

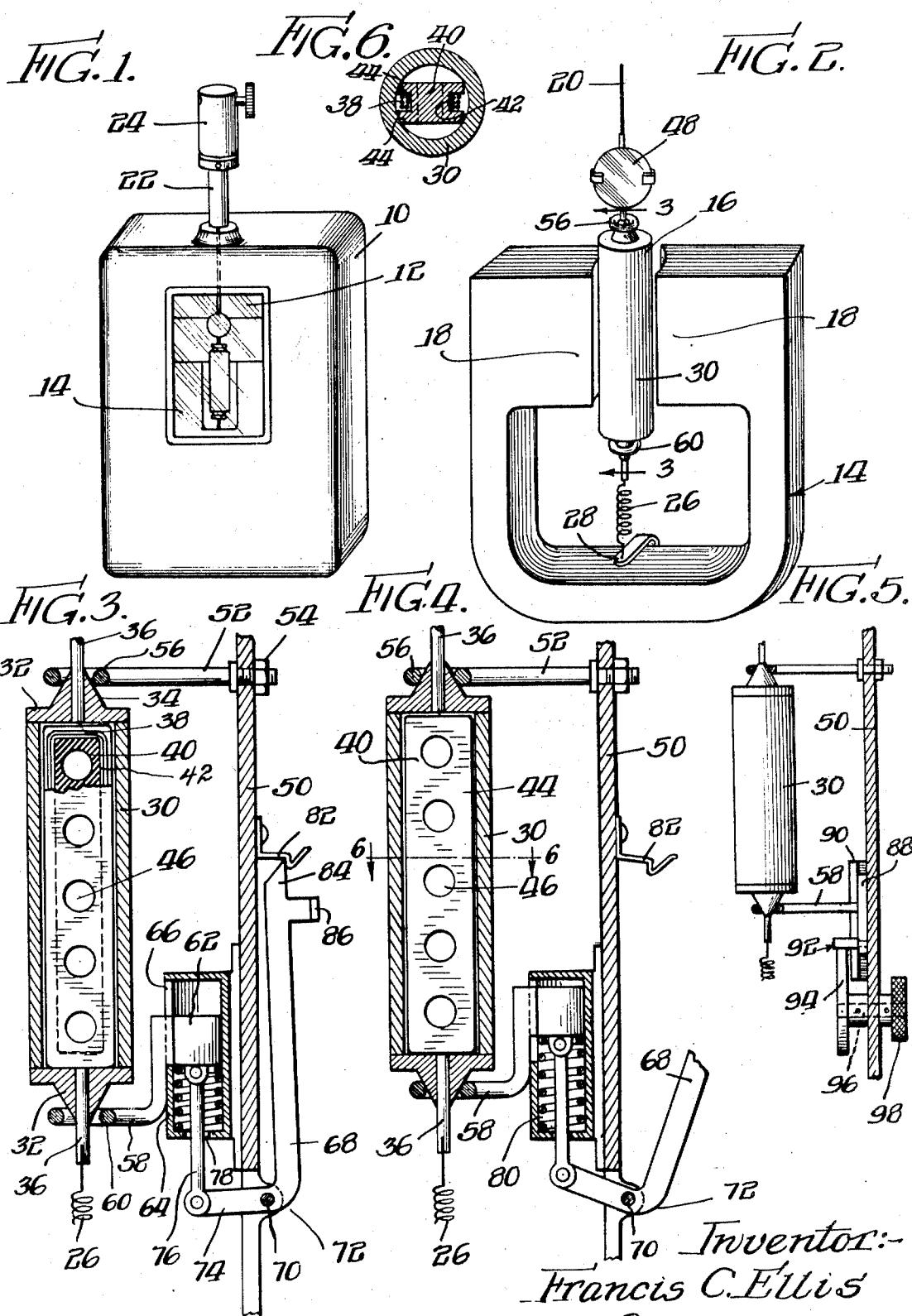
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GALVANOMETER

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GALVANOMETER

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The present invention relates to a galvanometer and more particularly to a galvanometer employing a movable coil of the suspension type.

