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(Issue No. 2 of 1/54)

INSTALLATION, OPERATION AND SERVICE OF BRISTOL SERIES 500 RECORDING A.C. AMMETERS AND VOLTMETERS

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THE BRISTOL COMPANY WATERBURY 20, CONNECTICUT

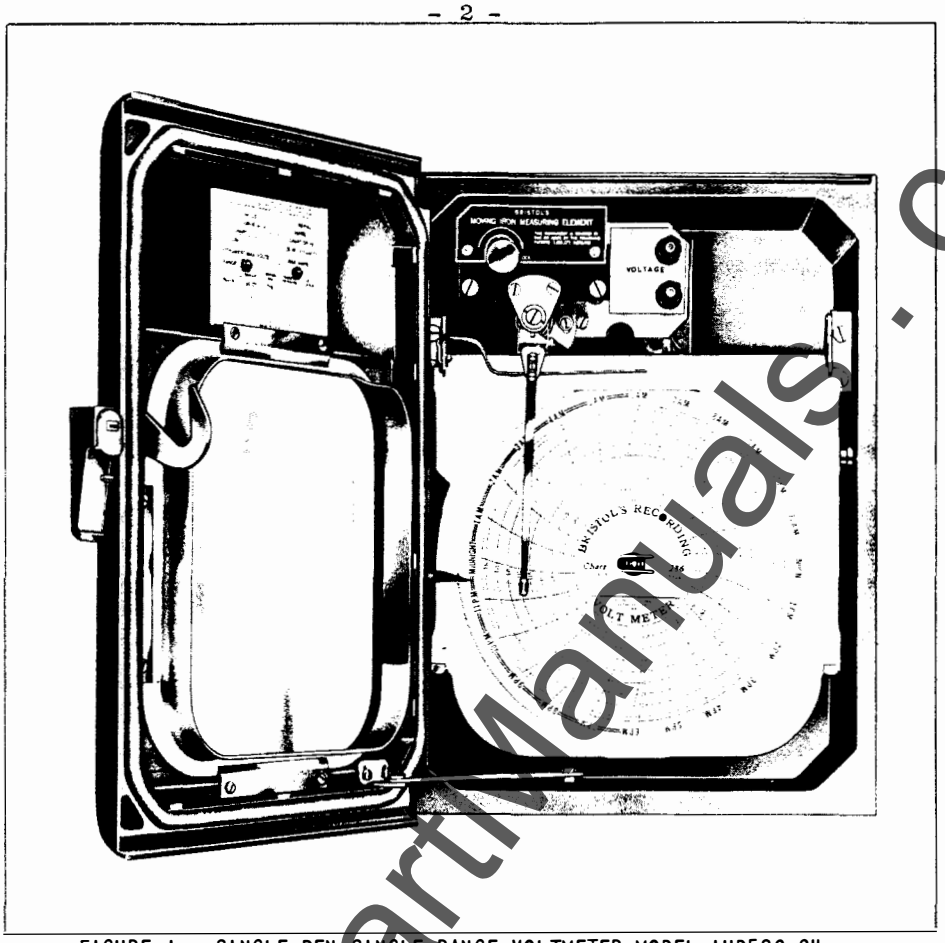

FIGURE 1. SINGLE-PEN SINGLE-RANGE VOLTMETER MODEL 1UD530-24

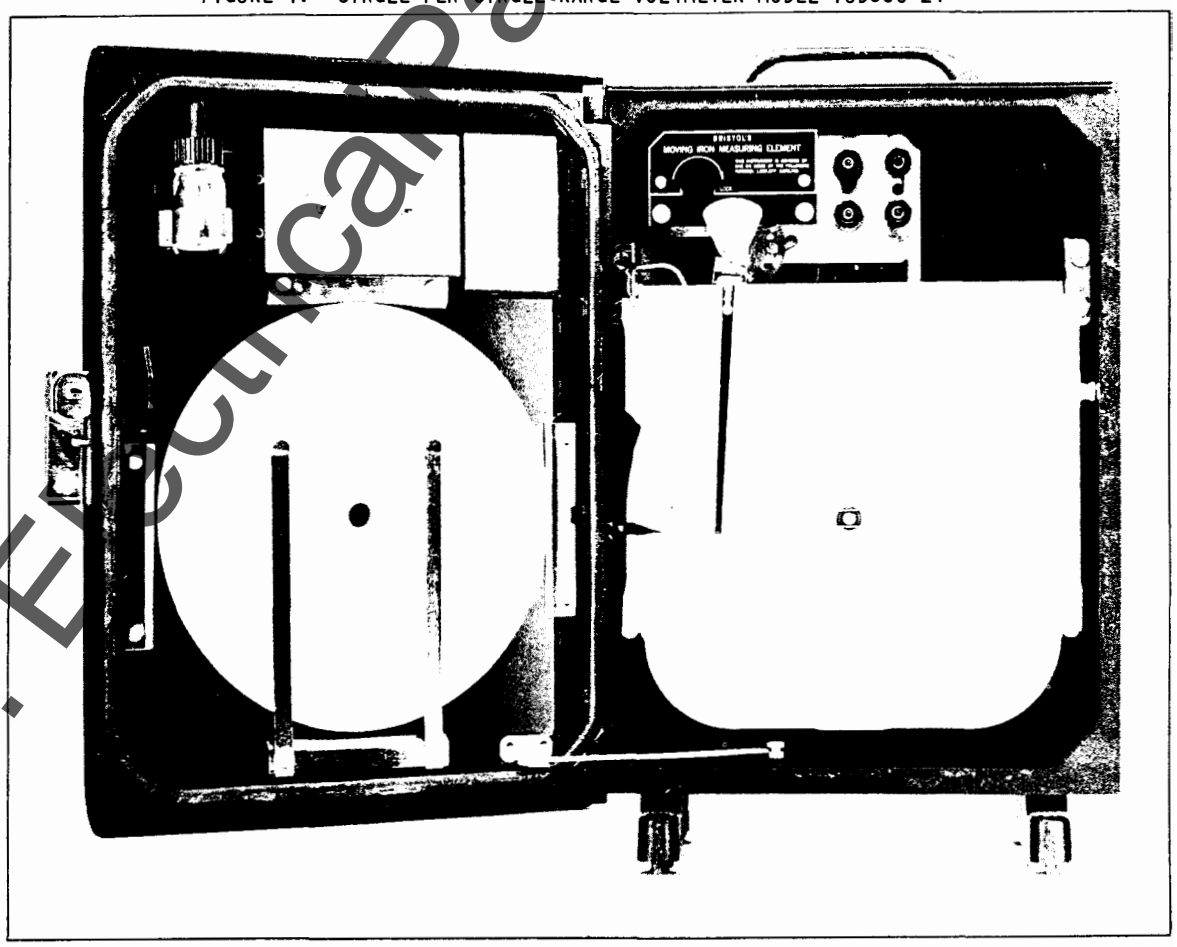

FIGURE 2. SINGLE-PEN DOUBLE-RANGE PORTABLE AMMETER MODEL 1UA541-25

PART I GENERAL

The Bristol Series 500 Ammeters and Voltmeters are the repulsion type, built especially for severe industrial and public-utility requirements.

The actuating torque in the instrument is produced by repulsion between two pieces of magnitized soft iron located within the coil. One piece of iron (Item 11, Fig. 5) is movable. The moving piece is mounted on a shaft which also carries the pen arm, restoring spring and damping vane. The current being measured flows thru the windings of the coil. The magnetic field thus created magnetizes the two pieces of iron. Because they are in nearly the same position within the field, both pieces of iron have the same magnetic polarity. Since like magnetic poles repel each other, the moving iron piece moves away from the fixed piece until the countertorque of the restoring spring equals the magnetic repulsion between the two iron pieces.

The amount of this magnetic repulsion is a function of the amount of current flowing thru the coil. The restoring spring has a constant torque gradient. Therefore, the movement of the recording pen is a function of the value of the current flowing in the coil.

PART II INSTALLATION

A. Unpacking the Instrument

Before disposing of the packing material, be sure you have found all accessories and supplies, such as mounting brackets or studs, charts, ink, pen cleaners, keys or any other items ordered.

B. Locating and Mounting the Case

See mounting-dimension drawings furnished with each instruction book. Nonportable cases are equipped with universal mounting brackets or studs for wall, flush-panel or surface-panel mounting.

Although the instrument is well protected from the harmful effects of dust, dirt, vibration, moisture, corrosive fumes and extremes of temperature, it should be located as far as possible from such unfavorable conditions.

