recommended, that the pen be occasionally cleaned as follows:

1. Clear the tip by means of the pen cleaning wire.
2. Force water into the pen tube by means of the pen cleaning syringe until water flows out of the pen inlet.
3. Reverse the process by forcing water into the inlet end of the pen. A clean pen will emit a fine solid stream of water.

CHARTS

The paper used for the charts is of a special type and has been specifically developed for use in these recording instruments. It is manufactured by a carefully controlled process and conforms to rigid specifications to assure optimum recording qualities.

To completely assure the best over-all performance of the recording system, the recommended inks and charts must be used exclusively.

CHART MECHANISM

The chart mechanism incorporates the chart roll-compartment, driving-drum, reroll-spool, reroll-drive mechanism, and chart drive in a single unit.

The reroll-drive mechanism is a spring driven device, which may be wound either automatically or manually. See limitations under "Chart Drive and Reroll Mechanisms". When in the automatic rewind position, the mechanism is linked with the timing mechanism which continuously rewinds the spring, constantly maintaining tension for taking up the chart. When in the manual rewind position, the spring must be fully wound with the key each time the chart is renewed. When fully wound, it will allow the reroll to collect well over a full roll of paper. The rewind key may be readily stored by placing it on the bottom of the case in front of the chassis cross bar with one wing of the key tucked under the cross bar. Synchronous motor chart drives are self starting and do not require any regulation. Permissible voltage variation is from 80 to 115 percent of nominal voltage rating.

The bearings in the synchronous motor chart drive and the reroll-drive mechanism should occasionally be cleaned and lubricated. These units may be removed for cleaning by taking out the three machine screws which secure each unit to the side-plates of the chart mechanism.

Bearings may be cleaned by brushing out with naptha or clock cleaning fluid. After being thoroughly dried, the bearings should be lubricated with a high grade of clock oil such as Westinghouse Clock Oil Style Number 935736.

The pen stops are mounted on a cross supporting bracket and are undercut to facilitate adjustment by bending.

LAMP REPLACEMENT

The scale plate is illuminated by two standard 6 volt bayonet-type lamps located behind the lamp shield. Terminal voltage for the lamp circuit is 120 volts. By means of an internally mounted filament transformer 6 volts is obtained for lamp operation. The lamp shield is pivoted and must be swung down to make the lamps accessible. This is done by placing the forefinger behind the shield and gently pulling it down to the position shown in Fig.

3. The lamp sockets are also pivoted and may be swung out to allow easy replacement of burned-out lamps.

CALIBRATION

The accuracy of recording instruments can be checked by comparing them with known standards in the same manner as for indicating instruments.

The calibration of recording voltmeters, ammeters and watt meters can be adjusted over a range of plus or minus 5% by changing the location of the outer end of the spring in the spring clamp. Increasing the active length of the spring increases the reading for a given setting of the standard. The location of the spring clamp is shown in Fig. 4.

The calibration of d-c instruments can be performed by adjusting either or both of the two magnetic shunts as follows: With the shield shown in Fig. 3 removed, loosen the set screws in the shunt bar clamps located at the top of the lamination stack assembly.

Shunt bars may be raised or lowered as desired by application of firm forefinger pressure on the bar. Final precise setting can be obtained by adjusting the shunt bar with the chart mechanism and pen in its normal position. The ends of the shunt bars are accessible for hand adjustment through the opening under the chart mechanism. When the desired instrument calibration is attained, the set screws in the shunt bar clamps must be tightened to lock the shunt bars in position.

In general, the calibration is performed in the same way as for indicating instruments, using portable standards of known accuracy such as the Westinghouse type P-5 instruments. In case mechanisms are repaired the original angles between the pen and the moving elements must be restored as follows:

a-c Ammeters—Axis of rotor 36 degrees in advance of the pen axis.

a-c Voltmeters—Axis of rotor 34 degrees in advance of the pen axis.

a-c Wattmeters—Axis of moving coils approximately in line with pen axis.

d-c Instruments—Axis of pen approximately 26 degrees in advance of moving coil axis.

When replacing a moving element, the moving coils or rotor must be centered in the air gap by means of the adjustable jewel screw mounts.

The calibration of voltmeters and wattmeters can also be varied by adjusting the series resistors, but this method is not in general recommended except for special cases. These resistance values are chosen to give the best accuracy under varying temperature or polyphase unbalancing conditions. Where it is desired to entirely change the rating or full scale capacity of an instrument, the instrument should be returned to the factory.

Shunted type d-c ammeters are calibrated as millivoltmeters with the rated millivolts (generally 50 mv full scale) applied to the outer ends of the calibrated leads furnished with the instrument. When calibrating these for use with shunts below 100 ampere capacity, allow for the shunted current taken by the instrument, which is approximately 0.2 ampere. For example, for a 25 ampere shunt, 50 mv = (25-0.2) = 24.8 amperes.

Polyphase wattmeters are calibrated on single phase circuits with the current coils in series and the potential coils in parallel. When used with transformers, the "Calibration Constant" is equal to the product of the CT and the PT ratios.

Varmeters (volt-ampere-reactive) are ordinary voltamperes. The calibration is the same as that of the standard wattmeter. In some cases the zero is placed in the center of the scale instead of at the left end to record lagging and leading reactive power.

Portable utility wattmeters are specially calibrated for both a-c and d-c operation by adjusting the full scale current to be 5 amperes at nominal watts d-c (i. e. for instance 500), and adjusting the resistance of the current coil and shunt leads to take 5 amperes when 100 millivolts are applied.

Accuracy Rating—The accuracy ratings are expressed in terms of full scale capacity per A.S.A. Standards (See 39.2) and are as follows:

Type M-44 a-c voltmeters and ammeters .....Within 1%
Type X-44 d-c voltmeters and milliameters .....Within 1%
Type X-44 d-c shunt operated (50 mv) ammeters.....Within 1-1/2%
Type F-44 a-c wattmeters and varmeters.....Within 1%
Type F-44 utility wattmeter
on a-c .....Within 1%
on d-c .....Within 3%
Type X-44 frequency meter with type VC840 transducer .....Within 2%
(See I.L. 43-840.)

