Fig. 5.
ADJUSTABLE LIMIT SWITCH MEANS

Philip Handelman, Pittsburgh, Pa., assignor to Reliance Steel Products Company, McKeesport, Pa., a corporation of Pennsylvania

Application March 7, 1946, Serial No. 652,767

3 Claims. (Cl. 192—66)

1. This invention pertains to an adjustable limit switch means and, more particularly, to means which can be readily adjusted so as to control the opening or closing of limit switches and thereby limit the travel of a controlled object such as an open hearth damper type reversing valve or any other object whose travel is to be controlled.

In many industrial operations such as, for example, in open hearth furnace operations, it may be desirable to operate a valve, which controls the egress of waste gases to the stack, or in other words, controls the stack draft for certain periods of time. This is accomplished by varying the lift of a valve thus diminishing and increasing the valve opening. These valves are usually operated by electric motors controlled by suitable pushbuttons. One pushbutton is operated to open the valve and the other to close it. In attempting to uniformly control the degree of opening solely by pushbutton, the matter of judgement on the part of the operator plays an important part and in many cases of misjudgement of an inexperienced operator, unsatisfactory operation of the furnace may be obtained thus causing a considerable loss of fuel and the possible spoiling of the material in the furnace.

An object of my invention, therefore, is to provide a novel adjustable limit switch means that will cause automatic limit switching and thereby avoid the above-named disadvantages inherent in many presently known control systems for controlling valves in furnaces and the like.

A further object of my invention is to provide a limit switch means including a pair of rotatable clutch members, one of which members is coupled to and is driven by an object whose motion is to be controlled, and wherein switching means are operated upon predetermined rotary movement of such member.

A more specific object of my invention is to provide a uniform, foolproof device which can be easily adjusted so as to secure different limits of movement of an element to be controlled, such as a motor actuated valve or the like.

Other objects and advantages will become apparent from a study of the following specification taken with the accompanying drawings in which:

Figure 1 is a top plan view of an adjustable limit switch means embodying the principles of my invention;

Figure 2 is a cross-sectional view taken along line II—II of Figure 1;

Figure 3 is a cross-sectional view taken along line III—III of Figure 2;

Figure 4 is a front elevational view of the device shown in Figure 1, and

Figure 5 is an enlarged front elevational view of the dial shown in Figures 1, 2 and 4.

Referring more particularly to Figures 1 and 2, numeral 2 denotes a supporting structure carrying a fixed sleeve 3 having a longitudinal bore. A hollow shaft or sleeve 4 has a portion of reduced diameter which extends through sleeve 3 and forms a telescopic fit therewith, or more strictly speaking, forms a telescopic fit with a hollow sleeve 4 therebetween. A drum 5 is keyed to the shaft 4 and has a cable 20 wound therearound, one end of the cable being fastened to main cable drum at 85 (Figure 2) and one end being fastened to small counterweight 21. Main cable 160 is wound around the main cable drum and one end of the cable is connected to an object whose motion is to be controlled, such as, for example, a valve 22 (see Figures 3 and 4) so that when the valve is being opened, the drum is driven or rotated in one direction and when the valve is being closed, the drum 5 is driven or rotated in the opposite direction by the small counterweight 21. Main cable 160, in this case, also has a counterweight 161 attached to its free end so that the movement of the valve will be always resisted by the weight.

Adherent to the periphery of drum 5 is integrally secured a cam or finger 6. The end face of the sleeve is knurled or serrated at 7. An end plate or switch actuator carrier 8 has a face which is also knurled or serrated and which is adapted to engage the knurled surface 7 to form a friction clutch. Plate 8 is keyed to an operating shaft 12. Plate 8 has an integral arm 16 to which is rigidly fastened a cam or finger 41. The operating shaft 12 which slidably and rotatably passes through an adjusting nut 15, compression spring 14, sleeve 27 to which it is key and through handles 13 to which it is keyed where operating shaft 12 ends. The compression helical spring 14 has one end which bears against
the adjusting nut 15 which is screwed into hollow shaft 4 and the other end bears against the shoulder 6 of drum 5, thereby tending to urge the shaft 2 toward the left, as viewed in Figure 2, to hold the knurled surfaces in frictional contact so that the arm 10 will be driven by and revolve with the drum. After the adjusting nut is screwed so as to obtain the desired tension, and spring 14, it may be locked in place by pin 18.

By manually grasping handle 13 and moving it to the right as viewed in Figure 2, the clutch face of plate 8 is moved away from the knurled surface so as to allow arm 10 to be rotated relative to drum 5 by the mere turning of handle 13. After handle 13 is turned so that plate 8 is rotated to the desired angular position with respect to shaft 4, the handle is released, thereby allowing spring 14 to cause the clutch surfaces to re-engage.

