

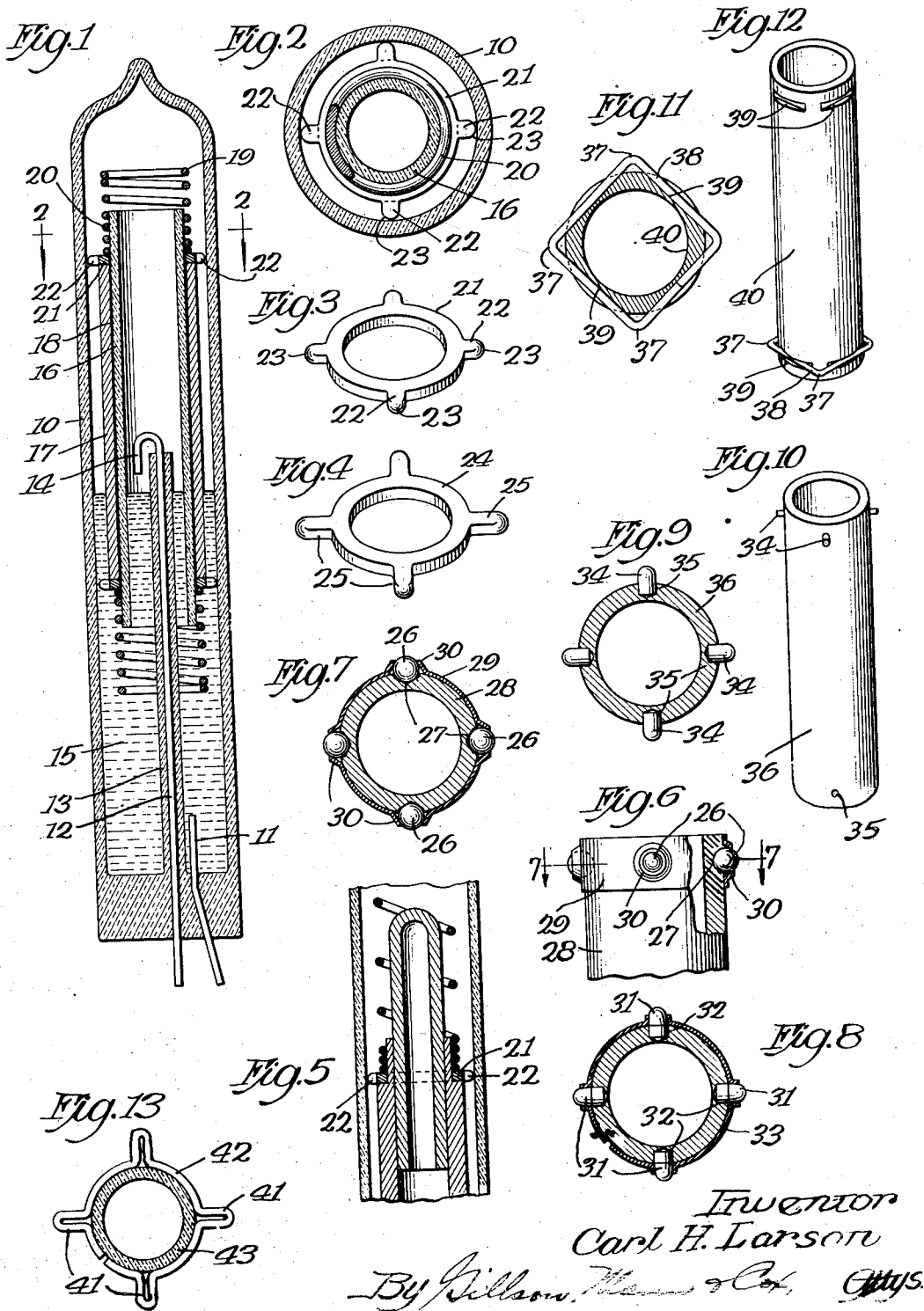
Nov. 17, 1936.

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2,060,811

ANTIFRICTION DISPLACER GUIDE

Filed Oct. 17, 1934



UNITED STATES PATENT OFFICE

2,060,811

ANTIFRICTION DISPLACER GUIDE

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Application October 17, 1934, Serial No. 748,583

10 Claims. (Cl. 200—112)

This invention relates to mercury tube switches of the type including an iron armature movable inside the glass envelope and cooperating with a charge of mercury and a magnet.

If the pick-up and drop-away values of such switches are to be maintained and other desirable characteristics are to be had, the mercury must remain lively and mercurial, and there must be a minimum of friction offered to the movement of the armature and the mercury.