VARIATION IN RECORDS

Sluggishness of action, indicated by the record not showing actual variations in the quantity measured, may be due to one of the following

meter element; (b) friction in the pen system.

Friction in the moving element can best be detected by removing the pen and tilting the chart mechanism forward. Move the pen arm slightly from side to side and note whether it returns to the original position. Friction in the moving element may be due to dirt or magnetic particles in the air gaps, or to a damaged jewel or pivot.

If the friction exists only when the pen is in action with the ink flowing correctly, the friction is due to the pen tip bearing too heavily on the paper. This may be caused by excessive pen tip pressure or to an improper clearance adjustment between the pen and the pen bearings. The former can be corrected by rebalancing the pen, the latter by adjusting the bearing supports to allow a total clearance of .005 to .010 inches between the pen and the bearings.

The character of the record obtained depends on the speed of the chart paper and the nature of the circuit. The choice of a chart speed depends upon the character of the load and the accuracy with which it is desired to read the time. On loads which are subject to large swings and oscillations, it is usually best to use the higher chart speeds. Otherwise, the ink will soak through the paper, and no distinct record will be obtained, as the pen traverses the same line several times. On a higher speed the paper will move slightly between successive oscillations of the pen, and the record will be legible.

DAMPING ADJUSTMENT

Magnetic damping is provided in all mechanisms. Degree of overshoot is adjustable by turning the screw identified in Fig. 4. (Remove mechanism shield for access) Turning screw clockwise decreases damping, — counterclockwise increases damping.

DESCRIPTION OF MEASURING ELEMENTS

Type 44 recording instruments are of the direct-acting type, in which the recording mechanism is driven directly by the measuring elements. In general, the measuring elements operate on the same principle as corresponding indicating instruments.

The following is a brief description of the type 44 measuring elements. The operating torque of all instruments is 150 cmg for a deflection of 360 degrees. X-44 instruments operate on the D-Arsonval principle, utilizing Alnico V magnets and a one piece laminated magnetic structure. A system of magnetic shunt calibrators provides an adjustment range of approximately plus 10 and minus 30 per cent. Standard power consumption is 0.0025 watts full scale, but power consumption can be reduced to 0.001 watts full scale by reducing torque to 100 cmg for 360 degree deflection and omitting the shunt calibrators.

M-44 instruments are of the attraction iron type, a laminated rotor moving in the field of an electromagnet. This design is simple, has high magnetic efficiency and high mechanical and electrical overload capacity. The inherent square-law torque characteristic of this type of mechanism gives rise to severe mechanical stressing of the moving element system during suddenly applied overloads. Protection against such overloads is accomplished by coupling the rotor to the rest of the moving element through a biased auxiliary spring. Sudden overloads forcefully deflect the rotor, but the rest of the moving element moves upscale more gradually by the action of the auxiliary biasing spring.

F-44 mechanisms utilize a one piece lamination with close magnetic coupling between the moving and stationary coils. This system has high magnetic and electrical efficiency and exhibits consistently uniform scale distribution. The arrangement and proportioning of the magnetic circuit is such that solenoid effect and voltage errors are eliminated. In each element both the moving and stationary coils are divided into pairs and astatically connected, making the element immune to the effect of uniform stray fields.

PREPARATION FOR SHIPPING

I. Moving Element Blocking

Remove ink well & pen from recorder, clean & pack in suitable carton for shipping.

The position of the moving element should be confined by the use of a rubber band looped over the 1/4" dia cross bar near the top of the case and the moving element pen arm.

The 1/4" dia cross bar is most accessible when the ink well operating lever is moved forward until the end of the lever is flush with the front opening of the case.

II. Chart Mechanism Blocking

The chart mechanism should be suitably blocked to prevent shifting during shipment. This can be done by wedging cardboard, gasketing material or paper padding between the top plate (both sides) of the chart mechanism and the under side of the recorder side plates.

SUPPLIES FURNISHED WITH EACH RECORDER
(These may be reordered as necessary)

Quantity	Style No.	Description
1	1 059 478	Red ink, 2 oz. bottle, ready to use.
1	1 545 191	Inkwell Filler.
1	873 390	Pen Starter.
1 pkg.	542-D-716G02	Pen cleaning wires.
1 pr.	1 546 164	Calibrated leads 5 ft. long (furnished with type X-44 millivoltmeters only).
2 pr.	1 208 383	Calibrated leads 5 ft. long (furnished with AC-DC utility wattmeter only).

ADDITIONAL SUPPLIES AVAILABLE ON ORDER

Description	Style No.
Red ink (8 oz. bottle, ready to use)	1 059 479
Red ink (16 oz. bottle, ready to use)	1 059 480
Green ink (2 oz. bottle, ready to use)	1 209 421
Green ink (8 oz. bottle, ready to use)	1 209 422
Green ink (16 oz. bottle, ready to use)	1 209 423
Ink well complete	1 544 747
Ink well gasket	1 730 275
Pen complete	542-D-716G01
Upper jewel screw	1 731 998
Lower jewel screw	1 732 029
Pivot and Holder	1 731 972

Description	Style No.
Synchronous motor chart drive, 120 volts, 60 cycles (for inches-per-hour chart speeds)	186A229G11
Synchronous motor chart drive, 120 volts, 60 cycles (for inches-per-hour and inches-per minute chart speeds)	1 267 235
Synchronous motor, 120 volts, 60 cycles, 1 RPM, for chart drive	1 098 213
Reroll spool	1 730 428
Reroll mechanism assembly	1 340 206
Winding key for reroll mechanism assembly	1 726 478
Thumb nut to hold chart speed change gears	186A189H01
Illumination lamp (mazda No. 44)	1 208 364

CHART-SPEED CHANGE GEARS

Chart Speed	Gear (Lower) on Timing Mechanism Shaft		Gear (Upper) on Countershaft	
	No. of Teeth	Style No.	No. of Teeth	Style No.
3/4 inch per hour	18	186A024H01	72	186A023G04
1-1/2 inches per hour	30	186A023G01	60	186A023G03
3 inches per hour	45	186A023G02	45	186A023G02
6 inches per hour	60	186A023G03	30	186A023G01
12 inches per hour	72	186A023G04	18	186A024H01

NOTE: 3/4 and 12 inches per hour speeds are obtained with one set of gears by interchanging them. Likewise, 1-1/2 and 6 inches per hour are obtained with one set of gears.

