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MAGNETIC COUPLING

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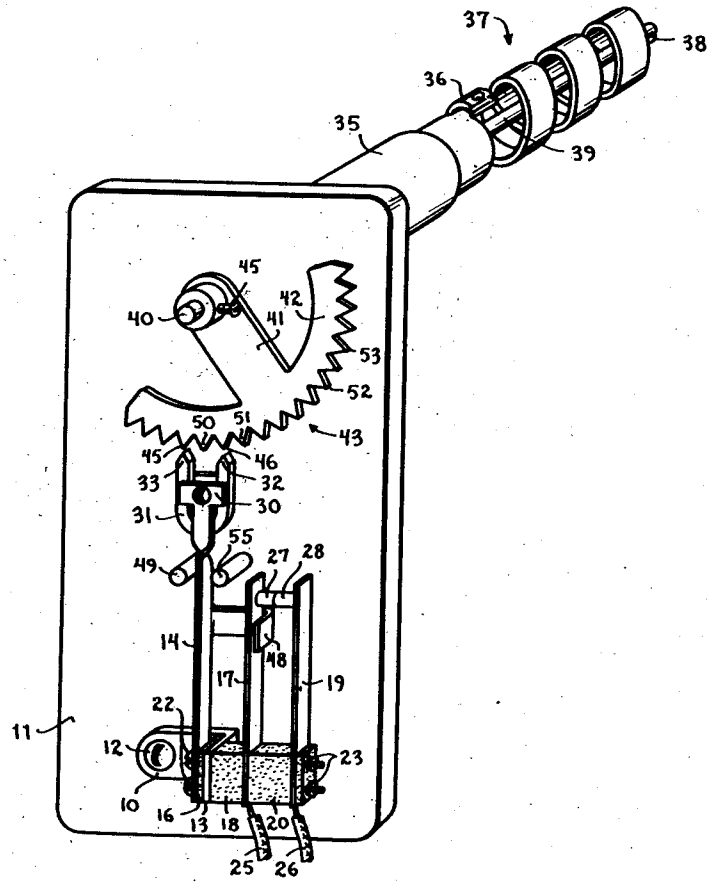

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MAGNETIC COUPLING

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This invention is directed broadly to a magnetic coupling by which one member may actuate or drive another. More specifically, the invention is directed to an arrangement whereby the driven member is operated through a very limited range and the driving member is operated through a much wider range, the magnetic coupling permitting relative movement between the two members but arranged to move the driven member in a reverse direction substantially immediately upon a reversal in movement of said driving member.

One of the principal uses to which such a device may be put is that of controlling an oil burner. In such controls it is desirable to operate a switch in response to the presence or absence of combustion. In order to adapt the present invention for such use the driving member may be operated by a thermostat mounted in the stack or some other place where it may respond to the heat of combustion. Upon the establishment of combustion the thermostat will operate the driven member through the magnetic coupling and the driven member will in turn close a switch and then stop moving, while the driving member will continue to move until the thermostat reaches its maximum temperature. Upon failure of combustion the thermostat will begin to cool and immediately move the driven member in the opposite direction to open the switch. Thus the switch will be actuated upon a change in temperature trend at the thermostat and will not depend upon the attainment of any particular temperature value for actuation.

The above function has been obtained in the past by the now well known "slip friction" switches, one example of which is shown in the patent to Phelan 1,847,036. It is therefore one of the prime objects of this invention to provide a mechanism having a function similar to "slip friction" devices, yet one in which there is no sliding friction and hence no wear insofar as the slipping function is concerned.

Another object of the invention is to provide a magnetic coupling between a driving member and a driven member such that the driving member has an overrun in each direction with respect to the driven member, yet the driven member will reverse substantially immediately upon a reversal of movement of said driving member.

A still further object is to provide a thermostatic switch having a magnetic coupling between the thermostat and the switch which provides for the switch being actuated upon a reversal in temperature change rather than upon any particular temperature value.

These and other objects will readily become apparent as the following specification is read in the light of the accompanying drawing in which the single figure shows a perspective view of a device embodying my invention.