Heretofore armatures have been provided with narrow guides projecting in the neighborhood of the ends and running against the walls of the glass envelope. The guides were made narrow to avoid any throttling of the gas fill or the mercury which would act as a brake on the movements within the envelope and, therefore, the time to make or break a circuit. As friction is independent of the area and proportional to the pressure, and the pressure between the guides and the glass is light, this arrangement was apparently appropriate to the conditions.

However, it has been found that mercury tube switches including soft iron armatures (soft iron is used to avoid residual magnetism) having narrow guide fingers or flanges such as described, have grown sluggish and unreliable after a large number of operations, and careful observations have revealed the facts that—

(1) The inner surface of the glass envelopes is streaked with blackish marks corresponding in length to the movements of the armatures;

(2) There is a scum of powder on the surface of the mercury, and

(3) The mercury has more or less lost its lively and quickly mobile character corresponding roughly to the extent of the streaking on the glass.

Apparently the friction between the soft iron and the glass is considerable, the iron wears away, forming a fine powder that streaks the glass and, falling on the mercury, amalgamates with it to form a sluggish compound, or in some way vitiates the lively character of the mercury.

Apparently, also, the coefficient of friction between the armature and the glass increases as the wear takes place. The static friction is apparently much greater because the plunger delays in starting and seems to be harder to start; it moves more slowly and stops sooner than when the switch was new.

But whether these appearances are warranted in fact, or not, equipping soft iron armatures with guides of selected materials does prevent the streaking of the glass and the sluggishness of operation.

Guides of hardened steel are easily made and applied to soft iron armatures and have the desired effect without introducing any undesirable effects.

Soft, annealed, cold rolled, crucible, strip steel is easy to fabricate, and takes on the appropriate hardness when heated to a cherry red or below the R-I transformation point and quenched in oil.

Steels are, however, so varied that the maker should be consulted as to the heat treatment. Alloy steel should be given a preliminary test to see what effect the alloying elements will have on mercury, particularly when direct current is passing through them. Nickel in steel is likely to be in a form that will amalgamate with the mercury to an objectionable extent.

Graphite, such as used in 9-H drawing pencils, makes good guides and can be easily set in the soft iron armatures, or attached thereto by iron clips. Mother-of-pearl has the desired anti-friction and non-wearing characteristics with heat resisting glass, and may be attached to the soft iron armatures in the same way as the graphite.

Fig. 1 is a vertical section through a mercury tube switch, having guides embodying this invention;

Fig. 2 is a cross section on the line 2—2 of Fig. 1;

Fig. 3 is a perspective view of a ring adapted to form a part of the displacer and including hardened steel guides;

Fig. 4 is a perspective view of a similar ring with long guides that may be used in one size of tube, or cut away to be used within smaller sizes;

Fig. 5 is a section of a portion of a mercury tube switch illustrating a different form of the displacer equipped with guides made according to this invention;

Fig. 6 is a side elevation, partly in section, of one end of an armature equipped with a different form of guide embodying the invention;

Fig. 7 is a section taken on the line 7—7 of Fig. 6;

Fig. 8 is a section similar to Fig. 7, of an armature having another form of guide embodying the invention;

Figs. 9 and 10 are cross section and perspective views of an armature having another form of guides embodying the invention;

Figs. 11 and 12 are cross section and perspective views of an armature having another form of guides embodying the invention; and

Fig. 13 is a cross section of a displacer having another form of guides.

An envelope 10 of suitable glass, such as borosilicate, described in Weintraub, No. 1,154,081, has sealed in it lead-in wires 11 and 12 of tungsten, molybdenum, tantalum, or the like, the lead-in wire 12 being shielded by glass tube 13, to a considerable height and then bent over at 14 to form 60

an electrode to contact with purified mercury 15, when the switch is closed.

The mercury is displaced by a composite displacer, including a sleeve 16 of quartz, glass, or other ceramic or non-magnetic material, telescoped within the armature 17 of ferro magnetic material, in this instance Swedish iron, known as Svea iron. The sleeves fit together with ample clearance 18 to allow for the differences in expansion and are held in assembled relation by springs 19 of piano wire, or any other material that will not react with the mercury.

The springs are coiled in the general form of a helix with one end portion 20 reduced in diameter to frictionally bind on the sleeve 16 at the opposite ends of the armature 17. Between each spring 19 and the corresponding end of the armature 17 is a ring 21 telescoped over the sleeve 16 and having outwardly projecting arms or fingers 22 to bear on the inner surface of the glass and guide the displacer in its movements while allowing the mercury or the gas fill, such as hydrogen, helium, and the like, to flow freely. Soft, annealed, cold rolled, crucible, steel has been found very satisfactory for making the guide rings. Strip steel of that description is easily worked and hardened to give the rounded bearing points 23 the proper characteristics for cooperating with the glass, with such light friction as to be negligible.