POWER CONSUMPTION
DIRECT CURRENT INSTRUMENTS

TYPE AND RATING	AT RATING	CIRCUIT	RESISTANCE OHMS	POWER WATTS
X-44 Millivoltmeter, 0-50 mv	50 mv	Millivolt	0.25	0.010
X-44 Millivoltmeter, 0-100 mv	100 mv	Millivolt	0.5	0.020
X-44 Voltmeter, 0-150 volts	150 volts	Voltage	150,000	0.150

ALTERNATING CURRENT INSTRUMENTS (ON 60 CYCLE CIRCUITS)

TYPE AND RATING	AT RATING	CIRCUIT	IMPEDANCE OHMS	RESISTANCE OHMS	REACTANCE OHMS	V.A.	% P.F.
M-44 Ammeter, 0-5 Amp	5 Amp	Current	0.140	0.015	0.139	3.5	10.
M-44 Voltmeter, 0-150 Volts	120 Volts	Voltage	1000.	987	173	14.4	99.+
F-44 Wattmeter, 2 Curr. Coils,	5 Amp	Current	0.24	0.04	0.239	6.	17.
2 Pot. Coils, 120 Volts, 5 Amp	120 Volts	Voltage	2350	2350	0.0	6.1	100.
F-44 Wattmeter, 3 Curr. Coils,	5 Amp	Current A	0.12	0.02	0.119	3	17.
2 Pot. Coils, 120 Volts, 5 Amp		B	0.24	0.04	0.239	6.	17.
		C	0.12	0.02	0.119	3	17.
	120 Volts	Voltage	2350	2350	0.0	6.1	100.

SYNCHRONOUS MOTOR CHART DRIVE

RATING	VOLT-AMPERES	WATTS	VARS	% P.F.
120 Volts, 60 Cycles	7	4	5.7	57
240 Volts, 60 Cycles	7	4	5.7	57
480 Volts, 60 Cycles	14	8	11.5	57

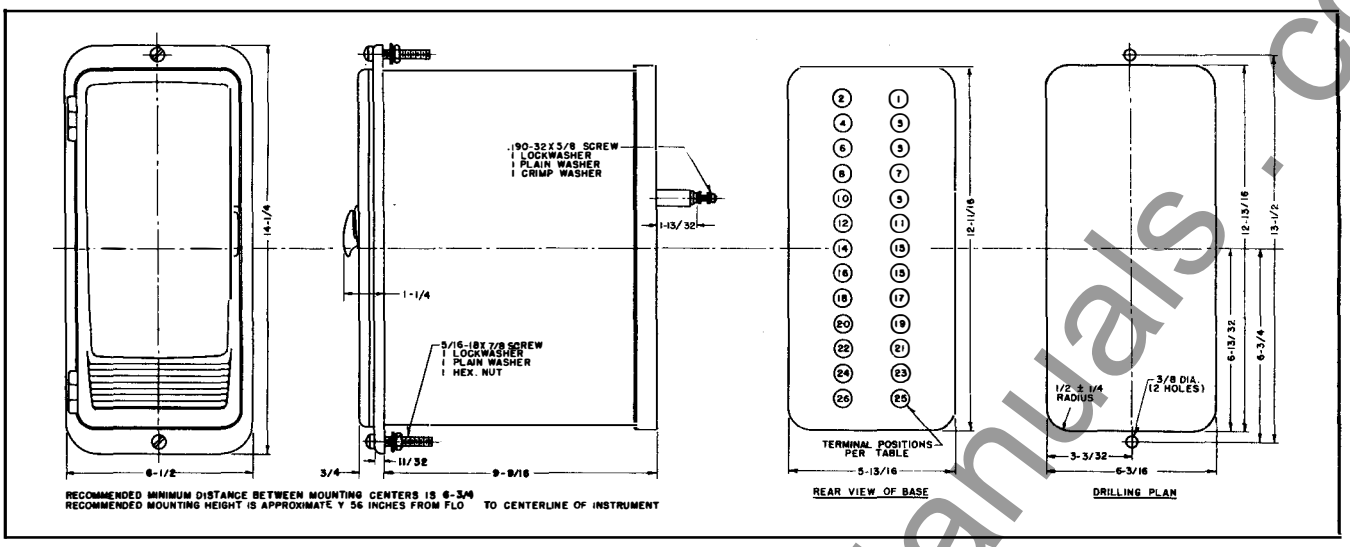

Fig. 5 - Outline Dimensions and Drilling Plan for Flush Type 44 Recording Instruments.