Referring to the drawing, a bracket 10 is suitably secured to an insulating base 11 by some suitable means such as the screw 12. This bracket is provided with an outwardly extending mounting flange 13. A switch actuating blade 14 is adapted to be carried by the flange 13 and is electrically separated therefrom by the insulating block 16. A first switch blade 17 is also adapted to be mounted on the flange 13 and is electrically separated therefrom by the insulating block 18. A second switch blade 19 is also adapted to be mounted on the flange 13 and is electrically separated from blade 17 by means of the insulating block 20. The blades 14, 17, and 19 along with their insulating blocks are suitably mounted on the flange 13 and maintained in assembled relation by some suitable means such as the bolts 22 and nuts 23. The blades 14 and 17 are flexible and are adapted to be actuated back and forth for the purpose of making and breaking the circuit between the electrical conductors 25 and 26 which are suitably secured to the base of the switch blades 17 and 19. The circuit is completed through the movable contact 27 carried on blade 17 and the stationary contact 28 carried on blade 19. The blade 19 may also be flexible to provide for press back. Blade 17 is biased toward the right as seen in the drawing so that the contacts 27 and 28 are normally in engagement.

The upper end of the switch actuating blade 14 is provided with a clamp 30 for securely fastening the horseshoe magnet 31 in the position shown. The magnet 31 is provided with a pair of poles 32 and 33 which are pointed, for a purpose to be described later.

Suitably fastened to the rear of the base 11 is a mounting sleeve 35, to the outer end of which is connected one end 36 of a bimetallic helix generally indicated at 37. The other end 38 of the helix is secured to an actuating rod 39 which extends longitudinally within the helix and sleeve 35 and through an opening in the base 11. The inner end 40 of the rod 39 carries an arm 41 which has an integral arcuate section 42 provided with a plurality of pointed teeth or projections indicated generally at 43. The arm 41 is

adjustably positioned on the rod 39 by means of the screw 45.

The arm 41 is so mounted that as it is rotated by the helix 37, the teeth 43 are successively brought to a point opposite the pointed poles 32 and 33 of the permanent magnet 31. The section 42 being made of some magnetic material such as soft iron is attracted by the magnet 31 and due to the fact that some of the teeth 43 are positioned closer to the magnet than the rest of the section, it is between these teeth and the magnet that the strongest attraction exists. For example, as indicated in the drawing, tooth 45 is adjacent pole 33 and tooth 46 is adjacent pole 32. For this reason the greatest attraction will occur between these teeth and the two poles of the magnet. As the bimetal helix responds to a change in temperature, for example a decrease in temperature, the arm 41 and hence the section 42 will be rotated in a clockwise direction. Due to the attraction between the teeth 45 and 46 and the poles 33 and 32 of the magnet 31, the magnet will be forced to follow the teeth and hence bend the switch actuating arm 14 toward the left. As this action takes place, the extension 48 on the switch actuating blade 14 will engage the switch arm 17 and carry it to the left breaking the circuit between the contacts 27 and 28. Shortly after this takes place, the arm 14 will engage the fixed stop 49 after which no further movement of this arm can occur. The movement of the arm 41 and section 42 is unhampered however, and a continued decrease in temperature at the helix 37 will cause continued clockwise rotation of the arm 41, at which time the teeth 43 will move successively across the poles 33 and 32 of magnet 31. There will probably be a slight oscillating movement of the magnet as the section 42 continues to rotate as the poles 33 and 32 move out of the field of attraction of one set of teeth, such as the teeth 45 and 46 and into the field of attraction of the next succeeding set of teeth such as the teeth 50 and 51. This slight oscillatory movement however, is insufficient to effect closure of the contacts 27 and 28.

When the helix 37 has reached its minimum temperature the section 42 will be in its clockwise position, at which time a different set of teeth, for example the teeth 52 and 53, will be adjacent the poles of the permanent magnet. At this time, the main attraction between the magnet and the section 42 will be between pole 33 and tooth 52, and pole 32 and tooth 53. If the temperature at the helix starts to increase at this time the section 42 will rotate in a counter-clockwise direction and the magnet 31 will be moved toward the right as seen in the drawing due to the attraction between it and the teeth 52 and 53. This movement will permit the switch blade 17 to move toward the right under its bias and reclose the contacts 27 and 28. The resilient arm 14 will eventually engage the stationary stop 55 and stop the movement of the arm. Continued movement of the section 42 will cause the teeth 43 to move successively over the poles of the magnet and as before, a slight oscillatory movement of the magnet will doubtless take place. The arm 48 and blade 17 are so positioned however, as to not engage during this slight oscillatory movement of the magnet and therefore the contacts 27 and 28 will not be affected. On an increase in temperature at the helix 37, the teeth which are then immediately above the poles of the magnet will cause the magnet to move to the left and again open the switch contacts 27 and 28.

