May 22, 1956 H. N. BRODSKY ET AL 2,747,036

FLUID-TIGHT ELECTRIC SWITCHES AND WATERPROOF SEPARABLE CONDUCTOR CONNECTING MEANS THEREFOR

Filed April 12, 1954

Fig. 1

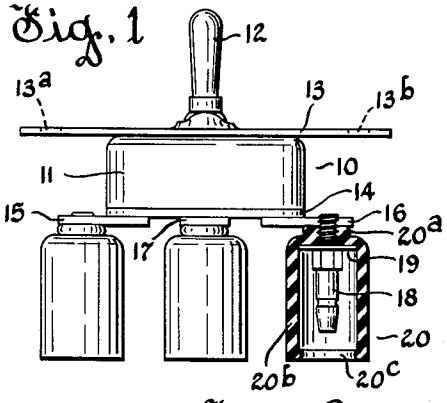


Fig. 3

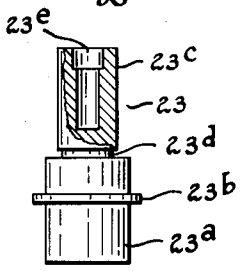


Fig. 2

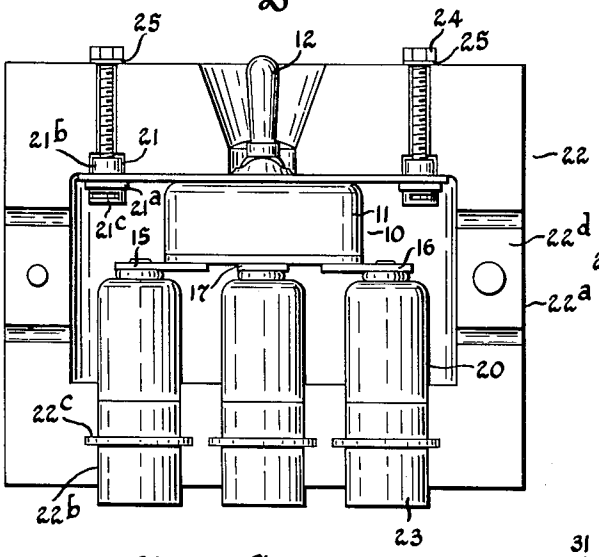


Fig. 4

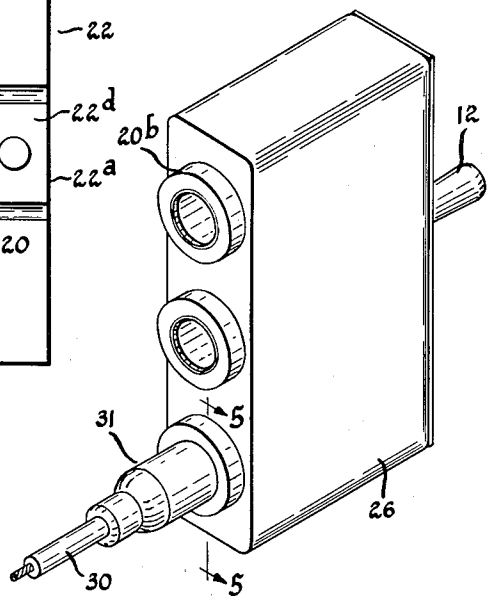


Fig. 5

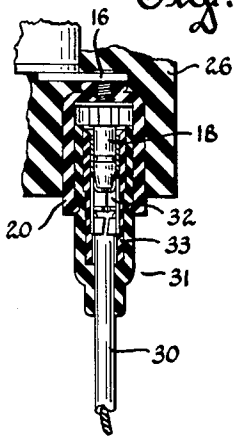
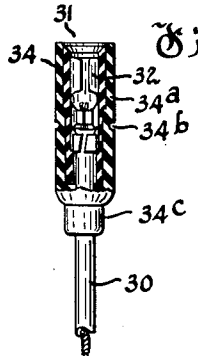


Fig. 6



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FLUID-TIGHT ELECTRIC SWITCHES AND WATERPROOF SEPARABLE CONDUCTOR CONNECTING MEANS THEREFOR

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Application April 12, 1954, Serial No. 422,563

5 Claims. (Cl. 200—51)

This invention relates to fluid-tight electric switches and waterproof separable conductor connecting means therefore.

