Dec. 15, 1942. C. P. PEPPER 2,305,441

SWITCH

Filed June 6, 1941

Fig. 1.

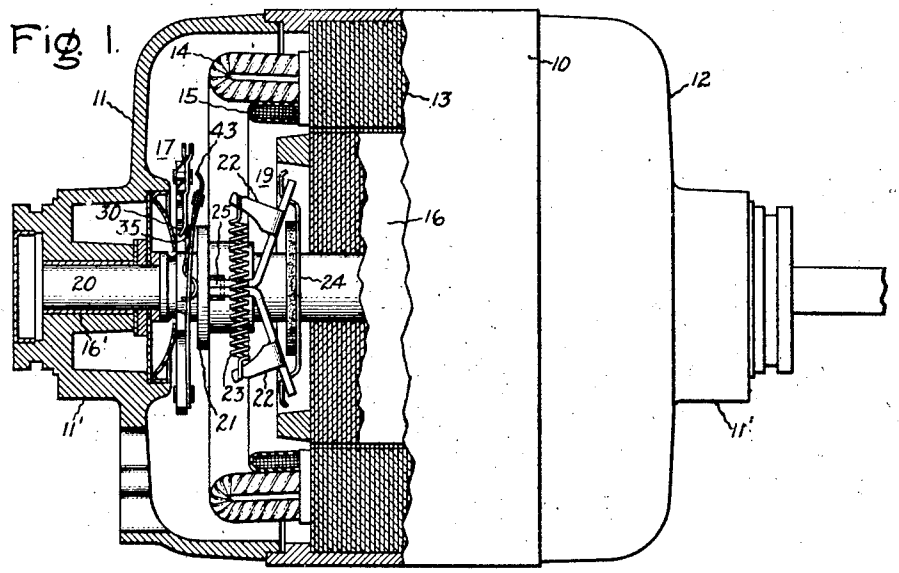


Fig. 2.

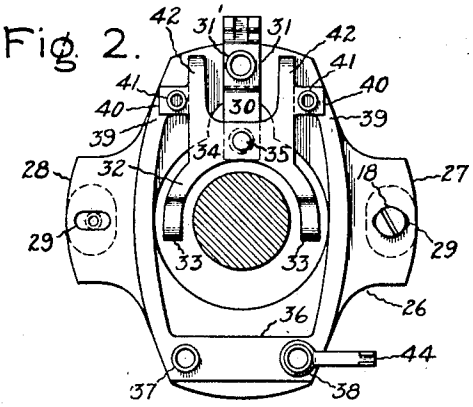


Fig. 3.

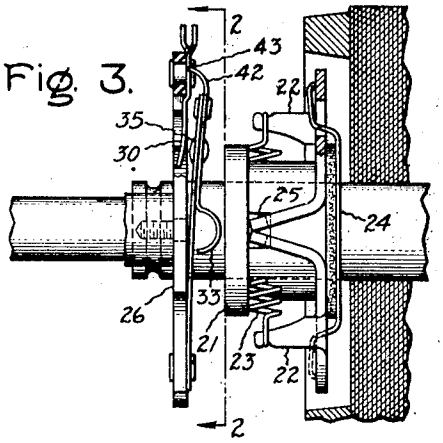


Fig. 4.

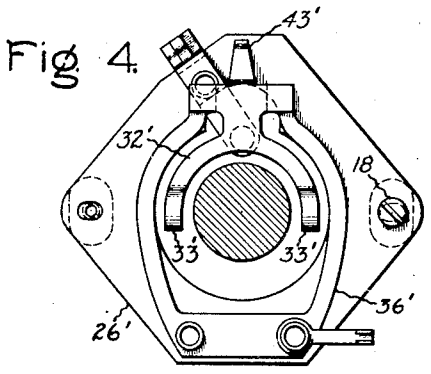
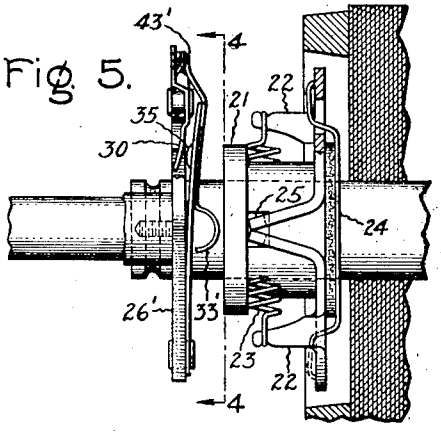


Fig. 5.



