Aug. 15, 1939. H. A. GILL ET AL 2,169,476

GALVANOMETER

Filed May 17, 1937

Fig. 1.

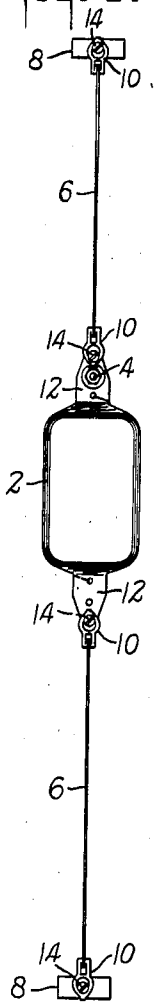


Fig. 2.

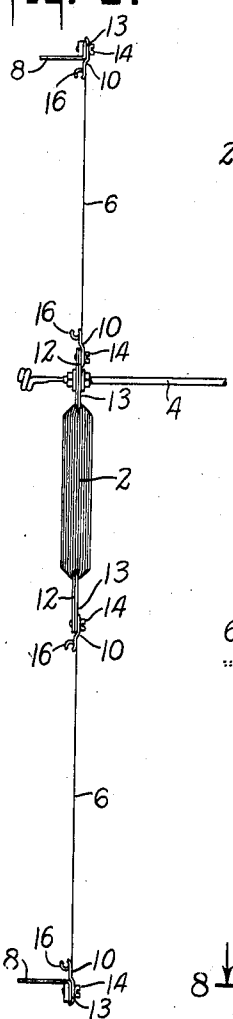


Fig. 4.

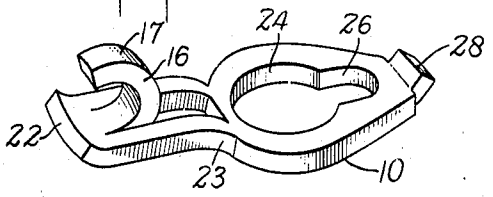


Fig. 5.

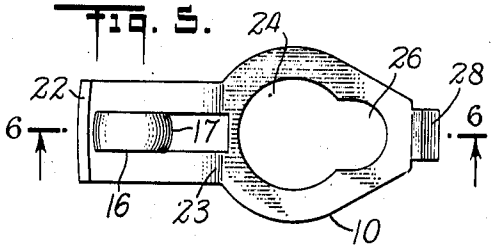


Fig. 6.

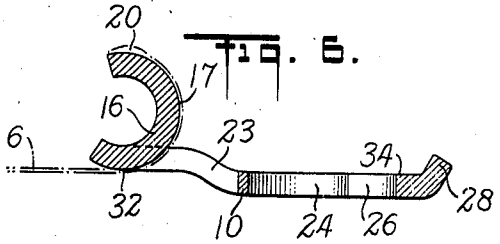


Fig. 7.

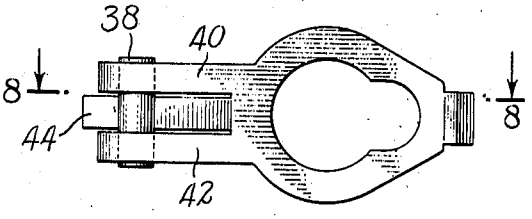


Fig. 8.

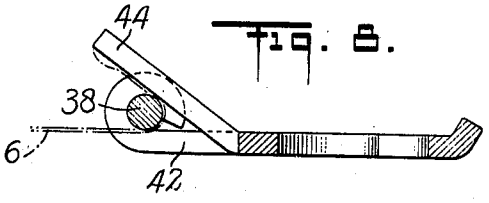
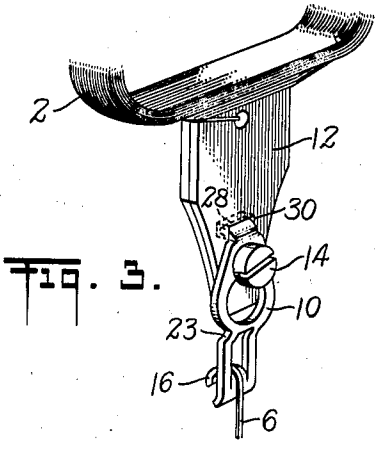


Fig. 3.



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Patented Aug. 15, 1939 2,169,476

UNITED STATES PATENT OFFICE

2,169,476

GALVANOMETER

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Application May 17, 1937, Serial No. 142,990

15 Claims. (Cl. 171—95)

This invention relates to galvanometers of the d'Arsonval type and more particularly relates to means for mounting the moving coils of such instruments.

