Dec. 2, 1947. J. O. ROSCHE 2,431,771

THERMOSTATIC SWITCH

Filed July 17, 1943

Fig. 1.

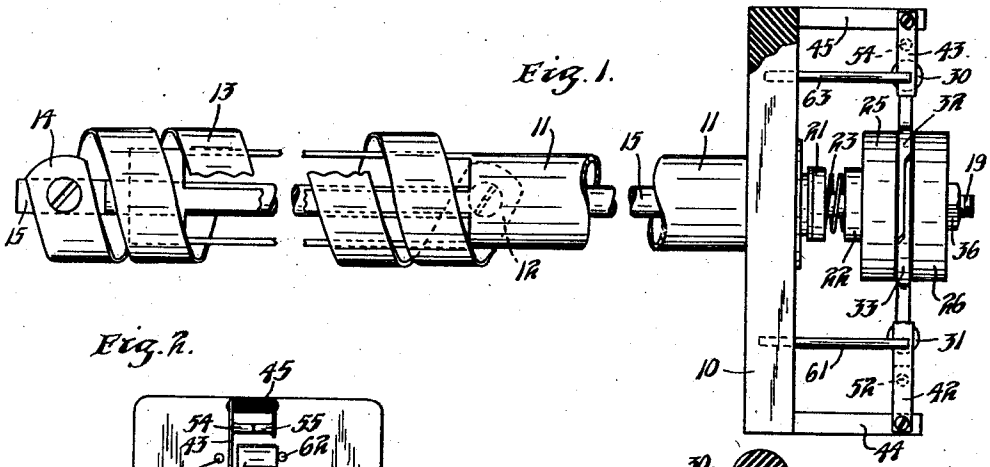


Fig. 2.

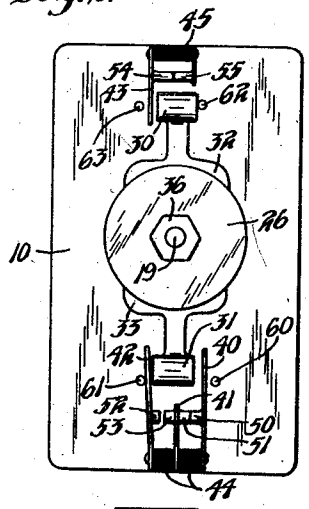


Fig. 3.

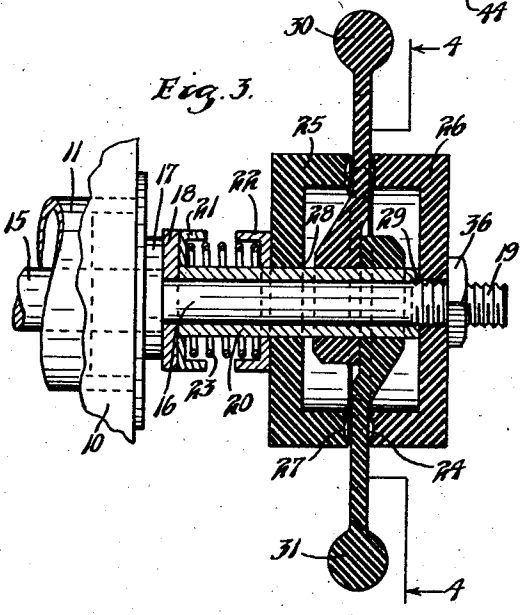
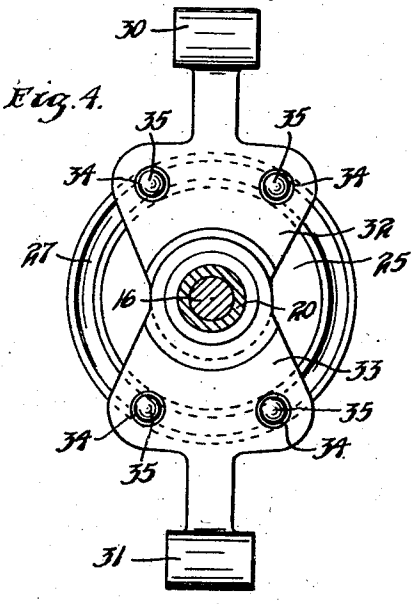


Fig. 4.