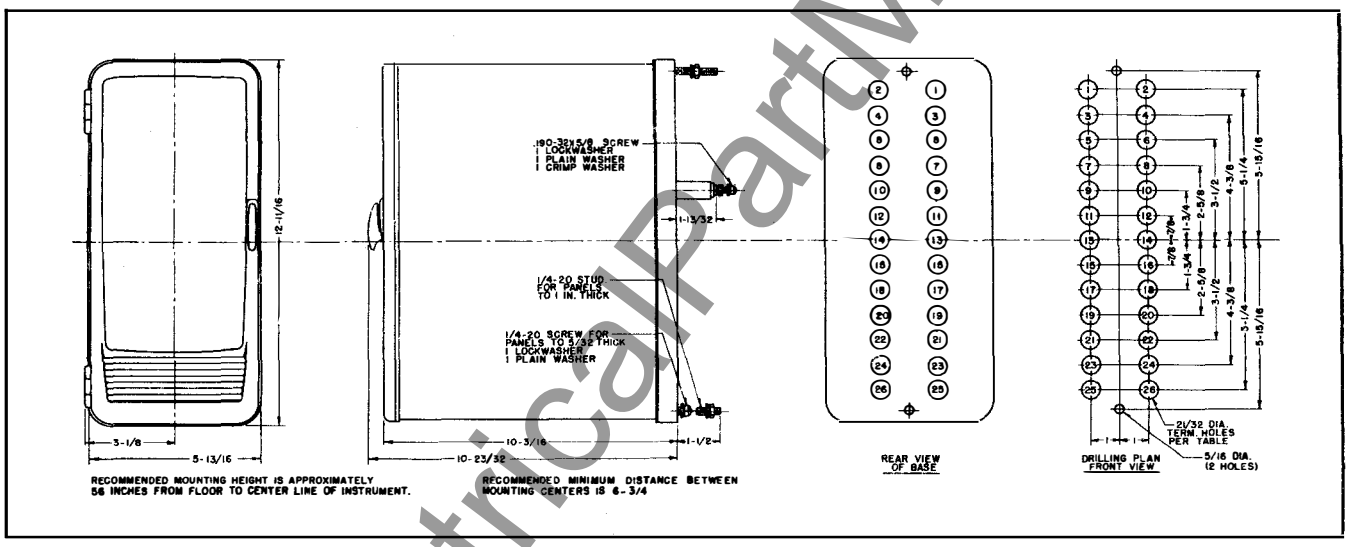

Fig. 6 - Outline Dimensions and Drilling Plan for Projection Type 44 Recording Instruments.

TYPE OF INSTRUMENT	MECHANISM TERMINALS	SYNC. CLOCK AND LAMP TERMINALS
X-44 SINGLE RANGE D-C INSTRUMENTS	19-20	23-24
M-44 SINGLE RANGE A-C AMMETERS	19-20	23-24
M-44 AC VOLTMETERS	19-20	23-24
F-44 WATTMETERS AND VARMETERS TWO CURRENT COIL	7 to 12-21-22	23-24
F-44 WATTMETERS AND VARMETERS THREE CURRENT COIL	7 to 14-21-22	23-24

Fig. 7 - Table of Terminal Positions used in Connecting Switchboard Instruments. For Projection Instruments these Positions must be Drilled as noted in Fig. 6.

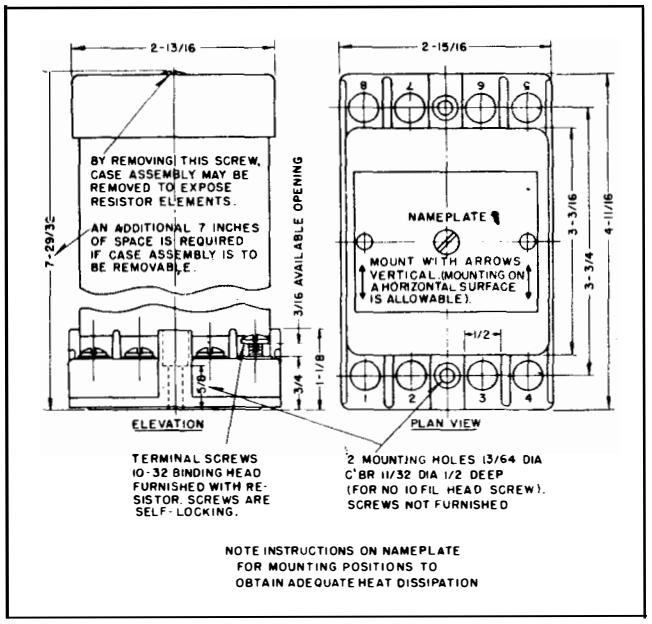

Fig. 8 - Outline Dimensions and Drilling Plan for Type VR-825 External Resistor.

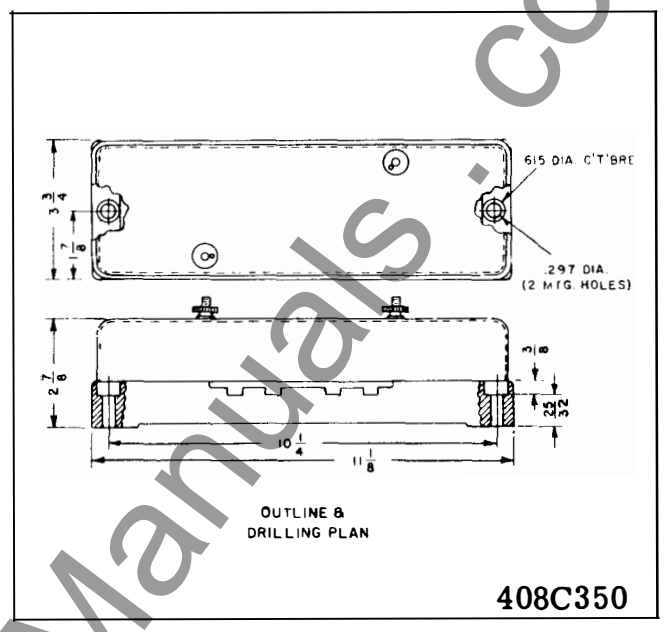

Fig. 9 Outline Dimensions and Drilling Plan for Type MV832 Phase Shifting Transformer (3PH. 3-w., and 3PH. 4-w).

