March 31, 1925. 1,531,917

H. G. FRENCH

ELECTRIC SWITCH

Filed Nov. 11, 1922

Fig. 1.

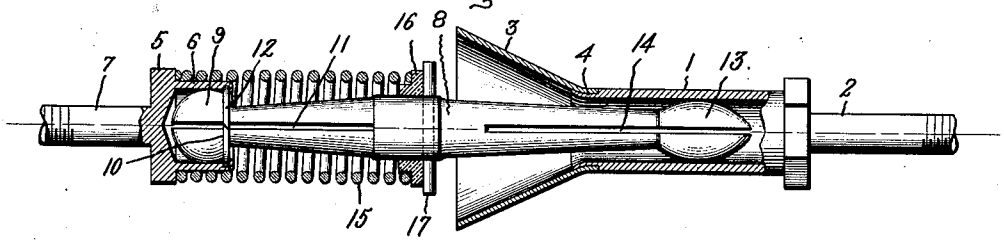


Fig. 2.

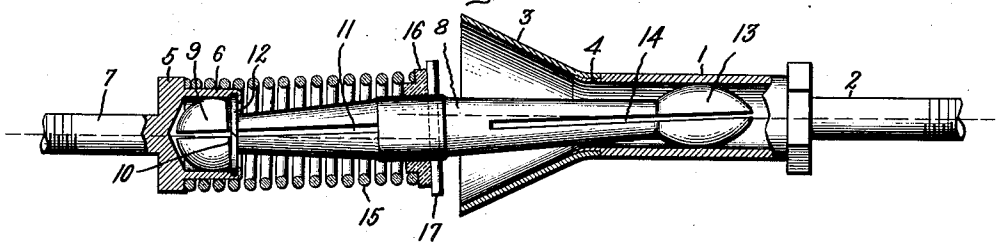
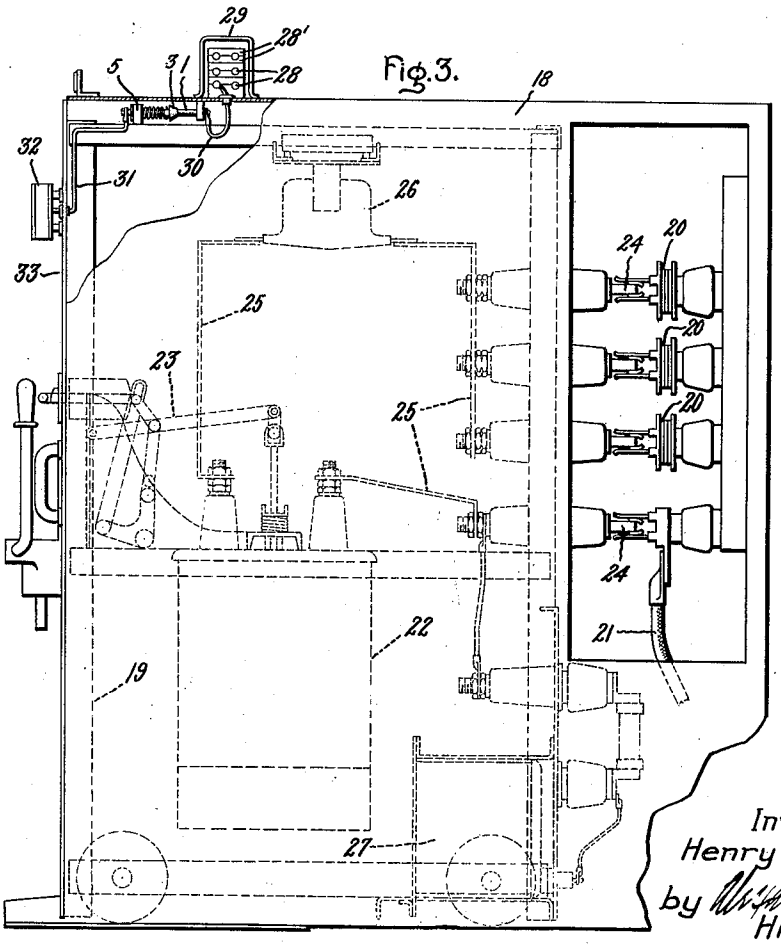


Fig. 3.