Inventor
JOHN O. ROSCHE

By George H. Fisher
Attorney

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THERMOSTATIC SWITCH

John O. Rosche, Minneapolis, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

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7 Claims. (Cl. 200—138)

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This invention relates to improvements in electric control devices controlling an electric circuit or a plurality of circuits actuated by a condition responsive device, wherein driven members are operated through a very limited range and a driving member is operated within a larger range, but with an arrangement whereby there is a substantially immediate reversal of the driven members upon a reversal in movement of the driving member. This arrangement is generally referred to as a slip-friction device.

While devices of this nature have particular utility in connection with condition responsive devices such as fluid fuel burners, having a plurality of electric circuits in association therewith, and will be described in such connection, it is adapted to be used in connection with other devices as a means of transmitting power.

One of the objects of this invention is to provide an improved slip-friction connection between an element actuated by a condition responsive device or other power driven device whereby one or more electric switches may be actuated by a relatively slight movement of the element and wherein continued movement of the element in the same direction is not injurious to the switches or to the driving element.

A second object is to provide an improved slip-friction connection which produces a substantially immediate reversal of the operating arms upon a reversal of the movement of the driving element.

A third object is to provide a slip-friction device which is simple to manufacture in quantity production and which is free of many of the defects of devices of the prior art.

With these and other objects in view, reference is made to the accompanying drawing illustrating a preferred embodiment of this invention, wherein:

Figure 1 is a side elevation of the device showing the relationship between the slip-friction connection and the condition responsive device;

Figure 2 is a front elevation of the slip friction device shown in relation to the switches;

Figure 3 is an enlarged central section of the slip-friction mechanism showing a longitudinal cross section of the control; and

Figure 4 is an enlarged front elevation taken along the line 4—4 of Figure 3 showing the details of the slip-friction arrangement.

Similar reference characters refer to similar parts throughout the several views of the drawing.

Suitably fastened to the rear of an insulating

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base 10 is a mounting sleeve 11, to which is connected one end 12, of a bimetallic helix generally indicated at 13. The other end 14 of the helix is secured to an actuating rod 15, which extends longitudinally within the helix and sleeve 11 and through an opening in the base 10. The inner portion of the rod 15 has a section of reduced diameter 16, and a shoulder 17, against which is disposed a washer 18. A sleeve 20, fitting over the reduced portion 16, carries two friction cups 21 and 22 preferably made of stainless steel and a spring element 23, between the friction cups, and biasing them away from each other.

A slip-friction element consisting of two disks 25 and 26, preferably formed from "Bakelite" or other insulating material having within their inner disposed faces a pair of annular grooves or races 24 and 27. Disk 25 has a central aperture 28, of sufficient dimension to fit upon sleeve 20, in a floating manner and disk 26 has a central aperture 29 of sufficient dimension to fit upon the rod 15. A pair of switching arms 30 and 31, which are also formed of "Bakelite" or other insulating material are molded or shaped as shown in Figure 3 and Figure 4 with a reinforced hub portion and are so disposed on sleeve 20, that the extensions of the arms are in the same central plane. An embossed or widened portion of each arm 32 and 33 has a plurality of apertures 34, radially disposed about the center point to accommodate an equal number of ball bearings or other spherical elements spherically rotatable therein. The positions of the apertures 34 with relation to the disks 25 and 26 are such that the spheres 35 are rotatable within the annular grooves 24 which is disposed on the inner face of disk 26, and 27 which is shown on the inner face of disk 25. Thus, the arms 30 and 31 are rotatable within predetermined limits between the disks 25 and 26 having only frictional engagement therewith by means of the rotatable spheres 35. The assembly is held in place on one end of rod 15, by the nut 36, turning on the threaded portion 19, of rod 15, so as to hold the disk 26, firmly against the outer end of the sleeve 20. The disk 25 is resiliently held in abutment with the ball bearings 35 by the compression spring 23, acting on its inner end against the friction cup 21, washer 18, and abutment 17, and on its outer end against the friction cup 22. It will be found that if the two arms 30 and 31 are held while the rod 15 is rotated that disk 26 will rotate with rod 15, while disk 25, which is held in resilient engagement with the ball bearings 35, will rotate in the opposite direction. However, if one of

the arms is held or brought into engagement with a stationary element which will prevent its further movement, the other arm under influence of the driving member will continue to move independently of the first arm for a distance which is only limited by the engagement of the members 32 and 33.