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2,305,441

SWITCH

Carl P. Pepper, Fort Wayne, Ind., assignor to General Electric Company, a corporation of New York

Application June 6, 1941, Serial No. 396,862

11 Claims. (Cl. 200—80)

My invention relates to switches; and although not limited thereto it has application in dynamo-electric machines for controlling the circuit of starting windings in single phase induction motors, repulsion-induction motors, or other electrical devices in which it is desired to control the circuits thereof in accordance with the speed of rotation of the machine or device.

An object of my invention is to provide an improved switch structure which is simple in design, reliable in operation, and easy to manufacture.

Another object of my invention is to provide an improved switch construction in which a sufficient contact pressure will be obtained with a minimum pressure being exerted by the operating mechanism.

A further object of my invention is to provide an improved switch construction in which a relatively short travel of the movable contact and a relatively high contact pressure will be obtained for a relatively low pressure exerted by the operating mechanism.

Further objects and advantages of my invention will become apparent from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In the drawing, Fig. 1 is a partial sectional side elevation of a dynamo-electric machine which is provided with a switch structure embodying my invention; Fig. 2 is an end view of the switch construction employed in Fig. 1; Fig. 3 is a side view of the switch structure and centrifugal mechanism illustrated in Fig. 1, the motor having attained normal running speed; Fig. 4 is a modification of the switch structure illustrated in Fig. 2; and Fig. 5 is a side view of the switch structure illustrated in Fig. 4, the centrifugal operating mechanism having moved to its position corresponding to a normal operating speed of the motor.

In the drawing I have illustrated my improved switch structure in its application to a centrifugal switch for connecting and disconnecting the starting winding of a capacitor or split-phase motor. However, it is to be understood that my switch construction may be employed wherever it is desired to open or close a circuit in response to movement of a suitable operating mechanism. The illustrated structure includes a base member carrying a relatively stationary contact, and a relatively rigid actuating yoke member carrying a movable contact. The actuating yoke member is in turn carried by a flexible or resilient member, such as a plate spring which is attached at one end to the base member. A portion of the actuating member or extension thereof is adapted to cooperate with the base member to form a fulcrum so that upon movement of the actuating member it may move about the fulcrum to actuate or open or close the contacts. The contact pressure is determined by the resiliency of the plate spring element and any over-travel of the actuating member will merely cause the fulcrum to move away from the base member so that further movement of the actuating member against the bias of the spring will be about the contacts which form a second fulcrum. As in the conventional centrifugal switch structure which is employed in the starting winding of a dynamo-electric machine, the switch contacts are closed when the motor is stationary and will open when the motor attains any suitable predetermined critical speed. Thus, the contacts are held in a closed position through the pressure exerted on the actuating member by the push collar of a centrifugal mechanism which is mounted on the rotatable member of the dynamo-electric machine, and when the machine attains the critical speed, the push collar will move away from the actuating member and allow the contacts to break the circuit of the starting winding circuit.

Referring more particularly to Fig. 1 of the drawing, I have illustrated a dynamo-electric machine having a stationary member which includes a frame member 10 and end shields 11 and 12. The frame member supports laminations 13 having suitable slots to receive a running winding 14 and a starting winding 15. A rotatable member 16 is arranged to cooperate electrodynamically with the stationary member and is provided with a shaft 20 rotatably supported in suitable bearings 16' mounted in hubs 11' formed in the end shields 11 and 12. My improved stationary switch structure, indicated generally by the numeral 17, is secured to the end shield 11 by bolts 18, see Figs. 2 and 4. A suitable centrifugal mechanism 19 for the switch structure 17 is mounted on the shaft 20, and may be of any suitable type, and the embodiment illustrated in Fig. 1 forms no part of my invention and is described and claimed in Patent 2,149,108 Welch, which is assigned to the same assignee as this present invention. The centrifugal mechanism includes a push collar 21 which is adapted to be moved by movement of outwardly movable weights 22. Springs 23 are connected between

the weights 22 which are in turn supported by a supporting structure 24 relatively immovably mounted on the shaft 20. When the desired critical operating speed is attained, above which the starting winding 15 is not needed, the weights 22 move outwardly against the bias of the springs 23 and move the push collar 21 through a connection at 25. When this critical speed is attained by the dynamo-electric machine, the push collar 21 will move to the right and allow the contacts of the switch structure 17 to be open circuited.

