

May 1, 1951

J. D. RUSSELL ET AL

2,550,868

CENTRIFUGAL SWITCH

Filed Aug. 5, 1947

Fig. 1.

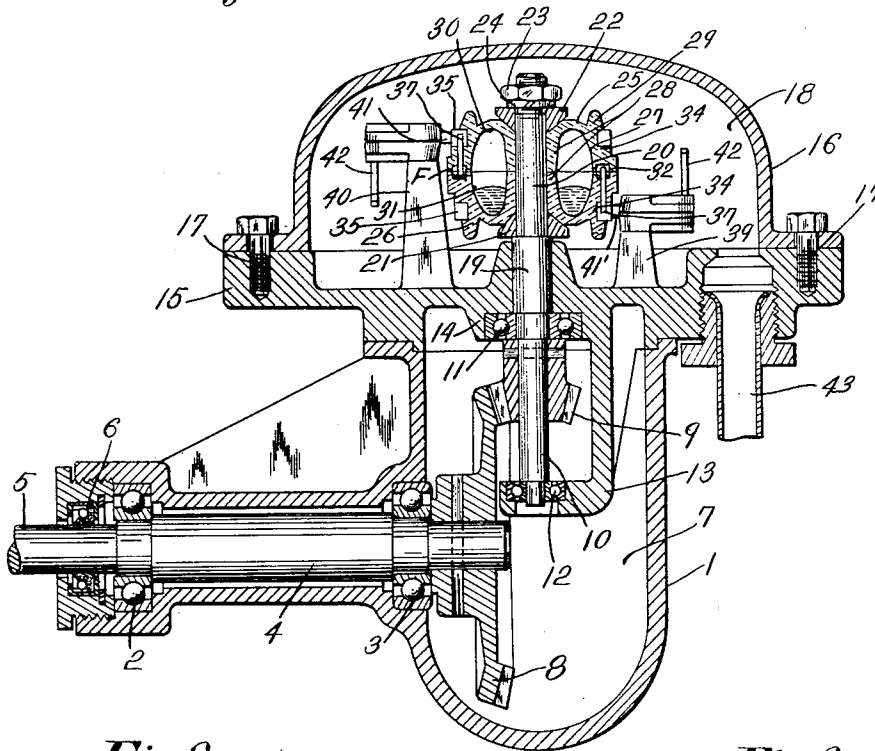


Fig. 2.

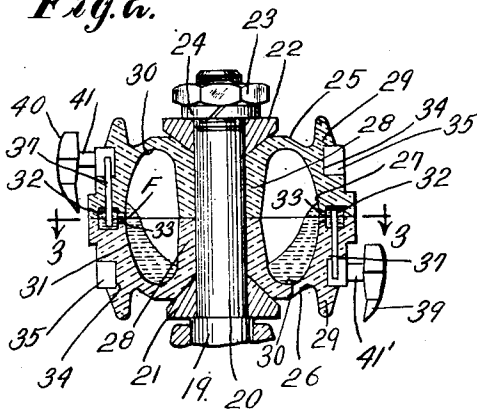
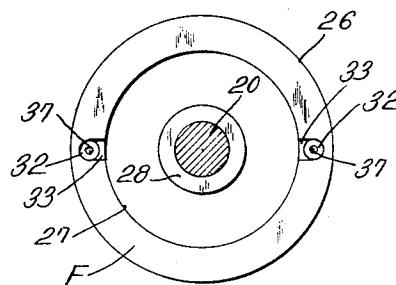


Fig. 3.



Inventors:
John D. Russell.
James W. Woolf.

by

Paul A. Maxon,
Attorney.

UNITED STATES PATENT OFFICE

2,550,868

CENTRIFUGAL SWITCH

John D. Russell and James W. Woolf, Franklin, Pa., assignors to Joy Manufacturing Company, a corporation of Pennsylvania

Application August 5, 1947, Serial No. 766,212

6 Claims. (Cl. 200—80)

1

Our invention relates to centrifugal switches, and particularly, though not in any sense limited thereto, to centrifugal switches which are very well adapted to the control of the operating circuits of motors driving belt conveyors.