Referring to Figure 2, a plurality of switches 40, 41, 42, and 43 which may be any conventional switches are suitably mounted as at 44 and 45 upon the insulating base 10. These switching elements of which only general reference is made, are for the operation of motive power such as a series of relays used on an ignition means and fuel feeding means of a heating system or other essential elements of a condition maintaining system. The switch blades are fitted with a series of suitable contact points 50 and 51, 52 and 53, 54 and 55, which may be biased to an open or closed circuit position depending on the needs of the elements or members which they control. A series of stops 60, 61, 62, and 63 are suitably mounted upon the base 10 to restrict the lateral movement of the arms 30 and 31 and the flexible switching members. However, since the rod 15 is held in slip-frictional engagement it may continue to rotate without injuring the arms or the helically wound bimetal element.

In operation of the above described instrument, when the bimetallic element is subjected to heat as in the stack of a furnace, the helix 13 tends to unwind and rotate the rod 15 in a counterclockwise direction. When this movement takes place the entire rotatable assembly including spring 23 and its associated parts together with disks 25, 26, and the two switching arms also move simultaneously in a counterclockwise direction without rotation of the roller elements 35, since the entire assembly moves as a unit. The arm 31 moves against the switch 40 breaking the contact between the points 50 and 51, and continues its movement until the switch 40 has been brought into contact with the stop 60. This movement causes switch 42 which is biased toward closed position to move to its closed position closing the contacts 52 and 53. Simultaneously, arm 30 moves to the left against switch blade 43 and opens contact between points 54 and 55. As the temperature increases, the movement of arm 30 continues independently until switch 43 has been moved against stop 63 wherein both arms 30 and 31 have moved to the extent which is desirable in this installation and on continued heating, the heat responsive element continues to rotates the rod 15, in a counterclockwise direction. This motion is transmitted to the disks 25 and 26, and disk 26 will commence to rotate in an opposite direction to the movement of disk 25 by reason of the frictional engagement of the two members with the ball bearings 35, that are in turn capable of rotating in grooves 24 and 27. Thus the movement of disks 25 and 26 in opposite directions serves to dissipate the residual force of the continued movement of rod 15 without injury to the arms 30 and 31 and the switches with which they are in contact. Assuming now that the source of heat has abated, in cooling the helix will rotate in a clockwise direction and coincident with this motion the two contact arms also immediately begin to rotate in a clockwise direction, thus permitting switch 43 to move to the right so that the contacts 54 and 55 close at the same time that switching controlling arm 31 moves in a clockwise direction permitting switch 40 to close contacts 50 and 51, and breaking contacts 52 and 53 formed between switches 41 and 42. It should be understood that one or more switches may be operated by this arrangement.

It will be seen from the above description that I have attained a slip-friction control device responsive to a condition responsive element which is simple in construction and yet positive in its operation which attains the objects which I have set forth. Since there are many other forms which this invention may take as a switch operating mechanism and as a means of transmitting power, I therefore desire to be limited by the scope of the appended claims and not by the specific embodiment of the invention disclosed in the present application.

I claim:

1. In a non-positive transmission mechanism, a plurality of driven members having a plurality of apertures therein of greater dimension than the thickness of said members, a roller element in each aperture of such circumference as to extend on each side of said members, a driving member on one side of said driven members and engaging the surface of said roller elements, a third member on the other side of said driven member and engaging the other side of the surface of said roller elements, said third member being frictionally connected to said driving member by said roller elements in such a manner that said third member and said driven members move in unision and at the same rate as said driving member until further movement of each of said driven members is arrested, and upon continued movement of said driving member said third member is caused to move in an opposite direction.

2. In a condition responsive control instrument, in combination, an element responsive to a change of condition, a driven member having a plurality of apertures therein of greater dimension than the thickness of said member, a roller element in each aperture of such circumference as to extend on each side of said member, a driving member movable upon impulse of said condition responsive element, said driving member being disposed on one side of said driven member and engaging the surface of said roller elements, a third member on the other side of said driven member and engaging the other side of the surface of said roller elements, said third member being frictionally mounted to said driving member by said roller elements in such a manner that said third member and said driven member move in unison and at the same rate as said driving member until further movement of said driven member is arrested, and upon continued movement of said driving member said third member is caused to move in an opposite direction.