It will therefore be seen that the switch 27, 28 is actuated not in response to the attainment of any definite temperature value but upon a reversal in the temperature trend. As stated in the objects of the invention, this function is similar to the function of the slip friction switches, but this arrangement has the advantage that there is no friction present between the magnet and the section 42 and therefore there is no wear between these parts.

There are many other forms which this invention may take and 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 as my invention:

1. In a device of the character described, a movable member, a flexible blade, and means including a magnetic coupling by which said blade is flexed by the movable member, the movement of said blade being restricted to a relatively narrow range, said member being movable through a much wider range, said magnetic coupling including magnetic means carried by said blade and member for causing movement of said blade substantially immediately upon a reversal in movement of said movable member regardless of the position of said movable member within its range of movement.

2. In a device of the character described, a movable member, a flexible blade, a magnetic coupling including a first magnetic means on said member and a second magnetic means carried by said blade by which said blade is flexed by the movable member, means for limiting the movement of said blade to a relatively narrow range, relative movement between said two magnetic means permitting continued movement of said member after said blade has reached one of its limits, a plurality of poles on one of said magnetic means for causing reverse movement of said blade substantially immediately upon reverse movement of said member, and switch means actuated by said flexible blade as it moves to each of its two limiting positions, said switch means including means providing for a slight movement of said blade at its limiting positions without actuating said switch.

3. In a device of the character described, a movable member, a flexible blade to be moved thereby, a permanent magnet mounted on said flexible blade, a plurality of poles on the movable member which may successively move into cooperative relation with one of the poles of said magnet, and means limiting the range of movement of said blade, said member having a much greater range of movement.

4. In a thermostatic switch, a thermostat, a member moved thereby in accordance with the temperature of said thermostat, a switch blade, a permanent magnet carried by said switch blade, a member of magnetic material carried by said movable member, said magnetic material having a plurality of projections which are successively brought adjacent at least one of the poles of said magnet as said member is moved, the magnetic attraction between said magnet and the adjacent projection on said magnetic means causing said blade to be moved by said movable member, and means for limiting movement of said switch blade, further movement of said movable member causing other projections on said magnetic means to successively move past said magnet, reverse movement of said member causing substantially immediate reverse movement of said switch blade

due to the magnetic attraction between said magnet and the then adjacent projection of said magnetic means.

5. In a device of the character described, a first member, a second member, one of said members carrying a magnet, the other member including a magnetic means having a plurality of pointed projections one of which may be located adjacent one pole of said magnet, means for moving said first member in one direction, the magnetic attraction between said one pole of the magnet and the adjacent pointed projection causing a corresponding movement of said second member, means for limiting movement of said second member, continued movement of said first member causing relative movement between said magnet and magnetic means whereby other pointed projections successively assume a position adjacent said magnet pole, the magnetic attraction between said magnet pole and the then adjacent pointed projection causing substantially immediate reverse movement of said second member upon a reversal in movement of said first member.

6. A thermostatic switch comprising in combination, a resilient switch operating blade, a horseshoe magnet having pointed poles carried by said blade, a magnetic means having pointed projections, a thermostat for moving said magnetic means to bring said pointed projections into successive magnetic cooperation with the poles of said magnet, movement of said magnetic means causing movement of said switch blade due to the attraction between the poles of said magnet and whichever projections are in magnetic cooperation therewith at the time, and means for limiting the movement of said switch operating blade to a relatively narrow range while permitting free movement of said magnetic means by said thermostat.

7. A device in combination comprising, a condition responsive controlling means operable in a first direction in response to an increase in said condition and in a second direction upon a decrease in said condition, switching means having a narrow range of operation, magnetic coupling means associated with said condition responsive member and with said switching means including a magnet associated with one of said two first mentioned means and an armature member having a series of projecting portions associated with the other of said two first mentioned means, said magnet and armature members being relatively movable throughout a wide range of operation for substantially instantaneous operation of said switching means upon initial operation of said condition responsive means in said first direction and substantially instantaneous reverse operation of said switching means upon initial operation of said condition responsive means in said second direction regardless of the extent of the relative movement of the said magnet and the said armature member throughout said wide range of operation under the control of said condition responsive means.

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