In the conveying of material by belt conveyors, sections of great length are undesirable, and where a number of conveyors are arranged in series between a point or points at which material is loaded onto the first of them and a point at which discharge is desired, it is important that means be provided to shut down any and all conveyors ahead, in the direction of material movement, of any conveyor section which may become deranged or inoperative. Such means may advantageously employ speed responsive control devices driven from each of the conveyor sections, as, for example, by a roller which supports the conveyor. These devices need to be simple, compact, durable, and not likely to be rendered inoperative as a consequence of substantial periods of use. Our invention is well adapted for controls of the kind mentioned, but is not, as previously indicated, at all limited in its utility to such mechanisms.

According to our invention, in a preferred embodiment thereof, there will be provided a suitable receptacle of insulating material, preferably rotating on a vertical axis, and providing a containing chamber for mercury, and desirably sealed, and having above the level at which the mercury stands when said receptacle is at rest, pockets adapted to contain pools of mercury and to be connected, through conductors extending into said pockets in such manner as to have portions thereof constantly immersed in the mercury therein, with conductors in a circuit to be controlled. Desirably, the mercury pools may be connected with stationary contacts through suitably spaced slip rings or the like turning with the mercury containing receptacle. Desirably, moreover, the receptacle and the circuit establishing connections which are associated with it may be housed in a suitable insulating housing having provision for the leading of conductors into it at its lower portion, and adapted to provide protection against both moisture and breakage.

An object of our invention is to provide an improved mercury switch. Another object of our invention is to provide an improved centrifugal type mercury switch. A further object of our invention is to provide an improved centrifugal type mercury switch in which mercury to mercury contacts are made to close a circuit

2

and in which the circuit is broken between bodies of mercury. Still another object is to provide an improved speed responsive mercury switch in which a body of mercury is adapted to be whirled in a circular, and, in a preferred embodiment, in an annular chamber having walls up which the mercury speeds upon rotation of such body, and having in said walls, at points to which the mercury attains only when whirling at a predetermined speed, pockets opening into the interior of the chamber, and each of a depth to receive and retain a pool of mercury, and connected by conductors having portions submerged in said pools and leading to annular conductors connected by brushes to stationary connector elements, said pockets being spaced appropriately to prevent arcing across between them when the circuit is broken upon reduction in rotative speed below a predetermined value. Yet a further object of our invention is to provide an improved speed controlled switch having improved protective bearing means. Other objects and advantages of our invention will hereinafter more fully appear.

In the accompanying drawings, in which one illustrative embodiment which our invention may assume in practice has been shown for purposes of illustration,

Fig. 1 is a central vertical sectional view through the illustrative embodiment of our improved centrifugal mercury switch, showing relative positions corresponding to one idle condition of the switch device;

Fig. 2 is a fragmentary view, on an enlarged scale, through the rotating, mercury-containing receptacle shown in Fig. 1, with the mercury shown in the position assumed when the device is being driven at a speed sufficient to establish and maintain a circuit; and

Fig. 3 is a horizontal section on the plane of the line 3—3 of Fig. 2, showing a detail of the mercury pool forming pockets which are to be connected by the mercury in the receptacle when a critical speed is exceeded.

Referring to the drawings, it may be observed that a suitable gearing-containing casing 1 supports, in bearings 2 and 3, a rotatable shaft 4 which is adapted to be driven by a shaft portion 5, which extends through a grease seal 6 to any suitable driving element, for example, a member driven from a belt conveyor. The shaft 4 supports, in a compartment 7 forming a portion of the housing 1, a relatively large bevel gear 8 which meshes with and is adapted to drive a smaller bevel gear 9 suitably carried by a shaft

3

10, herein a vertical shaft, which is journaled in anti-friction bearings 11 and 12 carried one by a support portion 13 and the other by a septum or bracket portion 14 of the cover member 15 of the gearing casing 1. Above the top of the cover member 15 there is provided an enclosure member 16 held to the cover member 15 by suitable screws 17. The shaft 10 extends upwardly into a chamber 18 provided inside of the enclosure member 16 and, as shown, comprises, above the bearing 11, an enlarged portion 19 and a reduced portion 20 and carries, on its reduced portion, conical collar members 21 and 22, which, in cooperation with a nut 23 and a lock washer 24, are adapted to clamp together and secure to the shaft 10 the component elements 25 and 26 of a mercury chamber providing structure 27. The parts 25 and 26 are, for convenience, made essentially identical and may be formed from suitable plastic material or the like in the same mold or in identical molds. Each comprises a centrally bored portion 23 snugly fitting around the shaft portion 20, and an outer annular wall portion 29, said portions connected by a curved end surface 30. Thus each contains an annular groove. The shape of the chamber 27 formed by the placing in conjunction of the two members 25 and 26 is in the shape of a torus, and the wall 31 is so shaped as to permit mercury contained in the chamber, under the action of centrifugal force, to move upward in the chamber. Each of the sections 25 and 26 in the outer annular face F which bounds one end thereof is provided with a pair of spaced recesses 32, each of which is connected by a slot 33 opening through the material of the compartment into the chamber 27. The recesses 32 and slots 33 are shown as diametrically spaced and those in the member 25 may be placed in overlying relation with those in the member 26.