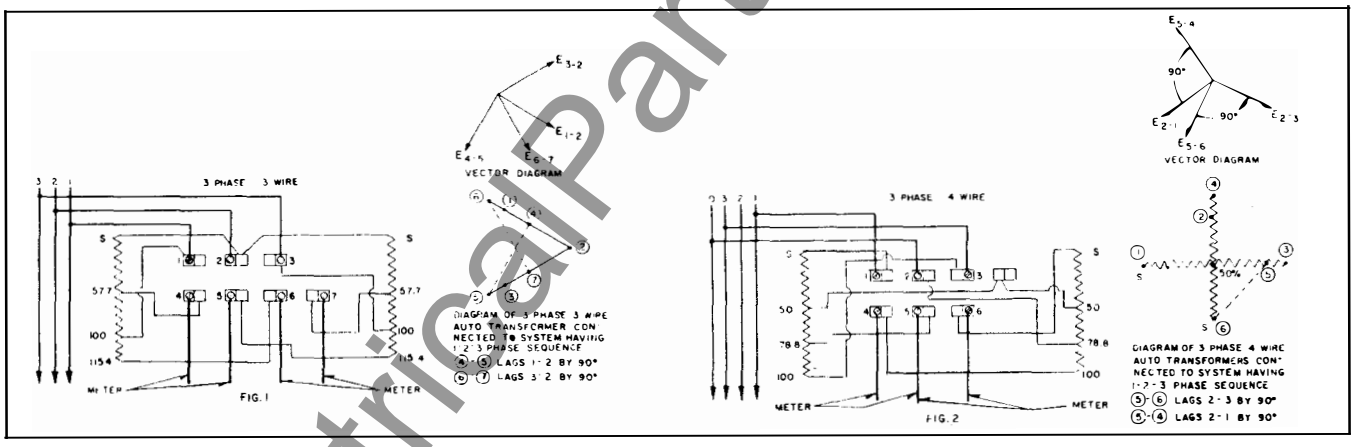

Fig. 10 Wiring diagram and winding development. (See applicable complete wiring diagram.)

EXTERNAL CONNECTION DIAGRAMS

INSTRUMENTS SHOWN REAR VIEW. EXTERNAL BOXES SHOWN FRONT VIEW.

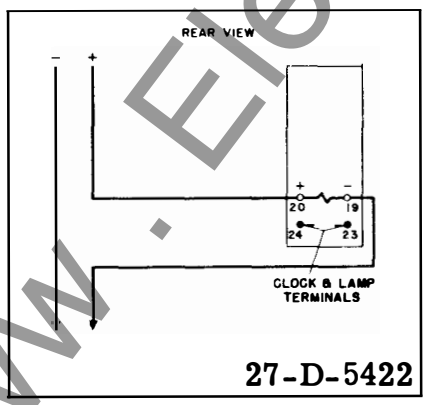

Fig. 11 - Type X-44 Ammeter and Milliameter (Self Contained).

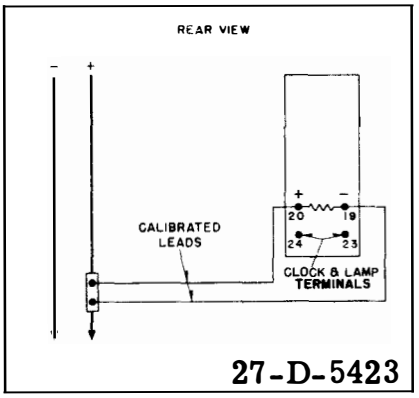

Fig. 12 - Type X-44 Ammeter with External Shunt.

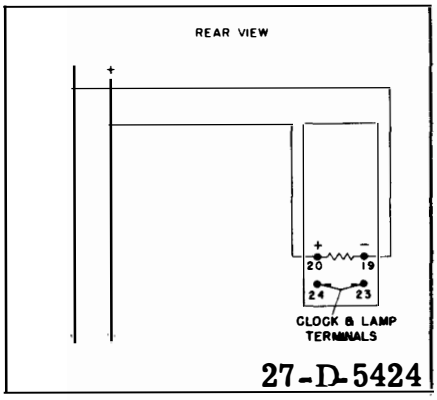

Fig. 13 - Type X-44 Voltmeter.

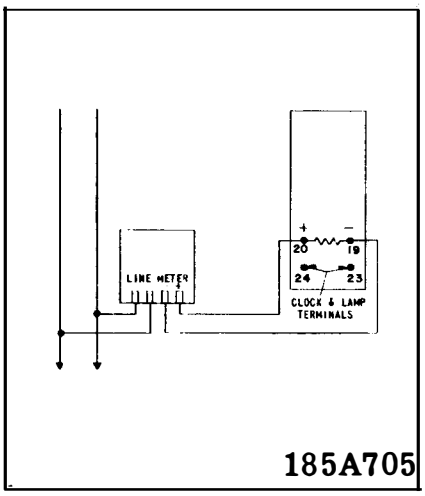

Fig. 14 - Type X-44 Frequency Meter with Transducer.

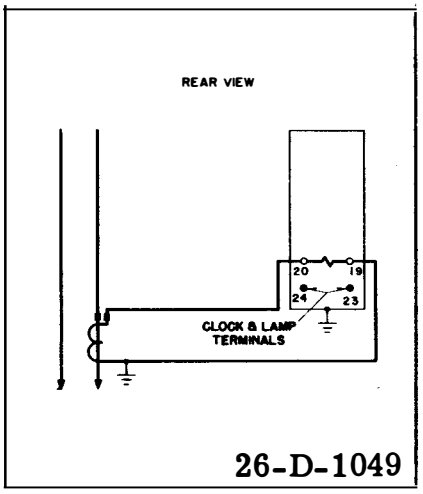

Fig. 15 - Type M-44 Ammeter with C.T.

