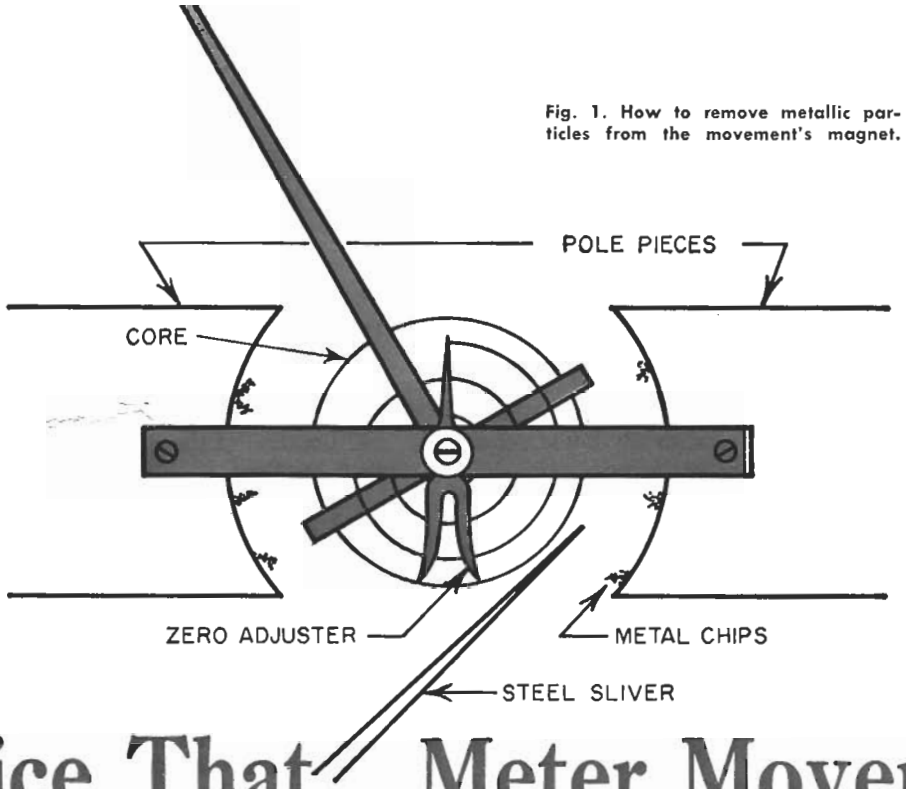



Fig. 1. How to remove metallic particles from the movement's magnet.

# Service That Meter Movement

***Despite the "hands off" warning for some defects, many remedies for erratic action are within the scope of the non-specialist.***

By THOMAS R. HASKETT

SINCE THEY feel that such work is properly left to specialists, few technicians will attempt to work on the movements of their meters. It is true that certain jobs must be left to the meter shops and labs specializing in this field. Nevertheless, there are certain maintenance and repair measures which, although they may require some care, are within the scope of the average technician interested in saving the expense of replacement or outside repair.

If the pointer tends to stick or move erratically, or if it cannot be "zeroed" reliably by means of the external, zero-set screw, the trouble is likely to be one that can be handled without going elsewhere. This applies to the d'Arsonval movement, or basic d.c. ammeter, which is common to most instruments technicians are likely to encounter and use. It is such meters with which we deal here.

The first rule is that work should be done in a closed room; one with little air circulation. A clean, well lit table should be covered with a large sheet of white paper. Any tools to be used should first be freed of metal particles, dirt, and lint by brushing with a small, clean paint brush. The technician then rolls up his sleeves, washes his hands thoroughly, and dries them. He is now ready for "surgery." At this point, the meter can be inspected to determine whether it can be repaired or not.

### *Preliminary Examination*

The movement is removed from its case carefully and a visual check is made of the coil and springs. If these have been burned out, no further attempts should be made; the unit is beyond repair.

If the glass or the case has been broken, it's extremely likely that dust has found its way into the coil. This would account, at least in part, for any sluggishness noted in the pointer's action. This can be remedied. However, it is also likely that the meter pivots are dull, and these can't be repaired in the field. However, if glass, case, coil, and springs are intact, cleaning and re-adjustment can be performed.

### *Lint and Dirt*

If the pointer tends to stick at some particular spot on the dial, or if tapping the case while a static measurement is being made causes the reading to increase without an increase of coil current, the most probable cause is lint, dust, or metallic particles in the coil or on the magnet surrounding it. Such foreign particles can be removed by either or both of the techniques described here.