Each of the elements 25, 26 is provided with an annular groove 34 in which a conducting annulus 35 may be fixed when the member is molded; and these annuli each have connected to them conductor rods 37 extending from their respective conducting annuli to points materially beyond the face F of the member which carries the annulus—far enough beyond to insure immersion of whichever one happens to be the upper conductor rod in the mercury pool in the recess which it enters. Stationary brackets 39 and 40 are provided for supporting brushes 41 and 41' respectively in position to cooperate with the upper and lower annular conducting rings 35. Conductors 42 connected with the brushes may be led through a suitable conduit 43 out of the chamber 18 and connected in the circuit which is to be controlled.

The mode of operation may be readily understood. The shaft 5 will be connected through suitable connections (not shown) with an element whose attainment to a critical speed it is desired to have establish a circuit between the conductors 42 and whose slowing down below that speed it is desired to have open such a circuit. The gears 8 and 9 are provided to step up the speed and thereby increase the centrifugal force exerted on the mercury by the rotating compartment-forming means. After the device has once been operated, pools of mercury will stand in the pockets 32 and be in electrical contact with the connecting elements 37. When the device is stationary, these pools will be separated from each other by substantially the full diametric dimension of the chamber 27. When the

4

critical speed of rotation of the device to which the shaft 5 is connected is attained, the centrifugal force will cause the mercury, which will be whirled rapidly in the chamber 27, to assume the shape shown in Fig. 2 and to establish a circuit, through the centrifugally displaced mercury entering the pockets 32 and establishing a circuit thereby between the conductors 42, 42. If, for any reason, the speed of rotation of the shaft 10 becomes less than the critical predetermined one, the mercury will recede from the position shown in Fig. 2 towards that shown in Fig. 1, and there will be separation between a quantity of mercury in each of the pockets 32 and the mercury in the annular chamber 27. Accordingly, destruction of the connecting elements 37 will be avoided because they will not be subjected to a fusing action from the breaking of the circuits. The pockets need only be spaced sufficiently to prevent arcing between them. By having the rods 37 project into the pockets beyond the four sides of the orifices provided by the slots 33, no particular care in assembly will be needed as the upper rod will thus always have its bottom immersed in mercury. The chamber 27 may desirably be sealed. The enclosure of the chamber, rings, brushes, etc. provides protection and a weather proof construction. The device is obviously simple, durable, certain in operation, well protected, and adapted to secure mercury to mercury establishment of contact, and, by separation of the main mass of mercury from the residual pools in the pockets 32, protect the rods 37 when the circuit is broken.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent is:

1. A centrifugal switch including, in combination, means forming an annular chamber, means supporting said annular chamber-forming means for rotation on an axis in the same line with the axis of said chamber, means for rotating said chamber-forming means on its axis, said chamber-forming means having spaced pockets in its walls, electrical contacts projecting one into each of said pockets, stationary conductors, and electrical connections between said contacts and conductors for maintaining circuits between them while said chamber-forming means is rotated, and mercury in said chamber out of contact with said pockets when said chamber-forming means is stationary, each of said pockets having an individual communication with said chamber the low point of which, in all of the different rotated positions of said chamber-forming means, is substantially above the then lowest point in said pocket and said electrical contact projecting into said pocket having a portion thereof disposed in said pocket between such low points, whereby a mercury pool is at all times maintained in each of said pockets in contact with the electrical contact which projects into said pocket.