Exact leveling of the case is not critical, but it is desirable to install it reasonably level. The movement is so balanced that tipping the case to the right or left will not affect its accuracy. However, the back of the case must be mounted vertically in order to maintain the proper pen pressure on the chart for a satisfactory record.

C. Wiring

See wiring diagrams attached. Make connections as called for in the proper external wiring diagram. All diagrams are shown as looking at the instrument from the front.

1. Voltmeters. Be sure the power to the measuring element and electric chart drive (if one is used) agrees with the voltage and frequency ratings given on the instrument name plate. Use potential transformers when necessary. Always connect voltmeters across the voltage source to be measured.

In a double-range portable voltmeter with electric chart drive, the range-change switch automatically maintains the proper chart-drive voltage when changing ranges.

In a two-pen instrument, element #1 (terminals V_1 and V_2) actuates the pen on the outer portion of the chart, and element #2 (terminals V_3 and V_4) actuates the pen on the inner portion of the chart (portion nearest chart hub).

In a three-pen instrument, element #1 (terminals V_1 and V_2) actuates pen on the outer portion of the chart, element #2 (terminals V_3 and V_4) actuates pen on the middle portion of the chart, and element #3 (terminals V_5 and V_6) actuates the pen on the inner portion of the chart.

2. Ammeters. Ammeters must be connected in series with the line under measurement. Before connecting the ammeter, check the name plate of the instrument for maximum current and for the chart-drive voltage and frequency. Separate terminals are provided for the electric chart drive if one is used.

If the instrument has two ranges, check to see that the range-changing links are in the required position (see diagram on the inside of instrument door).

Make connections according to wiring diagrams furnished.

Caution: When using current transformers with ammeters, **never** pass current thru the transformer unless the secondary circuit is completed. If an ammeter is to be disconnected from a current transformer, **always** turn off the current or short the secondary first.

In a two-pen instrument, element #1 (terminals A_1 and A_2) actuates the pen on the outer portion of the chart, and element #2 (terminals A_3 and A_4) actuates the pen on the inner portion of the chart (portion nearest chart hub).

In a three-pen instrument, element #1 (terminals A_1 and A_2) actuates the pen on the outer portion of the chart, element #2 (terminals A_3 and A_4) actuates pen on the middle portion of the chart, and element #3 (terminals A_5 and A_6) actuates the pen on the inner portion of the chart.

D. Installing the Pen

Install the pen arm and pen as shown in Figure 3.

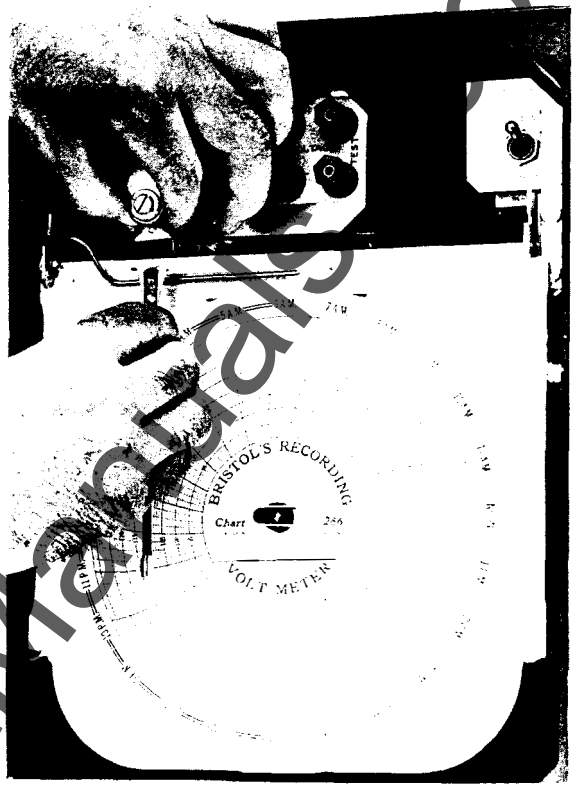

FIGURE 3. METHOD OF INSTALLING OR REMOVING PEN ARM

PART III OPERATION

After the instrument has been correctly installed and wired, turn the armature locking knob counterclockwise to release the armature. This knob should always be in the locked (clockwise) position whenever the instrument is being moved.

Check the chart to be sure it is tight on its hub and the pen is at the correct time division. Fill pen with ink, turn on the measured voltage or current, and turn on voltage to chart drive if instrument has an electric chart drive. Instrument requires a 15- to 20-minute warm-up period before accurate readings are recorded.