A thin sliver of steel is most suitable for drawing off chips of ferrous metal clinging to the magnet. This implement, which can be fabricated easily, should be filed extremely thin at its point. It should then be wiped carefully to make certain there is nothing on it that it can deposit in the movement. Then, as shown in Fig. 1, it should be inserted between the pole piece and the core in such a way as not to touch the springs or coil. This is not an easy job, particularly for someone who has not done it before, but it can be managed.

Use a magnifying glass to check for lint, since even a tiny piece can cause sticking. Relatively large pieces can be removed with fine tweezers. For others, a burning tool like the one in Fig. 2 may be needed. Wires can be taped to the outer surface of the wooden dowel for support. The working end is formed much like a small soldering tip. It may be necessary to hammer the point flat so that it can be inserted in the coil without disturbing the latter too much. Although the stepped-down voltage is intended to control the build-up of excessive heat, avoid a heavy hand or the application of the burning tool in one area for too long a time, lest the

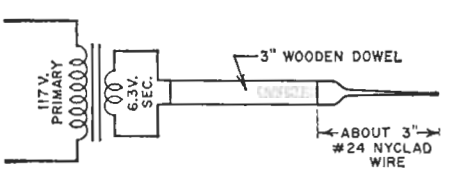
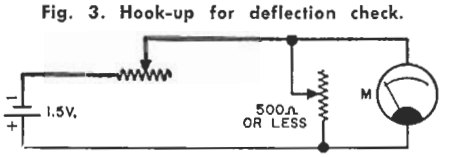



Fig. 2. A simple burning tool for removing fine particles of dust and lint.

Fig. 3. Hook-up for deflection check.



springs or the wire of the coil be subjected to damage.

### *Friction Problems*

If the moving pointer scrapes the dial at one or more points, this friction will of course cause sticking and erratic movement; the obvious remedy is to straighten the pointer. Use tweezers and work gently. Too much force can damage the coil or springs.

If a meter has been subjected to excessively rough treatment, there is a chance that the jewels have been cracked or the pivots dulled. You can do nothing about either of these defects—but there's one other possibility that could cause similarly erratic deflection. The bearings may be too tight. The jewel screw, located in the center, should be loosened slightly to see whether friction is thereby reduced. It will probably be necessary to use a jeweler's screwdriver for this job. If one isn't handy, a thin scrap of metal can be filed down to size but, once more, be sure to brush away any filings before use.

### *Rebalancing*

If the meter movement no longer returns accurately to zero indication when current is not applied, it is possible that misuse has disturbed its delicate balance. There is an externally available zero-set screw on the face of the case, of course, but its re-adjustment may not bring the pointer to rest at zero *regardless of the position of the meter.*

Correction of this condition involves adjustment of the balancing tail and side weights, located at the bottom end of the pointer near the pivot. Before attempting this, make sure that the pointer is straight. Then hold the meter so that the zero mark heads up at an angle of about 22 degrees from the horizontal, as in Fig. 4A. In this position, adjust the zero-set screw so that the pointer is exactly over zero.

Next rotate the meter until the zero mark and the pointer are heading horizontally, as in Fig. 4B. In this position, adjust the tail weight for exact zero. Finally, hold the meter so that the pointer and the zero mark are pointing straight up (Fig. 4C), and adjust the side weights for accurate zero indication in this position.

Screw-type adjustments may be used for these weights, but they vary with the make and model of the movement. Some ingenuity may be required in utilizing and even fabricating tools that will facilitate manipulation.

Before the movement is returned to its case, the latter should be cleaned, but never use a cloth: lint will almost certainly find its way back into the coil. Use a clean, soft-bristle brush and always stroke away from the movement itself.

Although this is largely a matter of appearance rather than performance, the dial face should be inspected for possible marks. As a rule, any that are found can be removed with an ordinary pencil eraser—but don't run the risk of having eraser particles get into the movement. Hold the meter upside-down so that debris will fall away from the coil and springs.

### *Checking and Calibration*

It is a good idea to get the meter back in its case before final checking and calibration, and this can be done if no internal shunt is used. Where a shunt is involved, the movement is best left uncased for these final steps, since the shunt itself may require correction.

First the deflection action of the pointer with current applied should be observed. A suggested hook-up is shown in Fig. 3. The series potentiometer should be high to start out with, greater than internal resistance of the movement. The procedure can be started safely with both potentiometers at full resistance, but one of the wires to the meter terminals should be held in place by hand rather than connected securely. Thus, if rotating the arm of the series pot causes the pointer to deflect suddenly, the wire can be released before the coil has a chance to burn out.