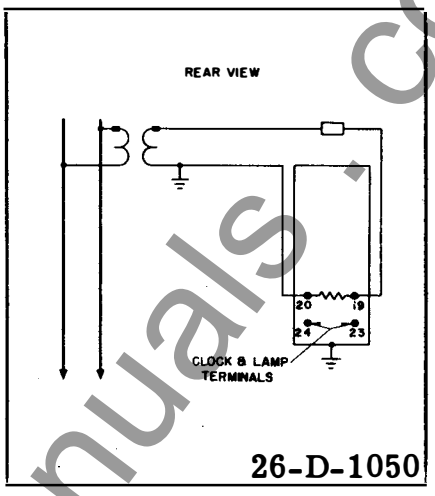

Fig. 16 - Type M-44 Voltmeter with P.T.

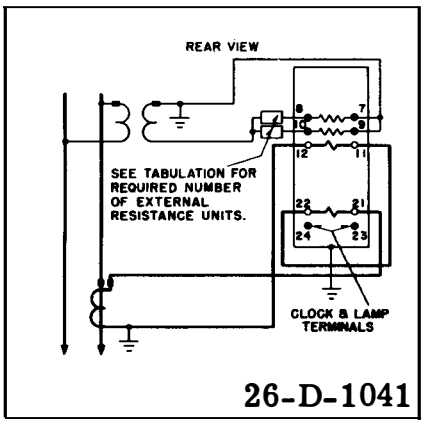

Fig. 17 - Type F-44 Wattmeter, 2 Current Coil with C.T. and P.T. on Single-Phase 2-Wire Circuit.

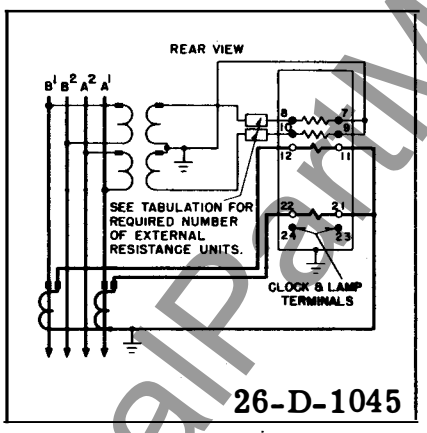

Fig. 18 - Type F-44 Wattmeter, 2 Current Coil with C.T. and P.T. on 2-Phase 4-Wire Circuit.

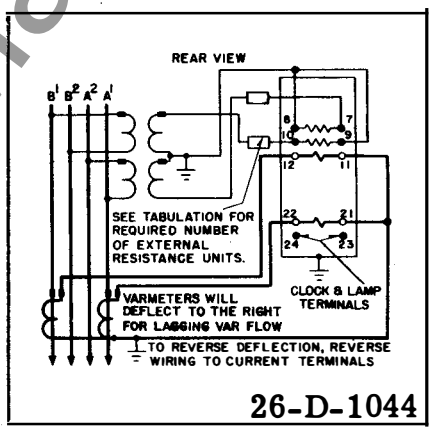

Fig. 19 - Type F-44 Varmeter, 2 Current Coil with C.T. and P.T. on 2-Phase 4-Wire Circuit.

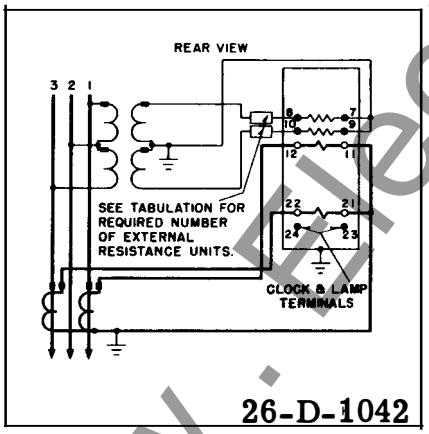

Fig. 20 - Type F-44 Wattmeter, 2 Current Coil with C.T. and P.T. on 3-Phase 3-Wire Circuit.

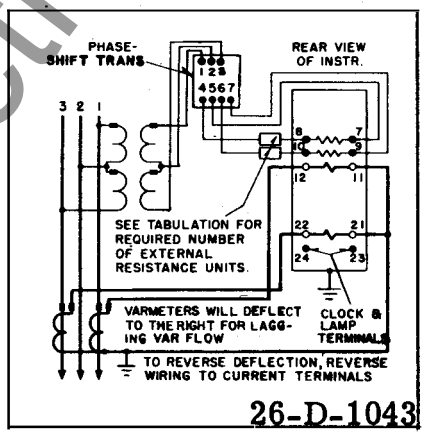

Fig. 21 - Type F-44 Varmeter 2 Current Coil with C.T. and P.T. on 3-Phase 3-Wire Circuit.

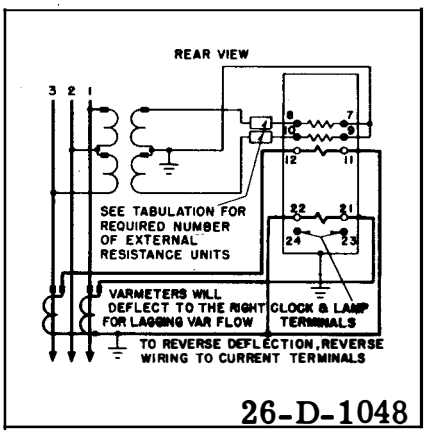

Fig. 22 - Type F-44 Varmeter, 2 Current Coil with C.T. and P.T. on 3-Phase 3-Wire Circuits. Special Calibration for use without Phase Shifting Transformer.

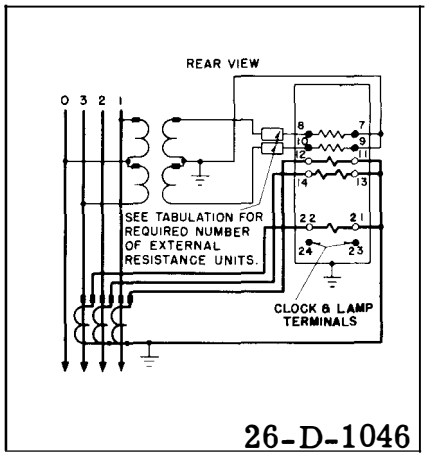

Fig. 23 - Type F-44 Wattmeter, 3 Current Coil with C.T. and P.T. on 3-Phase 4-Wire Circuit.