In galvanometers of the d'Arsonval type, in order to avoid the loss of sensitivity due to pivot friction encountered when a jewelled pivot type of mounting is used, it has been customary to suspend the moving coil of such a meter between suitable supports by two torsionally resilient vertical strips. These suspension strips are delicate and are under considerable tension. They must be firmly attached to the armature and to the support to prevent variations in the adjustment of the instrument and also to provide a good electrical connection to the galvanometer coil because these strips are usually used to conduct the current flow to and from the coil.

In the past it has been customary to solder these strips directly to a portion of the coil mounting and to the supports. Such an arrangement is somewhat impractical because it necessitates the services of a trained operator to replace the suspension strips in the event that they are damaged, broken or for some other reason need replacing. To overcome this difficulty it has been customary permanently to attach connectors in the form of pins to the ends of the suspension strips adapted to connect detachably with the coil frame and the supports. However, this type of pin connection and the manner of securing the pin to the strip has proven unsatisfactory because of the difficulty of assembling the parts and the susceptibility to breakage at the junction of the pins and strips.

In the present invention this manner of coil suspension has been improved to make assembly and disassembly easier and to make the whole support stronger without impairing the sensitivity of the instrument.

In accordance with an embodiment of the invention herein illustrated, a slightly crowned cylindrical surface is provided on each connector over which surface the suspension strip passes. The strip leaves the connector tangent to the surface and in a direction perpendicular to the generating element of the cylindrical surface, whereby the strip is not subjected at any point to sharp bending. In this way, too, the solder or other means for attaching the strip to the connector actually is only an anchorage for the end of the strip, and no forces are exerted on the strip at this connection other than along the line of the curved surface. Further, by passing the strip around such a curved surface before anchoring it, the benefit of a snubbing action is obtained.

This and other apparent objects and advantages are obtained by the means described in the following specification and may be more readily understood by reference to the accompanying drawing in which:

Figure 1 shows a front elevation of a galvanometer coil mounted in accordance with the method of this invention;

Figure 2 shows a side view of the galvanometer arrangement shown in Figure 1;

Figure 3 shows an enlarged view in perspective of the way in which the suspension strip is attached to the lower part of the coil illustrated in Figure 1;

Figure 4 shows an enlarged view in perspective of a suspension strip connector in accordance with one embodiment of this invention;

Figure 5 shows a plan view of the connector illustrated in Figure 4;

Figure 6 is a section taken through line 6—6 of Figure 5;

Figure 7 is a plan view of another embodiment of this invention; and

Figure 8 is a section taken on line 8—8 of Figure 7.

Referring to Figures 1 and 2 the moving coil 2 of a galvanometer, provided with a pointer 4 rigidly attached to the top thereof, is suspended on two torsionally resilient metal suspension strips 6 extending between two supports 8 which subject the strips to a resilient tension. The supports 8 are preferably provided with means, not shown, for adjusting the tension. The ends of the suspension strips 6 are soldered to connectors 10 which in turn are firmly clamped by screws 14 to attaching faces 13 on the supports 8 and on connection tabs 12 extending axially from coil 2.

Each of the connectors 10 is provided with a slightly crowned cylindrical surface, the generating element of which is perpendicular to the suspension strip, around which the strip is snubbed before being attached to the connector. The slight crown to the cylindrical surface of the connector is desirable because the greatest strain is exerted on the center of the strip rather than on its edges. In addition, it permits the strip to swing a small amount in any direction without placing a strain on the edge of the strip. Each of the connectors is also provided with a keyhole-shaped slot through which a screw passes to clamp the connector to the attaching face, and an offset portion to coact with the attaching face to aid in accurately positioning the connector with re-

spect to the attaching face to which it is clamped.

Figures 4, 5 and 6 show a connector which is one embodiment of this invention. This connector may be stamped out of sheet metal and is provided with a tongue 16 stamped out of the body of the connector and curved away from the connector to form a slightly crowned cylindrical surface 17 tangential to the body of the connector as is more clearly shown in Figure 6. The suspension strip, shown in broken line 6 in Figure 6, passes around this curved surface 17 and is soldered, welded or anchored in any other suitable manner to the end of the tongue 16 at an anchoring portion 20. The curved surface 17 is continued to the end 22 of the connector where the tongue 16 joins the body of the connector, so that the strip 6 leaves the curved surface 17 tangentially and never makes contact with a sharp corner (as at the end 22 of the connector) which might cause the strip to bend sharply and tend to damage it, causing it to break at this point.

The other end of the connector is expanded slightly and is provided with two intersecting holes 24 and 26 forming a keyhole-shaped slot. The diameter of the hole 24 is slightly larger than the diameter of the head of the clamping screw 14 and the diameter of hole 26 is smaller than the diameter of the head of the screw 14 but slightly larger than the shank of the screw. This end of the connector is also provided with a small offset portion or lip 28 which fits into a slot 30 in the attaching face 13 of the coil connection tab 12, as is more clearly illustrated in Figure 3, to aid in properly positioning the connector with respect to the attaching face.