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UNITED STATES PATENT OFFICE.

HENRY G. FRENCH, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCH.

Application filed November 11, 1922. Serial No. 600,202.

To all whom it may concern:

Be it known that I, HENRY G. FRENCH, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Switches, of which the following is a specification.

My invention relates to electric switches and more particularly to disconnecting or contact devices of the relatively movable cooperating type and has for an object to provide an improved contact device of such flexibility and construction as to insure that the relatively movable contacts register correctly for a highly efficient electric contact irrespective of niceties in alignment of the parts supporting the contacts. Another object of my invention is to provide an improved flexible contact which, irrespective of its alignment with the cooperating contact, is upon disengagement therefrom always positively self-restoring or self-aligning to substantially the same position.

My invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Figure 1 is an elevation partly in section, illustrating an embodiment of my invention, the supporting members of the relatively movable contacts being shown in alignment; Fig. 2 is an elevation similar to Fig. 1 but showing the contact supporting members out of alignment, and Fig. 3 illustrates an application of the embodiment of my invention shown in Figs. 1 and 2 to a switch structure of the removable truck panel type shown in elevation with parts broken away for clearness.

In switch gear embodying relatively movable cooperating contacts, it is frequently difficult and often impractical to employ the refinements of construction and adjustments necessary to a precise alignment of the contact supporting structures so as to insure that the contacts will register with that nicety essential to a highly efficient electric contact. Even though the refinements of construction and adjustments are carried to an extreme, the complex structure of modern switchgear, the inevitable wear of the parts, shocks and jars of operation which disturb the adjustments, and other causes make it very troublesome and difficult particularly in contact devices of the plug and socket type to obtain an efficient electric contact, principally because of variations and inaccuracies in the alignment of the contact supporting structures. According to my invention, I provide an improved construction of contacts which obviates this difficulty and renders unnecessary the refinements of construction requisite to a precise alignment of the contact supporting structures and therefore provides a more economical and efficient construction which is capable of withstanding relatively hard use.

In the figures of the accompanying drawing, I have illustrated an embodiment of my invention in an electric switching or disconnecting device of the plug and socket type comprising relatively movable cooperating contacts, one of which may be fixed. The fixed contact member is shown as the socket part of the switching device and may comprise a terminal or contact such as a tube 1 which for the purpose of mounting preferably has integral therewith a mounting member such as a stud or bolt 2 also serving as a conducting member. The tube 1 is provided with a flaring or mouth portion 3 in order better to receive and guide the engaging parts of the cooperating contact. The mouth 3 may be frusto-conical in shape and may be integral with the tube 1 or as shown may comprise a separate piece forced over a reduced section 4 of the tube 1, the end of the tube being then spun over a portion of the inner surface of the mouth to provide a smooth passageway and also to secure the mouth to the tube.

My invention particularly resides in the contact device which constitutes the plug part of the electric switching or disconnect-