If the instrument was not calibrated at the factory or if there is good reason to believe that the calibration has been disturbed, it should be checked as outlined in Part IV under "Calibration".

A. Point Adjustment

Point adjustment (sometimes called zero adjustment) should be checked after the instrument is first installed and as required thereafter. This check may be at any convenient point within the instrument range. Be sure to allow the required 15- to 20-minute warm-up period before taking readings.

1. Voltmeters. Connect a standard laboratory meter of known accuracy to the line terminals of a non-portable voltmeter or to the terminals marked "test" on a portable voltmeter. Apply voltage across the voltage terminals of the instrument. If the instrument does not read the same value as the test meter, loosen segment-gear locking screw (Item 14, Fig. 5) and turn point adjustment (Item 13, Fig. 5) in a direction to bring the pen to the correct value on the chart.

2. Ammeters. Ammeters may be adjusted in the same manner as voltmeters except that the test ammeter should be connected in series with the terminals of the instrument being checked.

PART IV SERVICE

A. General

Bristol Voltmeters or Ammeters should never be lubricated. Keep them as clean and dry as possible and they will give many years of service.

B. Calibration

Bristol Voltmeters and Ammeters are calibrated at the factory to ranges specified on customer orders. If there is any reason to believe that the calibration has been disturbed, it may easily be checked and adjusted as described below. This is not a field adjustment and should be done under controlled conditions. It is desirable to have a known source of variable voltage (with sinusoidal characteristics). Instrument requires a 15- to 20-minute warm-up period before accurate readings are recorded.

1. Portable Voltmeters. Connect a standard laboratory meter of known accuracy to the terminals marked "test". Apply the minimum value (as indicated on the chart by the lowest value) across the terminals of the instrument marked "voltage". The instrument should read exactly what the test meter reads. If it does not, loosen the segment-gear locking screw (Item 14, Fig. 5) and turn point adjustment (Item 13, Fig. 5) in a direction which will bring the pen to the correct value as indicated on the test meter.

Next, apply the maximum value (as indicated on the chart by the highest value) across the voltage terminals of the instrument. The instrument should read exactly what the test meter reads. If it does not, rotate the magnetic shunt (Item 8, Fig. 5) in a direction to correct the instrument reading. This adjustment can be made merely by rotating the shunt by hand. This shunt is held in place by an elastic stop nut (Item 9, Fig. 5) which need not be disturbed when adjusting the shunt.

The third check should be made by applying a voltage about midway between maximum and minimum to the voltage terminals. The instrument should read exactly what the test meter reads. If it does not, the magnetic-shunt mounting arm must be moved. This is done by loosening the lock screw (Item 7, Fig. 5) and moving magnetic-shunt mounting arm (Item 10, Fig. 5) up or down as required. Lower the mounting arm if the instrument reads low or raise it if the instrument reads high. Do not disturb the position of the magnetic shunt on the mounting arm.

Repeat each check in the sequence above until all readings agree with the test meter. Repeating these checks is very important because each adjustment depends upon the other.

2. Standard Voltmeters (non-portable) Checking or adjusting the calibration of non-portable voltmeters is done exactly as explained in paragraph 1 above except that the test voltmeter must be connected directly across (in parallel with) the line terminals of the instrument.

3. Ammeters (portable or standard). Checking or adjusting the calibration of ammeters is done exactly as explained in paragraph 1 above except that the test ammeter must be connected in series with the instrument being tested,

4. Double-range Instruments.

a. Voltmeters. A double-range voltmeter should be calibrated in its lower range. After the calibration has been completed in the low range, put the range-change switch in its high-range position and check the instrument reading against a test meter at any convenient voltage in that range. If the instrument does not check with the test meter, adjust the setting of the adjustable resistor until reading is correct. In a two-pen instrument, the upper resistor is for the #1 element and the lower resistor is for the #2 element.

b. Ammeters. A double-range ammeter may be calibrated in either range, whichever is more convenient. The other range will automatically be in calibration.

C. Armature Balance

1. General. The armature includes all parts mounted on shaft (Item 16, Fig. 5) and includes such items as the moving iron piece, pen and pen arm, vane and counterweight.