In Fig. 4 the ring 24, corresponding to that shown at 21 in Fig. 3, is provided with longer arms 25, and can, by trimming the arms to suit, be used in tubes of different sizes.

In this particular illustration the sleeve 16 is 2½ inches long by 9½ mm. outside diameter and 7½ mm. inside diameter. The armature is 1⅝ inches long, 15/32 inch outside diameter, 25/64 inch inside diameter. The guide rings 21 are 1⅞ inch inside diameter, the arms are 3/64 inch in width, and 17/32 inch from tip to tip, or, in other words, from the opposed anti-friction surfaces, which are about as small as can be readily worked and kept rounding.

This specific description, however, is not used in a limiting sense, but merely to disclose in detail one embodiment of the invention.

In Figs. 6 and 7 the guides are formed by hardened steel balls 26 setting in pockets 27 in the armature 28 and held in place by a split ring 29, having the cupped seats 30. The ring may be made of iron steel, or any other material that will retain the balls and not react with the mercury.

In Fig. 8 the guides are formed by small pointed pieces 31 of mother-of-pearl, or hardened graphite, such as used in 9-H drawing pencils. They are fitted in sockets 32 and held in place by a ring 33, similar to that shown at 29 in Figs. 6 and 7.

In Figs. 9 and 10 the guides are formed by small pins 34 of mother-of-pearl, graphite, or such like, frictionally held in sockets 35 in an armature 36, or set in ceramic cement such as potassium silicate.

In Figs. 11 and 12 the guides are formed by the corners 37 of square rings 38 of piano wire, seated in saw cuts 39 adjacent to the ends of the iron armature 40. The piano wire is easily given the appropriate shape and after hardening, presents the desired anti-friction surfaces and tightly grasps the armature.

In Fig. 13 the guides are formed by loop 41 in a split ring 42 of piano wire that grips the sleeve 43.

These illustrations will serve to show a variety of forms and materials in which the invention may be embodied and those skilled in the art will readily select materials and forms according to their particular needs.

I claim:

1. In a mercury tube switch, a glass envelope, 10 mercury therein, an armature of soft iron cooperating with the mercury and movable along the glass, guides on the armature adapted to travel along the surface of the glass and presenting to it a surface of hardened steel. 15

2. In a mercury tube switch, a glass envelope, mercury therein, an armature of relatively soft material cooperating with the mercury and movable along the glass and anti-friction guides of relatively hard material on the armature adapted to travel along the surface of the glass. 20

3. In a mercury tube switch, a tubular armature of relatively soft material a ring attached to one end of the armature and having anti-friction guides of relatively hard material projecting outwardly from it. 25

4. In a mercury tube switch, a tubular armature reduced at one end to form an external shoulder and a neck, and a ring telescoped over the neck and having anti-friction guides projecting from it beyond the shoulder. 30

5. In a mercury tube switch, a hollow armature, a tube within the armature and extending beyond it at each end, a guide ring on the tube against each end of the armature and springs holding each guide ring on the tube and projecting beyond it. 35

6. In a mercury tube switch, a hollow armature, a tube within the armature and extending beyond it at each side, a guide ring on the tube against each end of the armature and springs gripping the ends of the tube and projecting beyond it. 40

7. In a mercury tube switch, a tubular envelope, mercury therein an armature of relatively soft material cooperating with the mercury and movable along the envelope, and anti-friction guide of relatively hard material on the armature for contact with the envelope. 45

8. In a mercury tube switch, a tubular armature, a ring attached to one end of the armature and having loops to form anti-friction guides projecting outwardly from it. 50

9. In a mercury switch relay, a direct current coil, a mercury switch associated with the coil comprising a glass envelope, a mercury fill, an armature of soft iron movable along the envelope in response to the coil, and guides carried by the armature for contacting the envelope wall, said guides being of greater hardness, than the body of the armature. 55

10. In a mercury switch relay, a direct current coil, a mercury switch associated with the coil comprising an envelope of borosilicate glass, a mercury fill, an armature of soft iron movable along the envelope in response to the coil, and guides carried by the armature for contacting the envelope wall, said guides being of approximately the same hardness as the glass envelope. 60

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CERTIFICATE OF CORRECTION.

Patent No. 2,060,811.

November 17, 1936.

CARL H. LARSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 47, claim 7, for "and" read an; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of January, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.

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