3. In a non-positive transmission mechanism, in combination, a plurality of independently movable driven members so disposed with relation to one another that extensions thereof are in the same central plane, each of said driven members having a plurality of apertures therein radially disposed about the center point, a roller element disposed in each aperture, a driving member being disposed on one side of said driven members and engaging the surfaces of said roller elements and a third member being disposed on the opposite side of said driven members in yielding engagement with said roller members in such a manner that said third member and said driven members move in unison and at the same rate as said driving member until further movement of

each of said driven members is independently arrested, and upon continued movement of said driving member said third member is caused to move in an equal and opposite direction.

4. In a thermostatic control device, in combination, a thermal device adapted to rotate in opposite directions in response to changes in temperature, a driving member adapted to rotate in response to impulse of said thermal device, a plurality of independently movable driven members having apertures therein of greater dimension than the thickness of said members, said apertures being radially disposed about a center point, roller elements disposed in said apertures and engaging one side of said driving member, another member on the opposite side of said driven members and engaging the opposite side of said roller elements, said third member being frictionally connected to said driving member by said roller elements in such a manner that upon movement of said driving member in either direction said third member and said independently movable driven members instantly move in unison and at the same rate as said driving member until further movement of each of said driven members is independently arrested, and upon further movement of said driving member said third member is caused to move in an opposite direction.

5. In a control device, in combination, a disk shaped driving member having an annular groove upon one of its surfaces, driven members formed so that a portion thereof coincides with the contour of the driving disk, said driven members having apertures therein to accommodate a plurality of roller elements, roller elements disposed in said apertures, said roller elements extending on each side of said driven members and engaged on one side in the annular groove in said driving disk, another disk having an annular groove on its inner surface, said disk being disposed on the other side of said driven members and being adapted so that its annular groove is engaged with the other side of said roller elements, means rotatable with said driving disk for yieldingly holding said disks and members in frictional engagement with each other whereby said several members move in unison with said driving disk solely by the frictional engagement of said yieldable means until movement of said driven members is arrested, and on continued movement of said driving disk said other disk freely rotates on said roller elements in a direction opposite that of said driving disk to thereby provide non-positive action of said driven members.

6. In a slip-friction thermostatic control device, a helically wound thermal element rotatably responsive to a change in temperature, a rod rotatable on its longitudinal axis in response to movement of said thermal element, a driving member comprising a disk having an annular groove on its inner face disposed on one end of said rod, two driven members adapted to conform with each other so that their extensions are in the same central plane, one end of each arm being adapted to conform with the contour of the driving disk and having a plurality of apertures coinciding with said annular grooves, a plurality of roller bearings disposed in said apertures, said bearings having sufficient dimension to enable them to extend on each side of said driven members and into the groove formed in the driving disk, another disk having an annular groove, disposed on the opposite side of said driven members and being adapted so that the roller bearings rotate in said annular groove, biasing means rotatable with said rod for holding said members in yielding engagement with each other on said rotatable rod whereby said several disks and said driven members move in unison and at the same rate as said rotatable rod solely by the frictional engagement of said biasing means until further movement of said driven members is arrested, whereafter said several disks freely rotate in opposite directions on said roller bearings to provide slip-frictional engagement with said driven members, a plurality of electric switches positioned with relation to said driven members that upon movement thereof said switches will be moved to one of their positions, means for limiting the movement of said switches upon continued movement of said driving disk in one direction and means for moving said switches simultaneously to their other position substantially immediately upon reversal of rotation of said driving disk.

7. In a non-positive transmission device, in combination, a plurality of movable electric switches adapted to be biased to one of their positions, a plurality of independently movable driven members for successively engaging said switches and moving them against their bias to one of their positions, said driven members having apertures therein radially disposed about a center point, a plurality of roller elements disposed in said apertures, a driving member subject to movement in two directions being disposed on one side of said driven members and engaged with the surfaces of one side of said roller elements, another member disposed on the other side of said driven members and engaged with the opposite side of said roller elements, said other member being frictionally connected to said driving member by said roller elements in such a manner that said other member and said independently movable driven members move in unison and at the same rate as said driving members until said driven members have successively moved said switches to their said one position, and on reversal of movement of said driving member said independently movable driven members move in unison to allow said switches aided by their bias to move to another position.

JOHN O. ROSCHE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,235,338	Shaw	Mar. 8, 1941
2,167,003	Pensbee	July 25, 1939
1,883,164	Vassakos	Oct. 18, 1932
1,781,173	Green	Nov. 11, 1930
2,132,928	Blanchard	Oct. 11, 1938
1,528,530	Coffee	Mar. 3, 1925