ing device and is herein shown as the cooperating movable contact. The contact device comprises a terminal 5 which is provided with a substantially hollow cylindrical portion 6 and also suitable mounting means such as a stud or bolt 7 which may be an integral part of the terminal. A conducting contact member, such as a plug 8, preferably provided with an enlarged substantially spheroidal end 9, a portion of the surface of which adjacent the shank or body of the plug 8 may be substantially flat or concave thus forming a substantially well defined line of demarcation or intersection of the spherical and flat or concave surfaces to provide a relatively sharp fulcruming edge 10 for a purpose hereinafter to be set forth. The points forming this line or edge are preferably coplanar and define a plane which is preferably perpendicular to the axis of the plug. The fulcruming edge 10 is thus adjacent the body of the plug 8 and is substantially a circle concentric with the plug. The enlarged end 9 of the plug 8 is thus substantially in the shape of a segment of a sphere, the diameter of which is preferably somewhat larger than the diameter of the cylindrical portion 6 of the terminal 5. In order that the enlarged end portion 9 may enter the cylinder 6 and be capable of movement therein for a yielding joint and an efficient electric contact, the end of the plug 8 is provided with one or more slots such as saw cuts 11, there being preferably two of these slots which may be made substantially perpendicular to each other. In this way, there is provided a substantial resilient connection affording a good electric contact. In accordance with my invention, I so secure the plug 8 to the terminal 5 as to provide a sliding ball and socket or universal joint, that is to say one in which there is no fixed pivotal connection between the cooperating parts of the joint. For this purpose the cylinder or socket 6 may be counterbored or recessed to seat a suitable bearing member such as a split washer 12 which is set in place after inserting the spherical portion or ball 9 into the socket 6. The socket 6 may then be spun over the washer 12 to retain the same and therefore to maintain the assembly. For contact engagement with the tube 1, the free end of the plug 8 may also be provided with a convex curved portion 13 which as shown is substantially in the shape of a prolate spheroid whose smallest diameter is somewhat greater than the inner diameter of the tube 1, this end of the plug also being provided with slots 14 which may be saw cuts to provide a substantial resilient connection, affording a good electric contact. The shape of the ball 13 also provides for readily guiding this end of the plug 8 through the mouth 3 into the tube 1. In order to provide a flexible mounting for the plug 8 so that it may readily be deflected upon entering the mouth 3 and so that it may be self-restoring or aligning to a given position when withdrawn from the tube 1, I provide suitable resilient means such as a helical spring 15, one end of which as shown may embrace or surround the cylinder 6 and a bearing the other end of which may engage a holding member such as a flanged collar 16 restrained in place at an intermediate point on the plug 8 by a pin 17. The collar 16 is preferably insulating material so that the spring 15 does not carry current thereby eliminating any possible deleterious effects upon the static properties of the spring material from heating. The spring 15 as shown is arranged to be restrained under compression so as to exert a force tending to spread the plug 8 and the terminal 5 apart but allowing both linear and angular movement of the plug 8 relatively to the terminal 5.

Referring now to Fig. 2 in which the supports of the tubular contact 1 and the terminal 5 are shown out of alignment, it will be evident that, as the plug 8 is moved toward the contact 1, the enlarged end 13 will engage the flaring mouth 3 and be guided thereby into the tubular contact 1. The plug 8 will therefore be deflected out of alignment with the terminal 5 and the fulcruming edge 10 will not be in bearing throughout its length on the washer 12 as shown in Fig. 1, but will instead be in bearing on the washer at substantially only one point, the lowest point as shown in Fig. 2. The spring 15 is also deflected, the coils on the upper side being somewhat compressed and on the lower side somewhat distended. This flexure of the spring 12 of course tends to return the plug 8 into alignment with the terminal 5 when the contacts are disengaged but the force resulting from this flexure of the spring 12 is very frequently insufficient to align the plug 8, since there must of necessity be considerable friction between the enlarged end 9 and the cylindrical portion 6 of the terminal 5 to insure an efficient electric contact. Consequently, the plug 8 might upon disengagement of the contacts be held by this friction in spite of the flexure of the spring 15 so far out of alignment as to register incorrectly with the mouth 3 when it is again desired to make contact. By my invention, however, it will be obvious that when the plug 8 is canted or moved out of alignment with the terminal 5, there results a positively self-restoring or self-aligning moment or torque whose force is the resultant stress in the spring 15 which is in compression in the illustrated embodiment of my invention, exerted in a direction substantially coincident with the axis of the plug 8 and whose lever arm is the perpen-