In the embodiment shown in Figures 1 through 6, the portion of the connector to which the tongue 16 is attached is slightly offset with respect to the other portion of the connector by a bend 23 so that the point 32 where the strip meets the connector is in the same plane as the face 34 of the connector which is adjacent the attaching face 13 when the connector is clamped in position. Thus the longitudinal pull on the suspension strip is in the same plane as the attaching face of the coil tab 12 or the support 8. This arrangement is also advantageous where it is desired to have the line of pull of the suspension strips pass directly through the geometrical center of the galvanometer coil 2 because the bend 23 may be so designed as to accomplish this result regardless of the thickness of the connection tab 12. In addition it permits the tongue 16 to extend toward the back of the galvanometer assembly.

In galvanometer suspensions of the type herein described, it is important that the delicate suspension strips, which are usually made of a gold alloy, do not come into contact with any irregular surfaces which might tend to bend or damage them, or subject them to uneven stress. For this reason the connectors are suitably treated so as to avoid corrosion and are suitably processed so that all surfaces of the connectors which touch the suspension strips are very smooth. A method for fabricating these connectors which has proven satisfactory is to stamp the connectors out of bronze metal sheet, plate them with a layer of 14 karat gold, subject them to some smoothing process such as a tumbling operation, and finally to plate them with a layer of pure gold. This gives the connectors a smooth and highly polished surface which is extremely resistant to corrosion and to which the suspension strips may be readily soldered or welded.

In attaching a suspension strip to the anchoring portion 20 of the curved surface 17 of a connector care must be taken to avoid solder running around the curved surface so as to form a connection between the strip and the surface at any place near the point at which the strip departs tangentially from the surface. Otherwise forces other than those longitudinal of the strip may be exerted on the strip when the galvanometer assembly is subjected to forces other than those electrical forces rotating the armature.

With suspension members of this type, the mounting of a galvanometer coil may be accomplished very readily and without difficulty. The clamping screws 14 on the galvanometer coil connection tabs 12 and on the supports 8 are loosened, the connectors are slipped over these screws by means of the large holes 24 and are then moved along under the heads of the screws until the shanks of the screws fit into the smaller holes 26. They are then clamped tightly against the attaching faces 13 by tightening the clamping screws 14. The keyhole-shaped slots in the connectors permit the connectors to be hooked in position and clamped to the attaching faces 13 without removing the clamping screws 14 therefrom, and, in connection with the lips 28 on the ends of the connectors, they hold the suspension members in their proper positions so that the galvanometer assembly is operative even though the clamping screws 14 be loose.

A connector forming another embodiment of this invention is shown in Figures 7 and 8. In this connector a cylindrical bar 38 is clamped in place by two arms 40 and 42 extending from the body of the connector. The suspension strip 6 is snubbed around the cylindrical surface of this bar and is attached to the end of a third arm 44, substantially as shown.

As connectors of various forms may be constructed and various modifications may be availed of without departing from the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative only and not in a limiting sense.

We claim:

1. In a galvanometer suspension system of the type wherein a moving galvanometer armature is suspended to rotate on an axis between two delicate suspension strips extending from opposing supports, connectors for joining the ends of each suspension strip respectively to the armature and support, each connector comprising, in combination, a cylindrical snubbing surface, an anchoring surface adjacent and tangent to said snubbing surface to which the strip end is connected, and each connector having a keyhole-shaped opening adapted to pass over the head of a supporting screw and to slip down over the shank thereof whereby said connectors may be held in place so that the strip passing from the connector leaves it tangentially and perpendicular to the element generating the cylindrical surface.

2. In a galvanometer suspension system of the type wherein a moving galvanometer armature is suspended to rotate on an axis between two delicate suspension strips extending from opposing supports, connectors for joining the ends of each suspension strip respectively to the armature and support, each connector comprising, in combination, a body portion having a struck-up tongue forming a snubbing surface and an anchoring surface, a cut-out portion for receiving a sup-

porting screw, and an offset portion adapted to coact with a slot in the support to which the connector is attached to align the same with said support.

3. In a galvanometer suspension system of the type wherein a moving coil member of a galvanometer is rotatably suspended about an axis on two delicate suspension strips extending from said coil member to two suitable supports, the combination of connectors for joining said strips to said coil member, means for detachably connecting said connectors to said coil member, and means to aid in the positioning of said connectors with respect to said coil member including offset portions on said connectors adapted to coact with slots in said coil member.