If abrupt motion of this type is noted, a series pot of higher value should be substituted and the operation can be attempted again. By alternate re-setting of the two controls, a point is found where manipulation of one control produces a controlled deflection of the pointer. It should now be possible to adjust for deflection from one extreme of the dial scale to the other, in order to make certain that the pointer moves freely and smoothly throughout its arc of travel.

If another meter of known accuracy is on hand, it can be used to check the accuracy of the repaired unit by substitution for the latter in the arrangement of Fig. 3 or by placing the two meters in series. If such a precise standard is not available, the best thing to use is probably a simple, 20,000-ohms-per-volt v.o.m. Such an instrument generally contains a movement rated at about 50 microamperes in association with other elements that are entirely passive. Its inherent accuracy and stability are high. The v.o.m. should be switched to a current range as close as possible to the full-scale value on the dial of the repaired unit, but not lower than the latter.

If this test shows the repaired unit to be inaccurate and the latter uses an internal shunt, it may be possible to reconnect or replace the shunt to improve precision. Accuracy may have been impaired because age and the effects of other magnetic fields have weakened the magnet. Nevertheless, "re-shunting" can correct this condition. The proper resistance value is determined simply by the trial-and-error method. Make certain that voltage is not applied to the movement whenever the shunt is removed, or coil burn-out may result.

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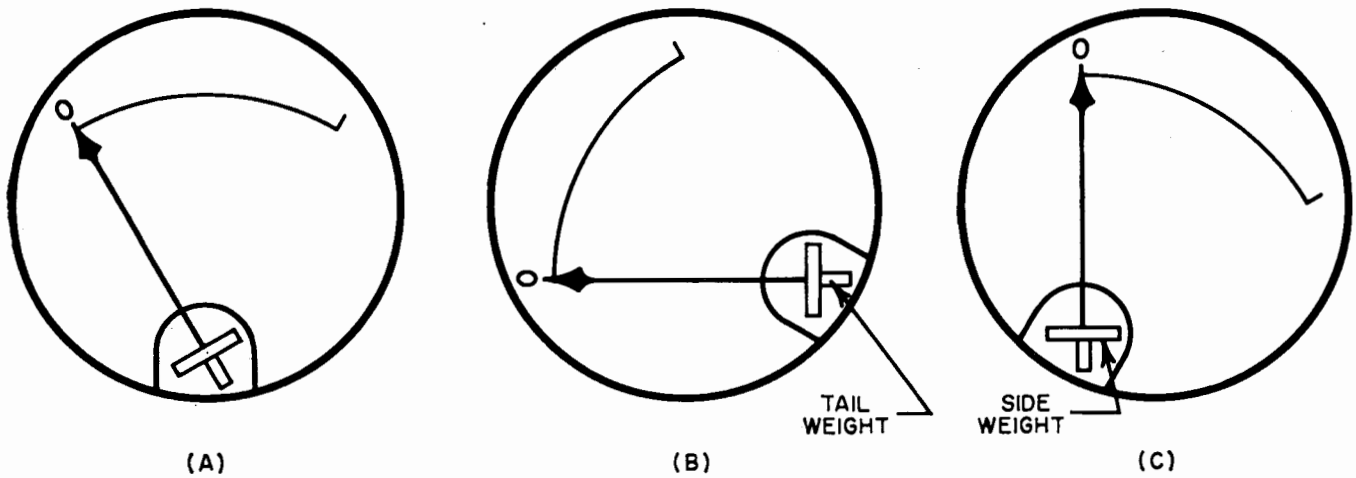


**Fig. 4. Zero set holds well in any position with proper balance. Check and adjust in the three positions shown.**

# Servicing Meter Movements

(*Continued from page* 45)

Increasing the shunt value will increase current through the movement, producing a higher reading. If readings are too high, compensate by reducing the shunt or adding one if needed.

A final note of caution is in order. The movement may be so delicate, once it is out of its case, that air movement will affect its action. Thus, if you are working with the meter at close quarters, normal breathing may interfere with the job. If you run into this, tying a clean handkerchief or other cloth over the nose and mouth should diffuse exhaled breath sufficiently to eliminate the problem. This may lead to a ribbing if someone should happen to see you, but it is an effective measure for dealing with the problem. ▲