The armature is in balance when the instrument leaves the factory and should

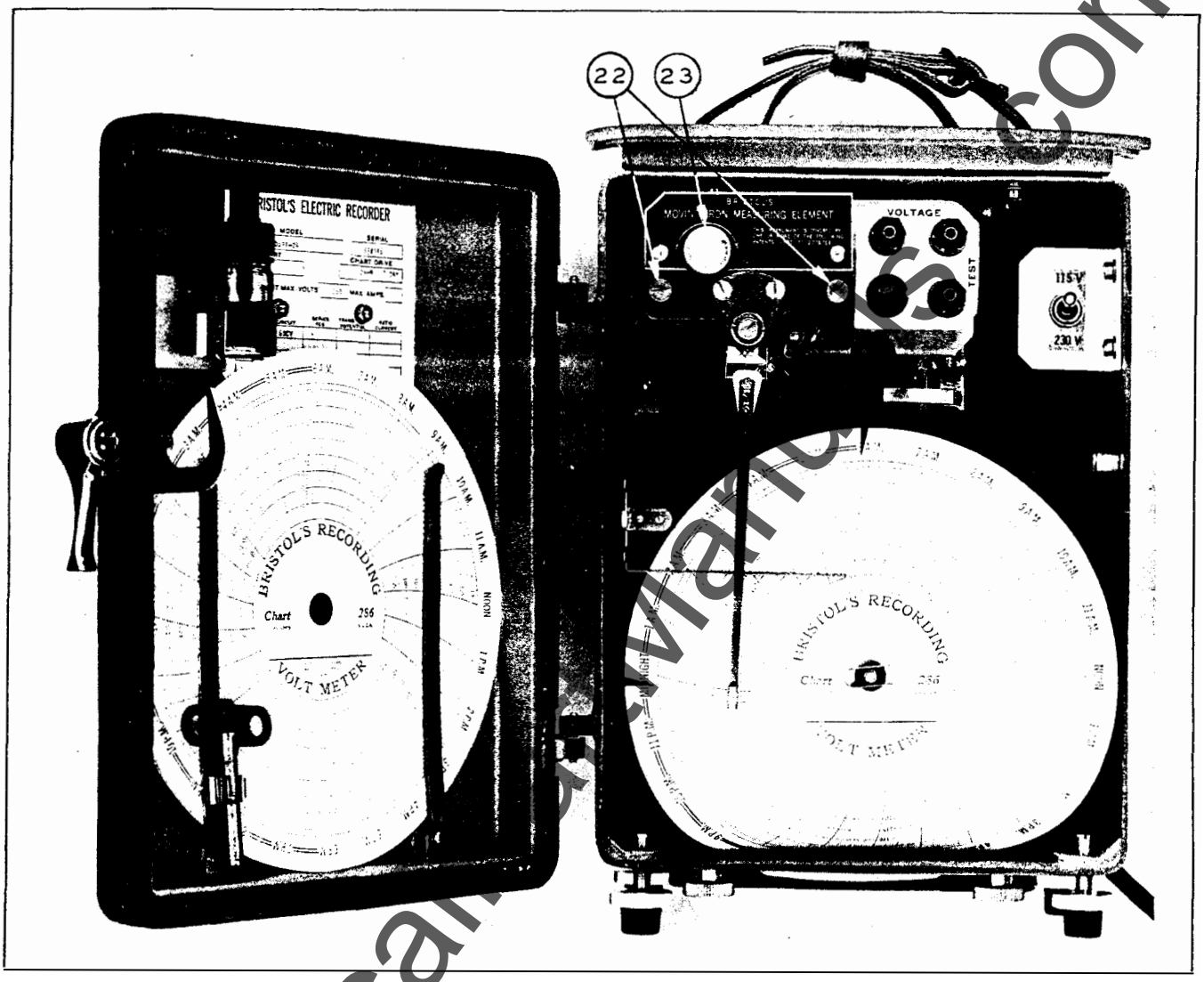

FIGURE 4. SINGLE-PEN DOUBLE-RANGE POLE-MOUNTED VOLTMETER MODEL 1U3D631-24

remain in balance if the measuring element is locked whenever the instrument is moved. Rough handling or a strong shock may, however, unbalance the armature and cause errors in calibration.

Armature balancing is not a field adjustment and should be attempted only under laboratory conditions and by qualified personnel. When such are not available, the instrument should be returned to the nearest Bristol Branch or Main Factory for balancing and recalibration.