Referring more specifically to Figs. 2 and 3, my improved switch structure includes a base or supporting member 26 which is composed of any suitable material, such as a molded insulating material. The base has two laterally extending portions 27 and 28 through which the base may be mounted on a suitable support. Thus, when employing my improved switch structure as a starting switch for a dynamo-electric machine, the base is supported on the end shield 11 by bolts 18 which are adapted to extend through slots 29 in the extensions 27 and 28 of the base. The base member supports a relatively stationary contact 30 connected in the circuit of the starting winding 15 through a connecting strip 31, which is secured to the base member 26 by an eyelet or hollow rivet 31'. An actuating member 32 is provided of any suitable material such as a metal, and having any suitable shape, and in the arrangement illustrated in Fig. 2 the actuating member takes a general H-shape form having a bifurcated portion 33 which is adapted to be pushed against or actuated by the push collar 21. A substantially central portion 34 of the actuating member carries a relatively movable contact 35 which is adapted to contact the stationary contact 30 upon movement of the actuating member 32 toward the stationary contact. The actuating member is in turn supported solely by a flexible or resilient member 36 which may be made of any suitable material, such as bronze or steel. The flexible or resilient member 36 is of U-shape in the arrangement illustrated in Fig. 2 and the closed end portion thereof is fixedly secured or held by the base member 26. The supporting connection is made by a plurality of eyelets or hollow rivets 37 and 38. The supporting connection between the resilient member 36 and the actuating member 32 is made between the ends 39 of the U-shaped member and outwardly extending ears 40 of the actuating member. The cooperating ears and ends may be attached in any suitable manner, such as by eyelets or hollow rivets 41.

In order to provide an arrangement for obtaining maximum contact pressure and minimum contact travel with a minimum of force obtaining between the operating mechanism and the actuating member, one pivot point is provided about which the actuating member moves until the contacts are closed, the structure being further constructed so that the actuating member may move about a second fulcrum point during further travel after the contacts are closed. In carrying out this feature in the illustrated embodiment, the actuating member 32 is provided with a pair of extending portions 42 which are bowed or of arcuate shape so that ends 43 may cooperate with the adjacent portion of the base to provide a suitable fulcrum about which the actuating member 32 may pivot to move the movable contact and actuate the contacts. The portion 42 may take any suitable shape and dimensions so that the relatively movable contact 35 will be normally held away from the relatively stationary contact 30 when the ends 43 contact the base member 26, as is illustrated in Fig. 3. The spring or flexible member 36 also forms part of the electrical circuit to connect the relatively movable contact 35 to the starting winding circuit 15. A tab or clip 44 is provided which is tightly secured against the member 35 by the eyelet 38, so that a suitable conductor may be attached to the clip 44 in order to connect the contact with the starting winding 15. Any other suitable arrangement may, of course, be provided for connecting the relatively movable contact 35 in any suitable circuit.

Operation of my improved switch structure is as follows: Let us assume that the speed of the dynamo-electric machine is below the critical speed so that the relatively movable contacts 30 and 35 each contact the other and the starting winding is connected in the circuit, as is illustrated in Fig. 1. The push collar 21 of the centrifugal mechanism will push against the ends 33 of the actuating arm 32 and the movable contact 35 will be forced against the stationary contact 30 with the desired contact pressure and the fulcrum 43 will be spaced from the base as will be seen in Fig. 1. This contact pressure may be of any suitable value and is determined by the resiliency of the flexible member 36. One way of varying this resiliency is to offset axially the connection between the spring and actuating member 32, so that the spring will be sprung more to the right when the contacts are closed. Upon the speed of rotation of the dynamo-electric machine reaching a critical speed, the weights 22 of the centrifugal mechanism begin to move outwardly and the push collar 21 begins to move to the right and causes the actuating arm 32 to pivot or move around a fulcrum which is the contacts 30 and 35. This movement of the actuating member 32 will cause a sliding or rolling movement between the contacts 30 and 35 until the end portion or fulcrum point 43 contacts the base member 26. Further movement of the push collar will cause the actuating arm 32 to move around the pivot or fulcrum point 43 and consequent relative movement between the contacts 30 and 35. Since the operating arm is relatively rigid and the support for the operating arm 32 is flexible, the desired movement of the contact 35 will be obtained. This movement will continue until the push collar has moved away from the ends 33 of the actuating arm 32, at which time the contacts 30 and 35 will be in their open circuit position, as illustrated in Fig. 3. It will be apparent that the ends 33 of the actuating arm 32 will be caused to move to the right with the push collar 21 due to the force caused by the inherent resiliency of the spring member 36.