dicular distance from the point where the fulcruming edge 10 bears on the washer 12 to the axis of the plug 8. This self-aligning torque is relatively constant since the lever arm is the radius of the circumferential fulcruming edge 10 and the movable pivotal center of the plug 8, that is to say the center of the enlarged end 9 is free to shift or move to the left as shown in Fig. 2 substantially in line with the axis of the terminal 5. Because of this shifting to the left of the pivotal center, the spring 15 is shortened, resulting in more compression in the spring. The resultant spring force therefore tends to increase somewhat in proportion to the increase in angular displacement of the plug 8 which is of course desirable since this makes the restoring torque increase with increased displacement of the plug 8. There is, therefore, at all times when the plug 8 is not in alignment with the terminal 5, a positive self-aligning moment, clockwise with reference to the showing in Fig. 2, tending to turn the plug 8 into alignment with the terminal 5, that is, to a position where the fulcruming edge 10 comes to an even bearing on the washer 12 as shown in Fig. 1 and the self-aligning moment becomes substantially the same in every direction, since the axis of the plug is in alignment with the terminal and the tendency for the spring 15 to turn the plug 8 is the same in every direction as the resultant force exerted by the spring is substantially in alignment with the axis of the plug 8 and the terminals 5 and merely tends to separate or spread them apart in this direction.

In Fig. 3 I have illustrated one application of the embodiment of my invention shown in Figs. 1 and 2 as a disconnecting device used in connection with the secondary circuits of switchgear known to the art as the removable truck panel type. This switchgear comprises a housing or cubicle 18 and a truck 19 arranged to be moved into and out of the housing 18. Mounted in the housing 18 at the rear thereof are distributing bus bars 20 and incoming leads 21, the particular arrangement shown being for a three phase alternating current system. The truck 19 has mounted thereon a suitable circuit breaker 22 arranged to be controlled by an operating mechanism 23 to complete a circuit from the bus bars 20 through primary disconnecting devices 24 and leads 25 to the incoming leads 21. Suitable auxiliary devices for operating relays, measuring and indicating instruments, etc. which may be mounted on the truck panel, such as current and potential transformers 26 and 27 are also mounted on the truck 19. In installations embodying this type of switchgear, it is often necessary and desirable to run secondary circuits for meters, relays, etc., from one panel to another but as the meters, relays, etc., are usually mounted on the trucks, they are movable relatively to the control circuits to which they are to be connected and my disconnecting device is particularly applicable to this use. These secondary circuits may for example, as illustrated in Fig. 3, comprise control buses 28 carried in suitable insulating supports 28' within a conduit or housing 29 supported on top of the truck panel housings 18. Also supported by the housing 18 on the interior thereof in any suitable manner and insulated therefrom is a tubular contact 1 comprising a mouth 4 as illustrated in Figs. 1 and 2, that is to say the socket part of my disconnecting device which may be connected to one of the buses 28 by a conductor 30. Mounted on the truck 19 and insulated therefrom is the cooperating or plug part of my disconnecting device as embodied in Figs. 1 and 2, the terminal 5 thereof being connected by a conductor 31 to an electrical device 32, such as a meter, relay, etc. mounted on the panel 33 of the truck 19. There may, of course, be more than one of these disconnecting devices but as they are usually mounted side by side, only one shows in the elevation as in Fig. 3. In the application of my invention shown, the tubular contact 1 is preferably made the fixed and live contact because of its extreme simplicity of construction and therefore slight probability of getting out of order. While the movable contact comprising the plug 8 is of more complex structure, it is dead when the truck 19 is removed and is therefore conveniently accessible for inspection and repairs.

With switchgear structure of the type illustrated in Fig. 3, it will be obvious that if the disconnecting or contact devices are of such construction as to necessitate a precise alignment of the contact supporting structures, an inordinate amount of time and labor is necessary to accomplish the requisite refinements of adjustment. Moreover as the truck panels are generally made interchangeable and as it is frequently desirable to provide spares, slight variations in the adjustments of the mountings increase the difficulty. Also dirt or other foreign matter either on or under the truck wheels results in misalignment of the contact supporting structures. Furthermore, the switchgear is subject to a certain amount of more or less hard use in operation and this tends to disturb any refinements in adjustment. By the use of contact devices embodying my invention, however, the necessity of such nicety of adjustment of the contact supporting structures is eliminated as the flexible construction of the contact device comprising the plug 8 permits considerable leeway in all directions with respect to the alignment of the contact supporting

structures. This reduces cost and simplifies operation and insures that the cooperating contacts will register with that nicety requisite to an efficient electric contact.