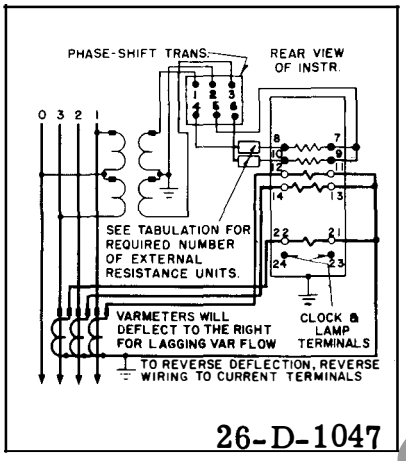

Fig. 24 - Type F-44 Varmeter, 3 Current Coil with C.T. and P.T. on 3-Phase 4-Wire Circuit.

RATING OF INSTRUMENT POTENTIAL CIRCUIT	TOTAL NUMBER OF EXTERNAL RESISTANCE UNITS USED
120 VOLTS	1 (Two-Circuit Unit)
240 VOLTS	2
480 VOLTS	2
600 VOLTS	4

Fig. 25 - Tabulation showing the number of external resistance units used with Type F-44 Wattmeters and Varmeters.

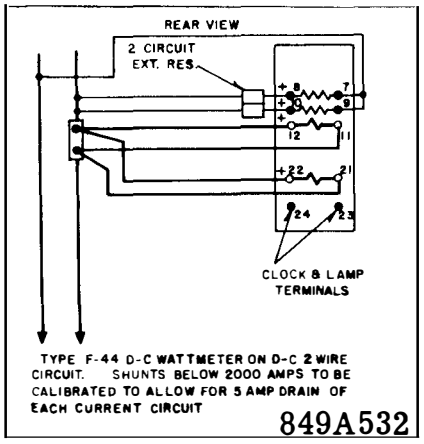

Fig. 26 - Type F44 D-C Shunt Operated Wattmeter 100 M.V. on 2 Wire D-C Circuit Ext. Wiring

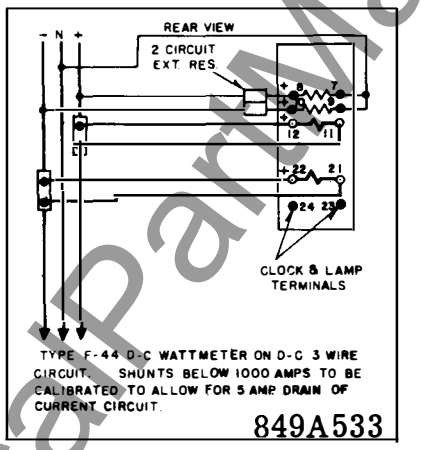

Fig. 27 - Type F44 D-C Shunt Operated Wattmeter 100 M.V. on 3 Wire D-C Circuit Ext. Wiring

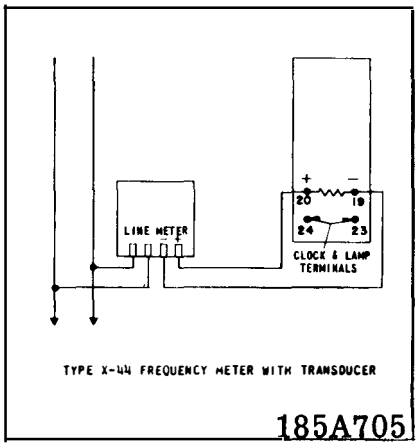

Fig. 28 – Type X-44 Frequency Meter With Transducer

PORTABLE RECORDING INSTRUMENTS

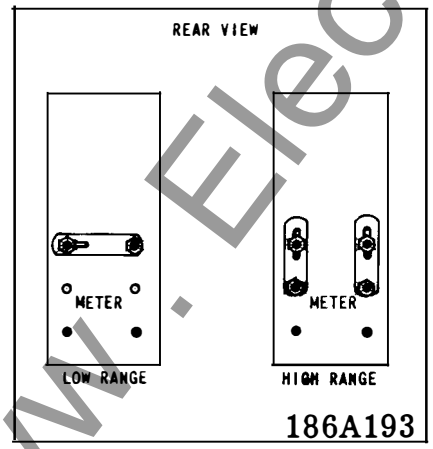

Fig. 29 - Type PM-44 Double Range Ammeters. Arrangement of Range Changing Links.

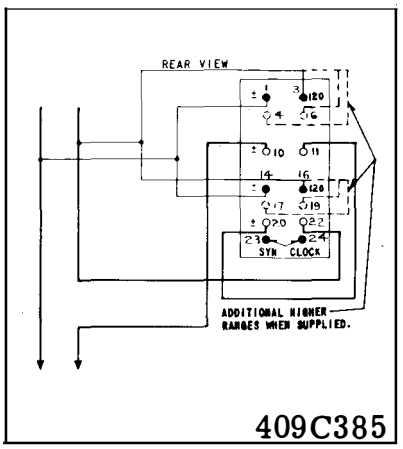

Fig. 30 - Type PF-44 Wattmeter 2 Current Coil on Single Phase 2-Wire Circuit.

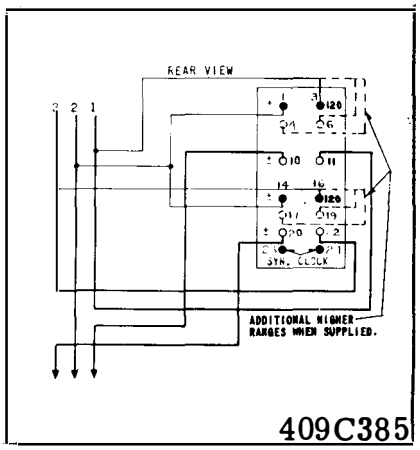

Fig. 31 - Type PF-44 Wattmeter 2 Current Coil on 3-Phase 3-Wire Circuit.