2. A centrifugal switch including, in combination, means forming an annular chamber, means supporting said annular chamber-forming means for rotation on a vertical axis with the chamber axis in the same straight line with said vertical

axis, said chamber-forming means having spaced pockets in its walls opening individually into said chamber at points each spaced from the bottom of the chamber in all of the different positions of said chamber-forming means attained by rotation upon its axis, each of said pockets having its bottom lower than the low point of its communication with the chamber, electrical contacts projecting into said pockets and each having a portion thereof below the low point of the communication with said chamber of the pocket into which it projects, mercury in said chamber below said pockets when said chamber-forming means is stationary, means for rotating said chamber-forming means on said vertical axis, stationary conductors, and electrical connections between said contacts and conductors for maintaining circuits between them while said chamber-forming means is rotated.

3. A centrifugal switch including, in combination, means forming a chamber having an outer wall conforming to a surface of revolution whose axis is upright and whose generatrix slopes outwardly and upwardly, mercury in said chamber partially filling the same, means for supporting said chamber-forming means for rotation on an axis in the same straight line with the axis of said surface of revolution, means forming pockets in said chamber-forming means having mouths spaced above their bottoms and opening inwardly through said outer wall at circumferentially spaced points in the latter and with such mouths above the static mercury level in said chamber, contact elements carried by said chamber-forming means and each having a portion extending into a pocket and to a point within such pocket below the lowest point in the mouth of the latter, stationary conductors, and means for maintaining circuits between said contact elements and said conductors while said chamber-forming means is rotated.

4. A centrifugal switch including, in combination, means forming a chamber having an outer wall conforming to a surface of revolution whose generatrix slopes outwardly and upwardly, mercury in said chamber partially filling the same, means for supporting said chamber-forming means for rotation on a vertical axis, with the axis of said surface of revolution in the same straight line with said axis, means forming pockets in said chamber-forming means having mouths opening inwardly through said outer wall at circumferentially spaced points in the latter and with such mouths above the static mercury level in said chamber, contact elements carried by said chamber-forming means and each having a portion positioned for continuous contact with mercury in a pocket at a point within such pocket below the lowest point in the mouth of the latter, stationary conductors, and means for maintaining circuits between said contact elements and said conductors while said chamber-forming means is rotated.

5. A centrifugal switch including, in combination, means forming a chamber bounded by a surface of revolution, means supporting said chamber-forming means for rotation on an axis

which lies in the same straight line with the axis of the surface of revolution of said chamber, said chamber-forming means having spaced pockets in its walls opening individually into said chamber through said surface of revolution at points each spaced from the low point of the chamber in all of the different positions of said chamber-forming means attained by rotation upon its axis, each of said pockets having its low point lower than the low point of its communication with the chamber in all of the different positions of said chamber-forming means attained by rotation upon its axis, mercury in said chamber, the upper surface of said mercury being lower than the low points of the communications with the chamber of said pockets when said chamber-forming means is stationary, said surface of revolution formed to cause the mercury to rise thereon on rotation of said chamber-forming means on the axis of rotation thereof, a mercury pool in each of said pockets in every position in which its respective pocket may come to rest after turning of said chamber-forming means upon its axis, means for rotating said chamber-forming means on said axis of rotation to cause the mercury in said chamber to establish a connection between the mercury pools in said pockets, stationary conductors, and electrical connections between the mercury in said pockets and said conductors for maintaining circuits between the mercury in said pockets and said stationary conductors while said chamber-forming means is rotated.

6. A centrifugal switch including, in combination, a drive, rotatable means, driven by said drive, and having an internal chamber for receiving, and holding therein, a pool of mercury, and for effecting movement of the mercury, in response to operation of said drive at a predetermined speed, to cause a predetermined rise in the mercury level, said rotatable means for receiving, and holding therein, a pool of mercury also having means for providing and maintaining mutually spaced smaller pools of mercury having individual communications with said chamber spaced above their own bottoms and wholly above the static level of said first mercury pool and in positions to be connected with each other by the mercury of said first pool upon a predetermined rise in the uppermost level of the mercury, stationary contacts, and means for electrically connecting said smaller pools with said stationary contacts.

JOHN D. RUSSELL.
JAMES W. WOOLF.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,031,893	Volk, Jr. _____	July 9, 1912
2,029,632	Moore _____	Feb. 4, 1936
2,265,023	Bergvall _____	Dec. 2, 1941
2,359,623	Coxon _____	Oct. 3, 1944