While I have shown and described only one embodiment of my invention, I do not desire to be limited to the exact arrangement shown and described but seek to cover in the appended claims all those modifications that fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In an electric contact device, a contact member provided at one end with a fulcruming edge substantially concentric with the axis of said member, a terminal arranged to retain the fulcruming edged end of said member and provided with a bearing for said fulcruming edge, and resilient means constructed and arranged to exert a force tending to turn said contact member about the fulcruming edge thereof on said bearing into alignment with said terminal.

2. In an electric contact device, a contact member provided at one end with a fulcruming edge substantially concentric with the axis of said member, a terminal comprising a hollow member within which the fulcruming edged end of said contact member is mounted, means for retaining the fulcruming edged end of said contact member in said hollow member arranged to provide a bearing for the fulcruming edge of said contact member, and resilient means constructed and arranged to exert a force tending to turn said contact member about the fulcruming edge thereof on said retaining means into alignment with said terminal.

3. In an electric contact device, a contact member provided at one end with a fulcruming edge substantially concentric with the axis of said member, a terminal comprising a hollow member within which the fulcruming edged end of said contact member is mounted, means for retaining the fulcruming edged end of said contact member in said hollow member arranged to provide a bearing for the fulcruming edge of said contact member, and a helical compression spring surrounding said terminal and said contact member and exerting a force tending to turn said contact member about the fulcruming edge thereof on said retaining means into alignment with said terminal.

4. In an electric contact device, a contact member having an enlarged end provided with a fulcruming edge substantially concentric with the axis of the member, a terminal comprising a hollow substantially cylindrical member within which the enlarged end of said contact member is slidably mounted, means for retaining the enlarged end of said contact member in said cylindrical member arranged to provide a bearing for said fulcruming edge, an insulating collar mounted on said contact member, and means tending to turn said contact member about said fulcruming edge on said retaining means into alignment with said terminal comprising a helical spring arranged concentrically with the axis of said contact member and having one end surrounding said cylindrical member and the other end engaging said insulating collar whereby said spring is insulated from said contact member.

5. In an electric contact device, a contact member having an enlarged substantially spheroidal end provided with a fulcruming edge, a terminal comprising a hollow substantially cylindrical member having the enlarged end of said contact member slidably mounted therein and cooperating therewith to form a sliding ball and socket joint, means for retaining the end of said contact member within said cylindrical member arranged to provide a bearing for the fulcruming edge of said end, and resilient means constructed and arranged to exert a force tending to turn said contact member about said fulcruming edge on said retaining means into alignment with said terminal.

6. In an electric contact device, a contact member having an enlarged substantially spheroidal end provided with a relatively sharp circumferential edge adjacent the body of the member and substantially concentric therewith, a terminal having a hollow substantially cylindrical portion with the enlarged end of said contact member slidably mounted therein and cooperating therewith to form a sliding ball and socket joint, means associated with said terminal for retaining the enlarged end of the contact member in the cylindrical portion of the terminal arranged to provide a bearing surface on which said contact member is movable about the edge of the enlarged end thereof, and resilient means adapted to allow movement of said contact member relatively to said terminal and arranged to exert a force tending to turn said contact member about said edge on said retaining means into alignment with the terminal.

7. In an electric contact device, a contact member having an enlarged substantially spheroidal end provided with a relatively sharp circumferential edge adjacent the body of the member and substantially concentric therewith, a terminal having a hollow substantially cylindrical portion with the enlarged end of said contact member slidably mounted therein and cooperating therewith to form a sliding ball and socket joint, retaining means associated with said terminal constructed and arranged to provide a bearing surface on which said contact member is movable about the edge of the enlarged end

thereof and comprising a flange on the cylindrical portion of said terminal for retaining said enlarged end therein, and resilient means associated with said contact member and said terminal adapted to allow relative movement thereof and arranged to exert a force tending to turn said contact member about said edge on the bearing surface of said retaining means into alignment with the terminal.

In witness whereof, I have hereunto set my hand this 9th day of November, 1922.

HENRY G. FRENCH.