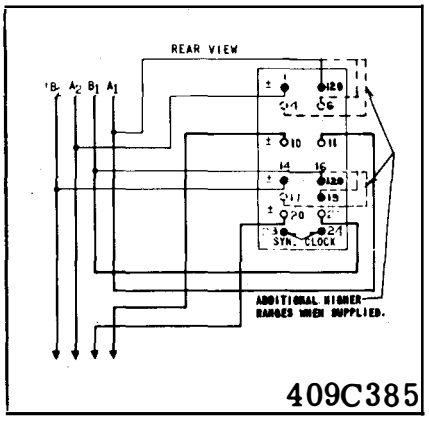

Fig. 32 - Type PF-44 Wattmeter 2 Current Coil on 2-Phase 4-Wire Circuit.

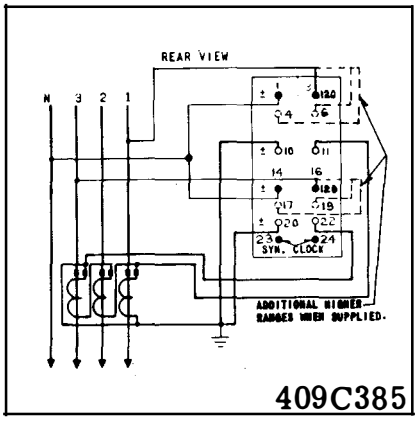

Fig. 33 - Type PF-44 Wattmeter 2 Current Coil with Delta Connected CT's on 3-Phase 4-Wire Circuit.

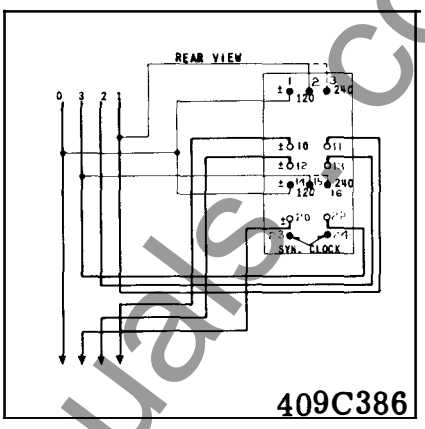

Fig. 34 - Type PF-44 Wattmeter 3 Current Coil on 3-Phase 4-Wire Circuit.

PORTABLE AC-DC UTILITY WATTMETER 5A-100MV

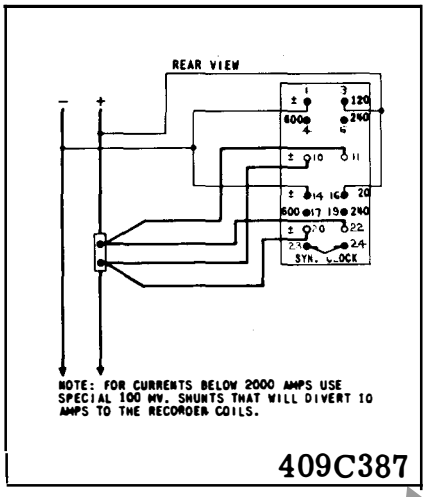

Fig. 35 - Type PF-44 AC-DC Utility Wattmeter on 2 Wire D.C.

With this connection the current circuit diverts 10 amperes from the shunt. Shunts below 2000 amperes should be calibrated with the recorder to allow for this.

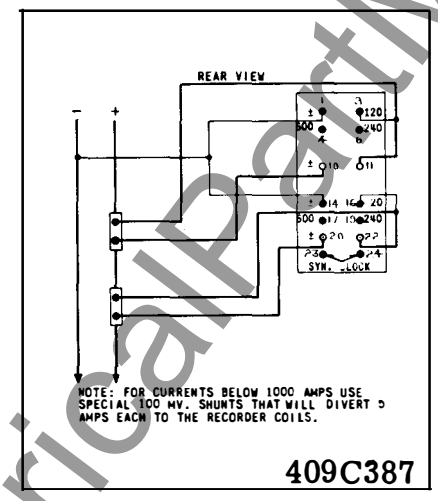

Fig. 36 - Type PF-44 AC-DC Utility Wattmeter on 2-Wire D.C.

With this connection the current circuit diverts 5 amperes from each shunt. Shunts below 1000 amperes should be calibrated with the recorder to allow for this.

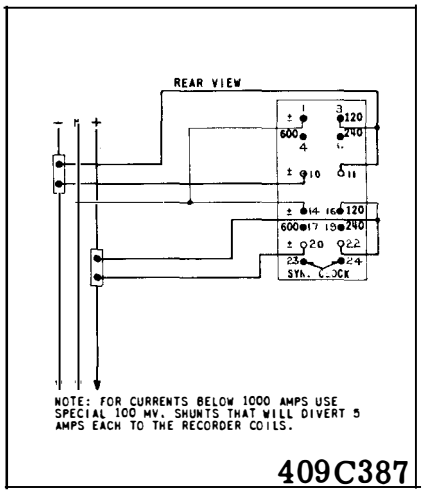

Fig. 37 - Type PF-44 AC-DC Utility Wattmeter on 3-Wire D.C.

With this connection the current circuit diverts 5 amperes from each shunt. Shunts below 1000 amperes should be calibrated with the recorder to allow for this.

NOTES: With connections Figs. 35, 36 and 37 it is especially important to use only the shunt leads furnished, and to have all the connections clean and tight.

For A.C. connections follow figures 30, 31, 32 and 33.

WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**
Printed in U.S.A.