As the dynamo-electric machine slows down and reaches a critical speed at which the force of the springs 23 overcomes the centrifugal force of the weights 22, the weights will fly inwardly and the push collar will move to the left so that it will push the ends 33 of the actuating arm, and the sequence of operation described above will occur in the reverse order, until the contacts are again actuated to their closed position, as shown in Fig. 1.

It is to be noted that with my improved switch construction the arrangement of parts is such as to provide a relatively long travel and low pressure at the points 33 or where the actuating arm

32 touches the push collar, but a relatively short travel and high pressure between the contacts. This will cause a minimum wear between the actuating arm at the points 33 and the cooperating surface of the push collar and will also produce the desired contact pressure between the contacts when they are in their closed position. The contact pressure between the contacts may be varied by changing the characteristics of the spring member 36 so that it will take either more or less force to flex the spring element when the contacts move into circuit closing position. It will also be noted that the contacts 30 and 35 are on one side and relatively close to a line passing through the points of connection 39 and 40 between the actuating arm and the spring 36, while the points of engagement 33 between the actuating arm and the operating mechanism are on the same side of the line but relatively far away from the line, or relatively remote therefrom. Also, the pivot points 43 are on the opposite side of the plane and about the same distance from the line as are the contacts. With such a construction, therefore, the desirable results of minimum pressure between the actuating member and operating mechanism and maximum pressure with minimum travel between the contacts is provided.

In the switch arrangement illustrated in Figs. 4 and 5, a structure is provided substantially similar to that illustrated in Figs. 1 to 3 except that only a single fulcrum point 43' is provided. With such a construction if the push collar 21 wobbles, the ends 33' of the actuating arm 32', which is supported solely by a resilient member 36', may oscillate around the single pivot point 43' and thereby cause a minimum contact chatter.

In the embodiments of my invention illustrated in Figs. 1 to 5, I have provided a pair of relatively movable contacts. It is to be understood, however, that my improved switch may be provided with any suitable number of stationary and movable contacts which may be so situated that one circuit will be closed while the other circuit is opened or a plurality of circuits may be opened and closed simultaneously.

In view of the foregoing, it will be seen that I have provided an improved switch construction which will have a reliable operation and which will be easy to manufacture.

Although I have shown and described particular embodiments of my invention, I do not desire to be limited thereto, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

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

1. A switch including a base member of insulating material, a relatively stationary contact mounted on said base member, a resilient element mounted on said base member, actuating means carried by said resilient element, and a relatively movable contact carried by said actuating means and adapted to make contact with said relatively stationary contact, said actuating means having a portion forming a fulcrum with said base member for actuating said contacts upon movement of said actuating means about said fulcrum.

2. A switch including a base member of insulating material, a relatively stationary contact mounted on said base member, a resilient element mounted on said base member, an actuating member carried by said resilient element, a relatively movable contact carried by said actuating member and adapted to make contact with said relatively stationary contact, said actuating member having a portion forming a fulcrum with said base member, and operating means for moving said actuating member about said fulcrum to move said relatively movable contact and actuate said contacts.

3. A switch including a base member, a relatively stationary contact mounted on said base member, a resilient element mounted on said base member, an actuating member supported solely by said resilient element, a relatively movable contact carried by said actuating member and adapted to make contact with said relatively stationary contact, said actuating member having a portion forming a fulcrum with said base member, said resilient means normally biasing said fulcrum against said base member, and operating means for moving said actuating member about said fulcrum to close said contacts.

4. A switch including a base member, a relatively stationary contact mounted on said base member, resilient element mounted on said base member, an actuating member carried by said resilient element, a relatively movable contact carried by said actuating member and adapted to make contact with said relatively stationary contact, said actuating member having a portion forming a fulcrum with said base member, said resilient element normally biasing said fulcrum point against said base member, and operating means for moving said actuating member about said fulcrum for closing said contacts, said actuating member being formed and arranged to cooperate with said operating means for causing said fulcrum point to move away from said base member and said actuating means to move about said contacts as a second fulcrum point on continued movement of said actuating member toward contact closing position.