It is an object of the present invention to provide an improved high sensitivity galvanometer coil of the suspension type which is completely closed and protected from dust and dirt so as to be generally insusceptible to contamination, particularly when it is necessary to disassemble the instrument for the purpose of changing suspensions and the like; to provide an improved galvanometer coil which does not tend to displace air upon actuation, but which moves freely in space under the influence of the currents to be measured free from any fanning action; and to provide a coil closure and support which is light, free from magnetic influence, electrostatic capacity, conductivity and the like, as well as capable of being damped under controlled conditions.

Another object of this invention is to provide an extremely high sensitivity type of suspension galvanometer, particularly adapted for portable use and being provided with improved means for lifting the weight of the coil off the suspensions and locking the coil in such raised position when the device is in transit, and which will also serve accurately and positively to center and properly position the coil in the magnetic field.

Yet another object of this invention is to provide a new and improved galvanometer coil structure and supporting means for use in a suspension type of galvanometer which will, not only fully support the coil free from its suspensions during periods of non-use, but will permit substantial elimination of swinging or oscillation of the coil upon release.

Numerous other objects and advantages will more fully appear during the course and progress of the following specification.

Figure 1 is a perspective view of the galvanometer constructed in accordance with the present invention.

Figure 2 is a perspective view of the galvanometer magnets and coil, together with its suspensions and associated parts shown removed from the casing.

Figure 3 is a detail sectional elevation showing the galvanometer coil.

Figure 4 is a view the same as Figure 3, showing the galvanometer coil lifted from its suspensions and locked in place.

Figure 5 is an elevational detail view showing an alternative type of locking mechanism.

Figure 6 is a sectional detail view taken on the line 6-6 in Figure 4.

The present invention relates to a galvanometer of the suspension type and the device disclosed for purposes of illustration, comprises an outer casing 10 having in its front wall a window 12 for the purpose of viewing the parts and permitting passage of the light ray such as is conventionally employed to indicate the reading in this type of meter.

Interiorly of the casing is mounted the magnet 14 which normally creates the field in which the galvanometer coil unit 16 is positioned. The magnet terminates at its upper end in two oppositely disposed poles 18 having a magnetic gap. The galvanometer coil unit 16 is supported in operative position by the upper suspension 20 which comprises a fine filament of gold or other suitable material which passes centrally and axially through the tubular extension 22 and is attached at its upper end to the adjusting sleeve 24. The lower suspension 26 is a similar fine wire or filament in the shape of a coil or spiral, as shown in Figure 2, and has for its main purpose, in conjunction with the upper suspension 20, to convey the electrical impulses to be measured through the coil. The lower suspension 26 may be secured at its lower end to any suitable support 28 arranged to assist in properly positioning the coil 16 in the magnetic field.

In accordance with the present invention, the coil is constructed in such a manner as to be completely enclosed and free from contamination by dust and dirt from any source whatsoever. Accordingly it comprises an outer casing formed of a tube 30. The present invention provides a casing made of a light-weight, easily machinable material having substantially infinite electrical resistance and which is devoid of electrostatic capacity and magnetic materials. To this end the tube 30 comprises preferably a suitable plastic resin, such as any of the known phenolic resin products characterized by the above properties. For example, the tube 30 may be formed of the cast phenolic resin product known as Catalin and comprising a substantially clear, non-magnetic phenol formaldehyde product. The tube 30 having a smooth outer cylindrical surface, is highly resistant to contamination and permits rotation of the coil on its suspensions without the creation of air currents such as is common with many of the conventional coils.

The ends of the tube 30 are sealed by means of the upper and lower disks 32 which may be either separately made and glued in place to the ends of the tube, or may comprise a completely integral casing therewith, being cast or molded

in a single piece. Each of the disks 32 is provided on its outer surface with an integral cone-shaped portion 34, each of which must be carefully aligned on opposite ends of the casing. The upper and lower spindles 36 are cast into the disks 32 and axially of the cone portions thereof for attachment to the upper and lower suspensions respectively.

The coil proper comprises an interior winding 38 comprising a plurality of turns of fine wire wound about the periphery of the rectangular form 40. In order to retain the aforementioned non-magnetic and electrostatic characteristics of the coil, the form 40 is preferably made of a plastic which is the same or equivalent to the material of the outer casing. A suitable groove 42 may be made about the peripheral edges thereof to form opposed flanges 44 for accommodating the winding therebetween. A series of apertures 46 serve to lighten the structure by eliminating a certain quantity of the material of the form 40.