As will appear more clearly in Figures 1 and 4, two limit switches L1 and L2 are associated with the device. Limit switch L1 is operated by cam 6 on the drum 5, which cam engages a roller 23 forming part of the movable member of limit switch L1 and which cam 6 trips the switch and opens the motor circuit when the valve reaches its closed position. The switch L2 is operated by the cam 11 on the rotating adjustable arm 10 which cam serves to engage roller 24 secured to the movable element of limit switch L2 and which serves to break the motor circuit when the valve is raised to a predetermined extent.

Suitable dials 25 and 26 are disposed on the front of the device and which indicate the zero or closed position of the valve and the setting at which arm 11 will engage the switch L2 to limit the opening movement of the valve. On large valves, the dials may be calibrated in inches to indicate the number of inches that the valve opens.

The legends appearing on Figure 5 denote the various positions at which the valve starts to lift, or begins to open, or is fully open.

In operation, it may be assumed that the inner dial 26 is set at zero and that the outer dial 25 is set at zero when the valve is closed. In this position, arms 11 and 8 would be at the same relative position with no angular separation therebetween. Assume that the valve is to be opened 30 inches. The handle 13 is depressed and turned in a counter-clockwise direction along the inner calibration to the position 30 and then released. The cam or finger 11 would then be angularly displaced from the cam or finger 6 a distance equal to the angular separation between the zero and numeral 30 positions. Similarly, if it is desired to operate the valve so as to cause greater or less opening thereof, handle 13 is depressed and turned an angular distance corresponding with the desired degree of opening of the valve.

Any well-known electric motor circuit controlled by pushbuttons, for example, for driving valve stem 22 in another direction, may be used, hence, illustration of such circuits is deemed unnecessary. Suffice to say that when the pushbutton is operated, the cam 6 will move away from switch L1 while cam 11, turning with the drum, will also be carried around. Because it is axially offset with respect to cam 6, it will start to move toward its switch L2. When the valve opens 30 inches or to any other degree, depending upon the relative preset positioning of shaft 4 and plate 8, the drum 5 will rotate to a position where cam 11 contacts switch L2 to open it, thereby stopping the raising of the valve. Upon pushing the valve-closing pushbutton, the drum 5 will rotate in the opposite direction until cam 6 operates the switch L1 at the closing position. The closing position is always the same, hence cam 6 is definitely fixed in its position with respect to drum 5, but arm 10 is angularly adjustable with respect to it.

It should be noted that while the above-described device, for purposes of illustration, is shown as being associated with a valve stem, it will be apparent to those skilled in the art that objects other than valves or valve stems may cause rotation of the drum so that movement of other such objects in one direction or an opposite direction may be similarly controlled by the limit switches. The limit switching means described above is particularly suitable for controlling the movements of objects traveling through appreciable distances.

Thus it will be seen that I have provided an efficient, compact and easily adjustable limit switch means for adjusting or controlling limitation of movement of said rotatable member, a first clutch element secured to an end surface of said rotatable member and at a right angle to the longitudinal axis of the bore, a rotatable shaft extending through said bore and adjusting nut and sliding axially therein, a second clutch element secured to one end of the shaft, a handle rigidly secured to the shaft, a sleeve providing a shoulder fixedly surrounding a portion of the length of the shaft and receivable in a bore formed within the bore and surrounding the shaft between the shoulder and the nut for biasing the second clutch element into engagement with the first clutch element whereby axial movement of the shaft by manipulation of the handle will compress said spring and separate the clutch elements.

2. In an adjustable limit switch operating device, the arrangement including a cylindrical rotatable member having an axially extending bore, an adjusting nut in said bore and having a threaded connection with said rotatable member, a first clutch element secured to an end surface of said rotatable member and at a right angle to the longitudinal axis of the bore, a rotatable shaft extending through said bore and adjusting nut and sliding axially therein, a second clutch element secured to one end of the shaft, a handle rigidly secured to the shaft, a sleeve providing a shoulder fixedly surrounding a portion of the length of the shaft and receivable in a bore formed within the bore and surrounding the shaft between the shoulder and the nut for biasing the second clutch element into engagement with the first clutch element whereby axial movement of the shaft by manipulation of the handle will compress said spring and separate the clutch elements.

3. A device of the class described including a rotatable member having a centrally disposed axially extending bore, a second clutch element secured to the end face of the member and around the bore, a rotatable shaft extending through the bore and
5 slidable therein, a switch actuator element secured to one end of the shaft and having a serrated surface oppositely disposed relative to the serrated portion, a shoulder on said shaft, an adjusting nut having a threaded connection to said member at one end of the bore, said nut having an opening through which said shaft extends and in which it is rotatable and axially slidable, the end of the nut and the end of the shoulder defining the ends of an annular space between the shaft and the bore, a helical spring in said space and bearing against the shoulder and against the nut, said spring serving to urge the serrated portion and the serrated face into clutching engagement, and when said shaft is moved axially against the spring the serrated portion and the serrated face will be separated.

PHILIP HANDELMAN.