5. A switch including a base member, a relatively stationary contact mounted on said base member, resilient means having a portion secured to said base member, actuating means secured to a portion of said resilient means spaced from said resilient means portion and carried thereby, a relatively movable contact carried by said actuating means and overlying said stationary contact so as to make contact therewith upon movement of said actuating means, said actuating means having a portion adapted to cooperate with said base member to form a fulcrum providing for moving said actuating means about said fulcrum to actuate said contacts, said fulcrum portion being on one side of a line passing through said connection between said resilient means and said actuating means, said contacts being on the opposite side of said line.

6. A switch including a base member, a relatively stationary contact mounted on said base member, resilient means having a portion secured to said base member, actuating means secured to a portion of said resilient means spaced from said resilient means portion and carried thereby, a relatively movable contact carried by said actuating means and overlying said stationary contact so as to make contact therewith upon movement of said actuating means, said actuating means having a portion adapted to cooperate with said base member to form a fulcrum providing for moving said actuating means about said fulcrum to actuate said contacts, said fulcrum portion being on one side of a line passing through said connection between said resilient

means and said actuating means, said contacts and said resilient means portion being on the opposite side of said line.

7. A switch including a base member, a relatively stationary contact mounted on said base member, resilient means having a portion secured to said base member, actuating means secured to a position of said resilient means spaced from said resilient means portion and carried thereby, and a relatively movable contact carried by said actuating means and overlying said stationary contact so as to make contact therewith upon movement of said actuating means, said actuating means having a portion adapted to cooperate with said base member to form a fulcrum providing for moving said actuating means about said fulcrum to actuate said contacts, said fulcrum portion being on one side of a line passing through said connection between said resilient means and said actuating means, said contacts being on the opposite side of said line and relatively close to said line, said resilient means portion being on said last-mentioned side of said line and relatively remote from said line.

8. A switch including a base member, a relatively stationary contact mounted on said base member, resilient means having a portion fixed to said base member, a relatively rigid actuating means secured to a portion of said resilient means spaced from said resilient means portion and carried thereby, a relatively movable contact carried by said actuating means and overlying said stationary contact so as to make contact therewith upon movement of said actuating means, said actuating means having a portion adapted to cooperate with said base member to form a fulcrum providing for moving said actuating means about said fulcrum to actuate said contacts, said fulcrum portion being on one side of a line passing through said connection between said resilient means and said rigid means, said contacts being on the opposite side of said line and relatively close to said line, said resilient means portion being on said last-mentioned side of said line and relatively remote from said line, and operating means adapted to push against a portion of said actuating means between said contacts and said fixed portion of said resilient means for closing said contacts.

9. A switch including a base member, a relatively stationary contact mounted on said base member, a substantially U-shaped resilient means having the closed portion of the U secured to said base member, actuating means having a portion bridging the open portion of the U and attached thereto, and a relatively movable contact attached to said actuating means at a point relatively close to a line passing through the points of connection between said actuating and said resilient means, said actuating means having a portion adapted to cooperate with said base member to form a fulcrum providing for moving said actuating means about said fulcrum to actuate said contacts.

10. A switch including a base member of insulating material, a relatively stationary contact mounted on said base member, resilient means mounted on said base member, a relatively rigid actuating means carried by said resilient means, a relatively movable contact carried by said actuating means and adapted to make contact with said relatively stationary contact, said actuating means having a portion adapted to cooperate with said base to form a pair of fulcrums, and operating means for moving said actuating means about said pair of fulcrums to move said relatively movable contact and actuate said contacts.

11. A centrifugal switch including a base member of insulating material, a relatively stationary contact mounted on said base member, a substantially U-shaped flexible means secured to said base member, actuating means having a forked portion carried by said flexible means, a relatively movable contact carried by said actuating means and adapted to make contact with said relatively stationary contact, said actuating means having a portion adapted to cooperate with said base to form a fulcrum, and speed responsive means arranged to engage said forked portion for moving said actuating means about said fulcrum to move said relatively movable contact to actuate said contacts.

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