In order to permit the current to be measured by the present instrument to be conveyed through the coil 38, the two ends thereof will be soldered or otherwise suitably placed in electrical connection with the opposed spindles 36 respectively, so that the outer terminals of the device (not shown) may be similarly electrically connected with the upper and lower suspensions 20 and 26. The mirror 48 affixed rigidly to the upper spindle 36 in any suitable manner, is provided to permit the reflection of a suitable light beam in the known manner in order to indicate accurately the degree of rotation of the coil unit 16 with respect to its magnetic field upon a suitable ground glass screen (not shown).

In Figures 3 and 4 there is disclosed a portion of the panel or frame 50 which may comprise the rearward wall of the casing 10 shown in Figure 1. The bracket 52 is bolted to the panel 50 by means of the nut 54 and terminates at its opposite end in a curved portion 56 having a central circular aperture which is situated about the upper cone portion 34, as indicated in Figure 3. A second bracket 58 having a similar curved end portion 60, adapted to extend about the lower cone portion 32 of the galvanometer coil casing, is supported for limited, carefully controlled, reciprocal movement in a vertical direction in order to rigidly clamp the coil between the respective curved ends 56 and 60 of the two brackets. To this end the bracket 58 extends upwardly and is provided at its opposite end with a cylindrical piston-like portion 62 mounted slidably in the tubular guide member 64. The tubular guide member in turn is rigidly bolted to the panel 50 so that the lower bracket 58 is at all times firmly and rigidly supported in its reciprocation. A slit 66 in the surface of the tube 64 permits passage of the bracket there-through.

Vertical reciprocation of the piston-like cylindrical portion 62 of the bracket is controlled by means of the relatively long lever 68 which in turn is mounted on the pivot 70 supported in the bracket 72 suitably formed in the panel 50 and has a rearwardly extending control arm 74. The left-hand end of the control arm, as viewed in Figure 3, is pivoted to the link 76 which in turn is pivotally secured at its upper end to the cylindrical piston-like portion 62 of the bracket. An aperture 78 in the lower wall of the tubular guide member 64 permits passage of the link 76 while a compression coil spring 80 normally tends to urge the piston member 62 in its uppermost po-

sition. The piston may be, on the other hand, held in its lower position against the action of the spring 80 by means of the catch member 82 mounted on the outer surface of the panel and arranged to engage over the upper edge 84 of the lever arm 68 when the lever is in its position adjacent the panel. Control of the lever is effected through the agency of the handle 86.

In operation, the parts will normally be situated in the position, as shown in Figure 3, the curved portions of the brackets 56 and 60, respectively, being free from contact with the cone portions 32 and 34 of the casing whereby the galvanometer coil is freely supported from its suspensions. An electrical current may be passed through the coil 38 through a path formed between the terminals of the device (not shown), the upper and lower suspensions 20 and 26, and the spindles 36, whereupon the magnetic characteristics of the coil 38 tend to co-act with the magnetic field of the poles 18 in which the coil is centered so that the latter member is rotated upon its suspensions through an angle corresponding to the current flowing therethrough.

After use of the device has been completed, the handle 86 of the lever 68 may be guided outwardly after being released from the catch 82 to a point wherein the lower curved portion 60 of the bracket 58 engages the lower cone member 32 and lifts the entire galvanometer coil unit through a short vertical distance until the upper cone is engaged by the curved portion 56 of the bracket 52. The coil spring 80 will at this time maintain the coil rigidly clamped between the two aforesaid brackets with its weight completely relieved from the upper suspension. When it is again desired to place the device in service, the handle 86 is actuated to force the lever 68 inwardly and slowly lower the bracket 58 and permit the coil assembly to move downwardly until it is supported by its upper suspension 20 in which position the upper edge 84 of the lever may be engaged under the catch 82 to retain the parts in operative position.

In many of the known locking devices, release of the coil is accomplished by more or less violent movement thereof which, in the case of very highly sensitive suspension galvanometers, starts a swinging or vibration which may take considerable time to overcome. In using the present device the long lever 68 may be carefully actuated against the tension of the spring 80 so that the coil is slowly lowered upon its suspensions without any vibration or jarring, after which the device may be immediately placed in service without further difficulty.