Our Patent No. 2,740,872, granted April 3, 1956, discloses and claims improved forms of fluid-tight electric switches and methods of making the same. The present invention constitutes an improvement thereon in respect of providing conductor connecting means, which are in part carried in the molded mass of electrical insulating material, in which the switch casing is embedded, and which are waterproof and readily separable.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates a preferred embodiment of the invention and various method steps in making the same, which will now be described in detail, it being understood that the embodiment illustrated and the steps used in making the same can be modified in respect of details without departing from the scope of the appended claims.

In the drawings:

Figure 1 is a view in side elevation showing certain initial steps in the process of making a fluid-tight electric switch in accordance with the invention.

Fig. 2 shows the assembly of Fig. 1 mounted in one part of a molding die preparatory to a molding step.

Fig. 3 shows in detail a core member used in connection with the die of Fig. 2.

Fig. 4 is a perspective view of a completed fluid-tight electric switch and connected conductor,

Fig. 5 is a fragmentary cross-sectional view taken along the line 5—5 of Fig. 4, and

Fig. 6 is an enlarged view of a plug-in connector shown in Figs. 4 and 5.

Referring to Fig. 1, it shows a switch **10** having a metal casing **11** for the commutating mechanism (not shown), a toggle lever actuator **12**, a top metal mounting plate **13** which is riveted to the casing by rivets (not shown), and a bottom insulating plate **14**. While not shown, it may be assumed that fluid-tight sealing means are provided for actuator **12** interiorly of casing **11** within the opening through which the actuator projects, or alternatively by sealing means extending about the actuator exteriorly of the casing as disclosed in our aforementioned patent. Switch **10** is provided with outwardly extending end terminal lugs **15** and **16** and a center terminal lug **17**. Each of said terminal lugs is provided with a threaded opening extended therethrough, and as an initial step, assemblies, each comprising a brass male terminal stud **18**, a brass disc washer **19**, and a molded rubber female connector boots **20** are secured to each terminal lug. The boots **20** are provided with bosses **20a** having openings extending therethrough, and threaded end portions of studs **18**, penetrating the openings in the washers and bosses **20a**, take into the threaded opening, to secure such assemblies in place as depicted in Fig. 1. Each of the boots is provided with a resilient hollow cylindrical portion **20b** which at its outer end is provided with an inwardly projecting circumferential lip portion **20c**.

After attachment of the aforementioned assemblies to each of the terminal lugs, the assembly thus effected is subjected to cleaning, as by, buffing, grit blasting or by use of emery paper on the under side of plate **13**, the casing **11**, the plate **14** and the outer surfaces of the boots **20**. Then the lower surface of plate **13**, the casing **11**, terminal lugs **15**, **16** and **17** and plate **14** are coated with a suitable rubber-to-metal adhesive, and the outer surfaces of boots **20** are coated with a suitable rubber-to-rubber adhesive, and such coatings are then permitted to air dry at room temperature.

As shown in Fig. 2, internally threaded lock nuts **21**, having flange portions **21a**, upper cylindrical portions **21b** and a transversely slotted lower cylindrical portion **21c** are inserted through the mounting holes **13a** and **13b** in top plate **13**, with the flange **21a** thereof seating against the lower side of plate **13** and the cylindrical portions **21b** extending above the upper surface of plate **13**. The assembly is then placed in the bottom part **22a** of a molding die **22**. The die **22** is similar to a molding die shown and described in connection with our aforementioned patent, but differs therefrom in having case hardened metal cores **23** for the boots **20**, which retain the normal shape of the boots and proper placement of the same in the die during the molding operation. The cores **23**, which are preferably of the form best shown in Fig. 2, are provided with lower cylindrical portion **23a** having peripheral flanges **23b**, and upper cylindrical portion **23c** of reduced diameter having an annular recess **23d** and an axial recess **23e** to accommodate a stud **18**.

A core **23** is inserted into the open end of each boot **20** until the upper end of its cylindrical portion **23c** seats against a washer **19**, and the assembly is then placed in die part **22a** as shown in Fig. 2, with the lower cylindrical portions **23a** and peripheral flanges fitting into complementary semi-circular recesses **22b** and **22c** of die part **22**.