2. Balancing Procedure. See Figures 4 and 5 for location and identification of item numbers referred to below.

a. Loosen screw (2). Remove screws (22) and top-bearing plate. Lift armature assembly until it clears bottom bearing. Turn armature clockwise until vane (20) clears magnet (21) and then lift armature out of movement.

b. Visually line up the moving iron (11) parallel to shaft (16). Loosen the counterweight and vane assembly setscrew slightly so that assembly may be twisted on the shaft but will not slip of its own weight.

c. Mount the armature between a set of knife edges or bearings. Tighten screw (4) so that pen arm and pen will not fall out of position when the armature is rotated. Fill pen half full of ink.

d. Swing the armature so that counterweight (19) is horizontal. Loosen counterweight locking nut. Screw counterweight in or out as required until the armature will stay in position when released. **Note:** The side counterweights (17) on a 25-cycle movement should not be disturbed.

e. Swing the armature so that counterweight (19) is vertical. Twist

CODE TO FIGURES 4 AND 5

1. Pen Arm
2. Spring locking screw
3. Restoring spring
4. Pen-arm locking screw
5. Front bearing
6. Fixed iron piece
7. Shunt-arm locking screw
8. Magnetic shunt
9. Elastic stop nut
10. Shunt mounting arm
11. Moving iron piece
12. Coil
13. Point adjustment
14. Segment-gear locking screw
15. Segment gear
16. Shaft
17. Side counterweights (25-cycle voltmeters only)
18. Rear bearing
19. Counterweight
20. Vane
21. Magnet
22. Mounting screws
23. Armature locking knob

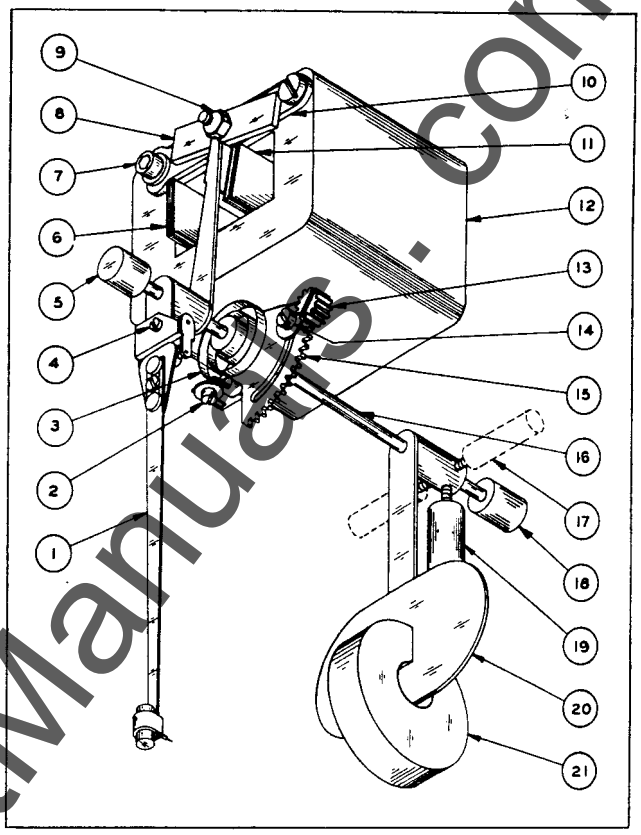

FIGURE 5. ISOMETRIC VIEW OF MOVING IRON ELEMENT

the counterweight and vane assembly on the shaft if required so that armature will stay in position when released.

f. Recheck balance with counterweight in both positions (horizontal and vertical). Repeat steps **d** and **e** above if necessary. When armature is completely balanced, tighten counterweight locking nut and counterweight and vane assembly setscrew, being careful not to change the settings. Again recheck balance with assembly in both positions.

g. Loosen screw (4) until pen arm swings freely without end shake and replace armature in instrument. Replace top-bearing plate and screws (22). Check to make sure vane (20) does not touch magnet (21) at any point in its swing.

After performing the balancing procedure, instrument must be recalibrated as outlined in paragraph B, page 5.

D. Repairs, Correspondence and Shipping

If your voltmeter or ammeter does not function properly after the calibration has been carefully checked, it should be returned to one of the Bristol factories for repair or replacement. **Do not** ship instruments to Bristol Branch Offices.

In all correspondence please mention the instrument model and serial numbers and your repair order number. Address all correspondence and orders to the nearest Bristol Branch Office, a list of which may be found in all instruction manuals. Be sure to mark your return address plainly.

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