4. In a galvanometer suspension system of the type wherein a moving coil member of a galvanometer is suspended on an axis on two delicate suspension strips extending from said coil member to two suitable supports, in combination, connectors for joining said strips to said coil member and supports, means for detachably connecting said connectors to said coil member and supports, and means to aid in the positioning of said connectors with respect to said coil member and supports including flat tabs bent away from the body of said connectors adapted to coact with straight edges on said coil member and supports perpendicular to the axis of said galvanometer suspension.

5. A connector for connecting the end of a strip supporting a galvanometer armature to either the armature or the support, comprising a strip-connecting portion having a struck-up tongue, the tongue and end portion of said strip-connecting portion being curved and provided with a crowned surface and the end of said struck-up tongue being curved slightly toward said end portion, and a mounting portion having a keyhole-shaped opening adapted to pass over a headed screw and to slip over the shank thereof to hold the connector so that the strip leaves the struck-up tongue portion tangentially.

6. A connector for connecting the end of a strip supporting a galvanometer armature to either the armature or the support, comprising a strip-connecting portion having a struck-up tongue, the tongue and end portion of said strip-connecting portion being curved and provided with a crowned surface and the end of said struck-up tongue being curved slightly toward said end portion, and a mounting portion having a keyhole-shaped opening adapted to pass over a headed screw and to slip over the shank thereof to hold the connector so that the strip leaves the struck-up tongue portion tangentially, said connector being formed from bronze and having a 14 karat gold plating covered by a pure gold plating.

7. A connector for connecting the end of a strip supporting a galvanometer armature either to the armature or the support, comprising, in combination, an end portion cut into three fingers, the outer two of which are bent to form bearings, a pin held in said bearings, and the middle finger bearing downwardly against said pin, said middle finger being adapted to form an anchorage to which the strip is attached, the strip then passing over the pin which forms a snubbing surface, said connector also having a supporting portion by which the connector is attached to the armature or support.

8. For use in a meter assembly having an armature and a delicate suspension strip for said armature, means for securing an end of said strip to a portion of said assembly, comprising, in combination, a convex cylindrical snubbing surface over which the suspension strip passes in leaving said means, and an anchoring surface on said cylindrical snubbing surface removed from the point at which said strip leaves the snubbing surface so that in leaving the snubbing surface the strip is held against the snubbing surface only by the tension placed on it.

9. In a meter assembly having an armature and a delicate suspension strip for said armature, in combination, means for securing an end of said strip, and a crowned cylindrical snubbing surface over which the suspension strip passes in leaving said means.

10. In a meter assembly having an armature and a delicate suspension strip for said armature, in combination, a connector for joining an end of said strip to a portion of said assembly, means for detachably securing said connector to said portion, and means for aiding in the positioning of said connector with respect to said portion including a projection and a positioning surface adapted to coact therewith, one of said last-named elements being associated with said connector and the other with said portion.

11. A meter assembly, including, in combination, a moving armature suspended between two delicate suspension strips extending from opposing supports, and means for joining the ends of each strip respectively to its support and to said armature, each of said means having a convex cylindrical snubbing surface over which its suspension strip passes in leaving said means.

12. A meter assembly, including, in combination, a moving armature suspended between two delicate suspension strips extending from opposing supports, connectors for joining the ends of each strip respectively to its support and to said armature, each of said connectors having a convex cylindrical snubbing surface over which its suspension strip passes in leaving said connector, and means for detachably securing said connectors to said armature and supports.

13. In a meter assembly having an armature and a delicate suspension strip for said armature, in combination, means for securing an end of said strip, and a convex cylindrical snubbing surface over which said strip passes in leaving said means, said means and cylindrical surface being so arranged that the strip contacts the snubbing surface throughout an arc of approximately 120° or more.

14. For use in a meter assembly having an armature and a delicate suspension strip for said armature, means for securing an end of said strip to a portion of said assembly, said means comprising, in combination, anchoring means for anchoring said end, a convex cylindrical snubbing surface so positioned that said strip passes from said anchoring means in a tangent to said snubbing surface, passes over a portion of said snubbing surface, and leaves said snubbing surface tangentially, and means to prevent said strip from being moved inadvertently from its tangential path between said anchoring surface and said snubbing surface.

15. In a meter assembly having a moving armature, a support therefor, a delicate suspension strip for supporting said armature from said support, and means for maintaining said suspension strip under tension, in combination, a connector secured to an end of said strip for attaching said strip to a connection portion of said support and means for detachably securing

said connector to said portion including means for hooking said connector to said portion and aligning it therewith in a given position, and means for clamping said connector to said portion to maintain it in said aligned position, said hooking means serving to hold said connector in said position in spite of the tension exerted on said strip until said connector is rigidly clamped to said connection portion of said support in said aligned position.

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