Temporary securing screws **24** take into the nuts **21**, and together with washers **25** underlying the heads of the screws are used to secure switch **10** in place in die part **22a**. With the other half of die **22** (not shown) closed on the upper surface **22d** of die part **22a**, the assembled die is then placed in a suitable molding fixture, and the same subjected to the injection or extrusion of plasticized rubber into the die casting as shown and described in our aforementioned patent; to which reference should be made for the details of the steps and means utilized for molding a mass of flexible rubber material about the switch casing and portions of the outer surfaces of the connector boots.

Following the molding and curing steps, and cutting-off of all excess rubber which extruded through relief openings in die **22**, etc., the switch casing, terminal lugs and the greater part of the connector boots will be embedded in and intimately bonded with a substantially rectangular block of rubber **26**, as depicted in Fig. 4. As will be seen from Fig. 4, portions **20b** of the connector boots extend beyond one surface of the rubber block **26**.

As shown in Figs. 4, 5 and 6, conductor leads, such as the flexible insulated leads **30**, are adapted to be connected to the terminal studs **18**, through the medium of plug-in connector assemblies generally designated **31**. Each connector assembly comprises a longitudinally split metal, female connector **32**, to which a conductor lead is attached, and into which a terminal stud **18** fits for electrical connection therewith. A hard plastic ferrule or sleeve **33** is fitted about connector **32** and sleeve **33** fits within the bore of a molded flexible rubber male plug **34**. Plug **34** is provided with a cylindrical portion **34a** which is slightly larger in diameter than the inside diameter of

portion 20a of boot 20 so as to elastically engage in a force fit therewith, and portion 34a is provided with a semi-circular annular groove 34b into which the lip portion 20c of boot 20 fits when plug 34 is pushed into engagement with the washer 18. At their lower ends the plugs 34 are provided with bosses 34c having openings through which conductor leads 30 extend in tight elastic fitting engagement.

The aforedescribed plug-in connectors 31 when fitted to flexible conductor leads permit ready making and breaking of electrical connection between the leads and switch terminals, which connections are of the self-sealing waterproof type which can be made and broken repeatedly.

We claim:

1. A fluid-tight electric switch unit comprising, a switch including a case for the commutating mechanism and an actuator extending through an opening in said case and a plurality of external terminals, sealing means for said opening in said case constructed to permit free operation of said actuator, a plurality of assemblies each of which is associated with a respective terminal and comprises a hollow flexible rubber boot and a male connector stud electrically connected to its associated terminal and disposed concentrically within the bore of a boot, and a molded mass of elastic and moisture impervious insulating material in which said case, said terminals and a greater portion of the outer surfaces of said boots are embedded in bonded and sealed relation, said assemblies constituting built-in receptacle portions of separable connectors into which complementary plug-in portions may be waterproofly fitted to effect connection between said switch unit and conductor leads.

2. The combination according to claim 1 wherein said boots are secured to their associated terminals by said studs.

3. The combination according to claim 1 wherein said boots are substantially cylindrical in form and extend outwardly beyond the surface of said molded mass of insulating material to their open ends.

4. The combination according to claim 3 wherein said boots at their open ends are provided with inwardly projecting annular lips adapted to fit within complemental grooves in plug-in connectors fitted into said boots to facilitate waterproofing therebetween.

5. In combination, a fluid-tight electric switch unit comprising a switch including a case for the commutating mechanism and an actuator extending through an opening in said case, and a plurality of external terminals, sealing means for said opening affording free operation of said actuator, a plurality of assemblies each of which is associated with a respective terminal and comprises a hollow flexible rubber boot and a male connector stud electrically connected to its associated terminal and disposed concentrically within the bore of a boot and a molded mass of elastic and moisture impervious insulating material in which said case, said terminals and a greater portion of the outer surfaces of said boots are embedded in bonded and sealed relation, and at least one plug-in assembly comprising a hollow, substantially cylindrical member formed of elastic material fitted into and engaging the inner wall of such boot with an elastic force-fit, a female electrical connector concentrically disposed in said member which interfits with the connector stud associated with such boot, and a conductor lead connected to said female connector and extending through an opening in a substantially closed end of said member with an elastic force-fit.

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