An alternative structure for controlling the locking and releasing of the galvanometer coil is shown in Figure 5 wherein the bracket 58 is rigidly secured to a slide member 88 mounted for vertical reciprocation in the guide-way 90 rigidly secured to the panel 50. A pin 92 fastened to the lower portion of the slide 88 is engaged by the cam 94 mounted for rotation upon the panel 50 about the shaft 96 and controlled by the knurled knob 98. It will be apparent that this device may be operated to lock or release the galvanometer coil by rotation of the knob 98 to actuate the slide 88 in a vertical direction.

The present invention provides a galvanometer coil for instruments which are of extreme sensitivity and wherein replacement of the delicate suspensions is sometimes necessary by those not particularly skilled in this type of operation. In the event of such an operation the casing 30 pro-

fects the coil and prevents contamination thereof by particles of dirt or magnetic material from the fingers. The extremely high electrical resistance of the coil structure, together with its lack of electrostatic capacity and a complete absence of magnetic materials, renders it free from variation in characteristics and permits complete and accurate damping control of the coil by means of an external shunt resistance.

The instant structure, moreover, not only serves to prevent damage of the coil suspensions by rigid locking and support of the coil during periods of non-use, but also serves to center this portion of the structure properly and accurately in the magnetic field; that is, the coil is released at each time, at the same place in the field and accordingly is characterized by great uniformity in its calibration and measuring characteristics. Furthermore the particular structure disclosed enables the device to be placed in operation without undue swinging or vibration when the control lever is carefully actuated.

It is thought that the invention and numerous of its attendant advantages will be understood from the foregoing description and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the form herein described being a preferred embodiment for the purpose of illustrating the invention.

The invention is hereby claimed as follows:

1. In a galvanometer of the suspension type, a frame, a galvanometer coil unit suspended from said frame, opposed cones arranged on the upper and lower surfaces of said coil unit and centered on the vertical axis thereof, an upper ring bracket mounted rigidly on the frame, a lower ring bracket adapted to engage the lower cone, said lower ring bracket being mounted in a slide for movement in an accurately controlled path, resilient means normally urging the lower ring bracket into contact with the lower cone member, and a relatively long control lever operatively connected with said bracket to permit actuation thereof against the tension of said resilient means.

2. In a galvanometer of the suspension type, a supporting frame, a galvanometer coil unit

suspended from said frame and having oppositely disposed conical portions at either end thereof, a ring bracket mounted on the frame and adapted to engage the upper cone, a lower ring bracket adapted to engage securely about said lower cone, means to move said brackets together to engage the oppositely disposed conical portions to clamp and center the coil unit therebetween, spring means normally urging the said ring brackets into coil-engaging position, and manual control means for actuating said ring brackets relatively apart against the action of said spring means to suspend the coil unit in the magnetic field.

3. In a galvanometer of the suspension type, a supporting frame, a galvanometer coil unit suspended from said frame and having oppositely disposed seating portions adjacent either end thereof, a gripping bracket operatively supported by the frame and adapted to engage the upper seating portion, a lower gripping bracket adapted to engage the lower seating portion, said brackets being relatively movable toward each other to engage the oppositely disposed seating portions to clamp and center the coil unit therebetween, resilient means normally urging said brackets into coil engaging position, means for actuating said brackets relatively apart against the action of said resilient means to suspend the coil unit in the magnet field.

4. In a galvanometer of the suspension type, a supporting frame, a galvanometer coil unit suspended from said frame and having oppositely disposed seating portions adjacent either end thereof, a gripping bracket operatively supported by the frame and adapted to engage the upper seating portion, a lower gripping bracket adapted to engage the lower seating portion, said brackets being relatively movable toward each other to engage the oppositely disposed seating portions to clamp and center the coil unit therebetween, resilient means normally urging said brackets into coil engaging position and operative to exert a predetermined resilient tension upon the coil when the brackets are disposed in coil gripping position, and means for actuating said brackets relatively apart against the action of said resilient means to suspend the coil unit in the magnetic field.

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