May 25, 1937. F. SCHAUM 2,081,604

CENTRIFUGAL CIRCUIT BREAKER

Filed Feb. 1, 1935 3 Sheets-Sheet 1

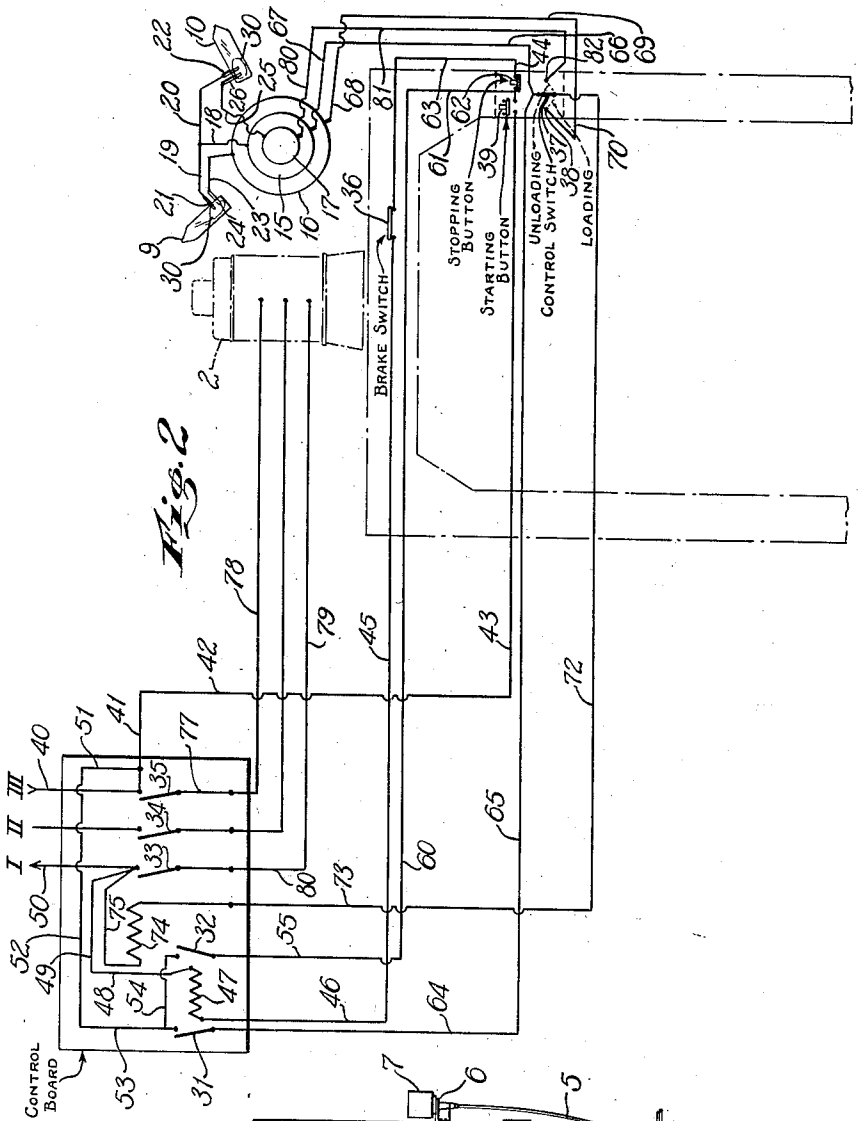


Fig. 2.

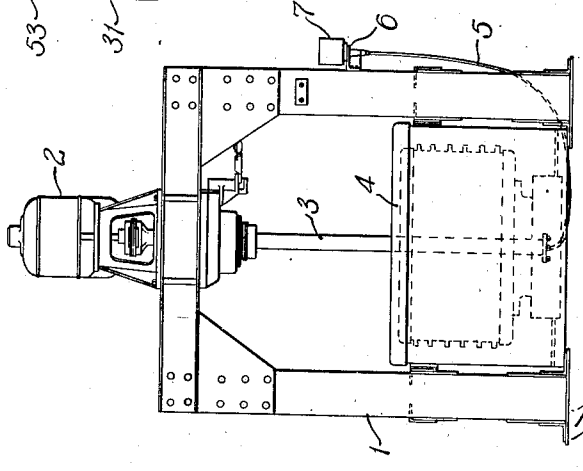


Fig. 1.

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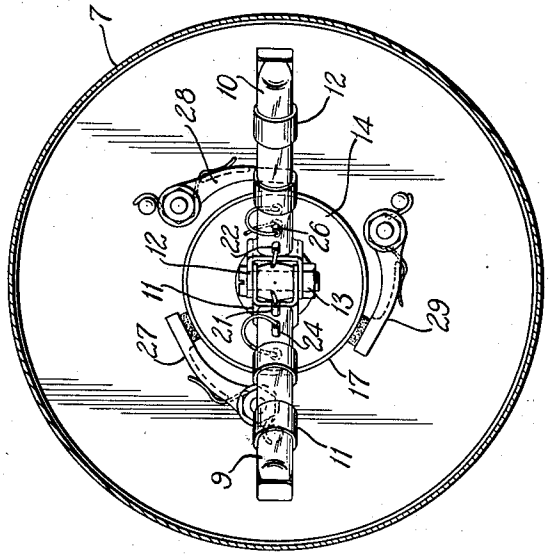


Fig. 4

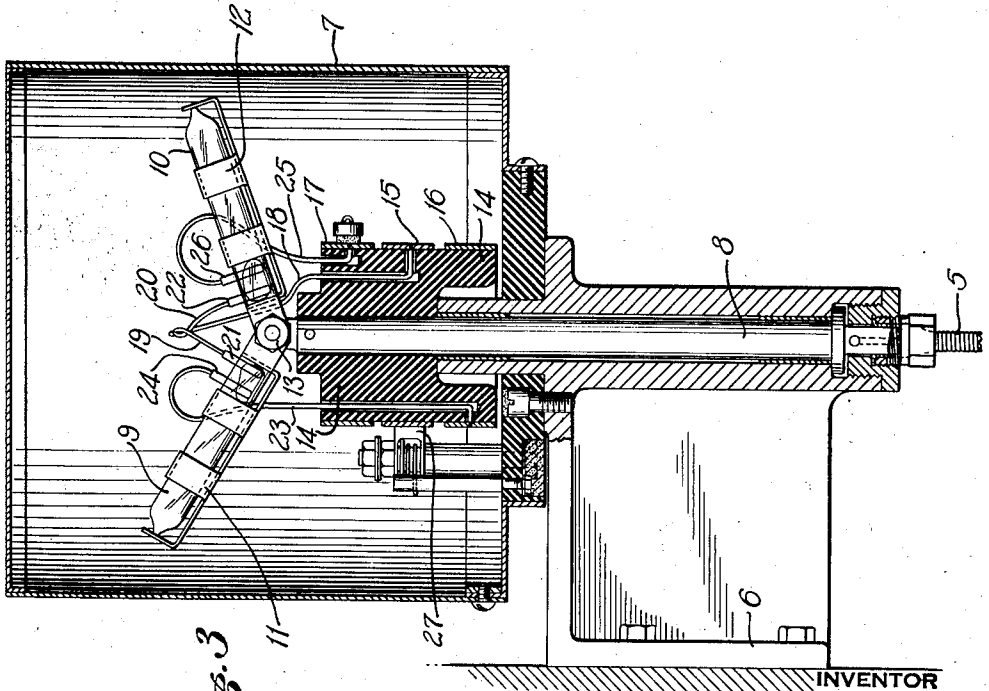


Fig. 3

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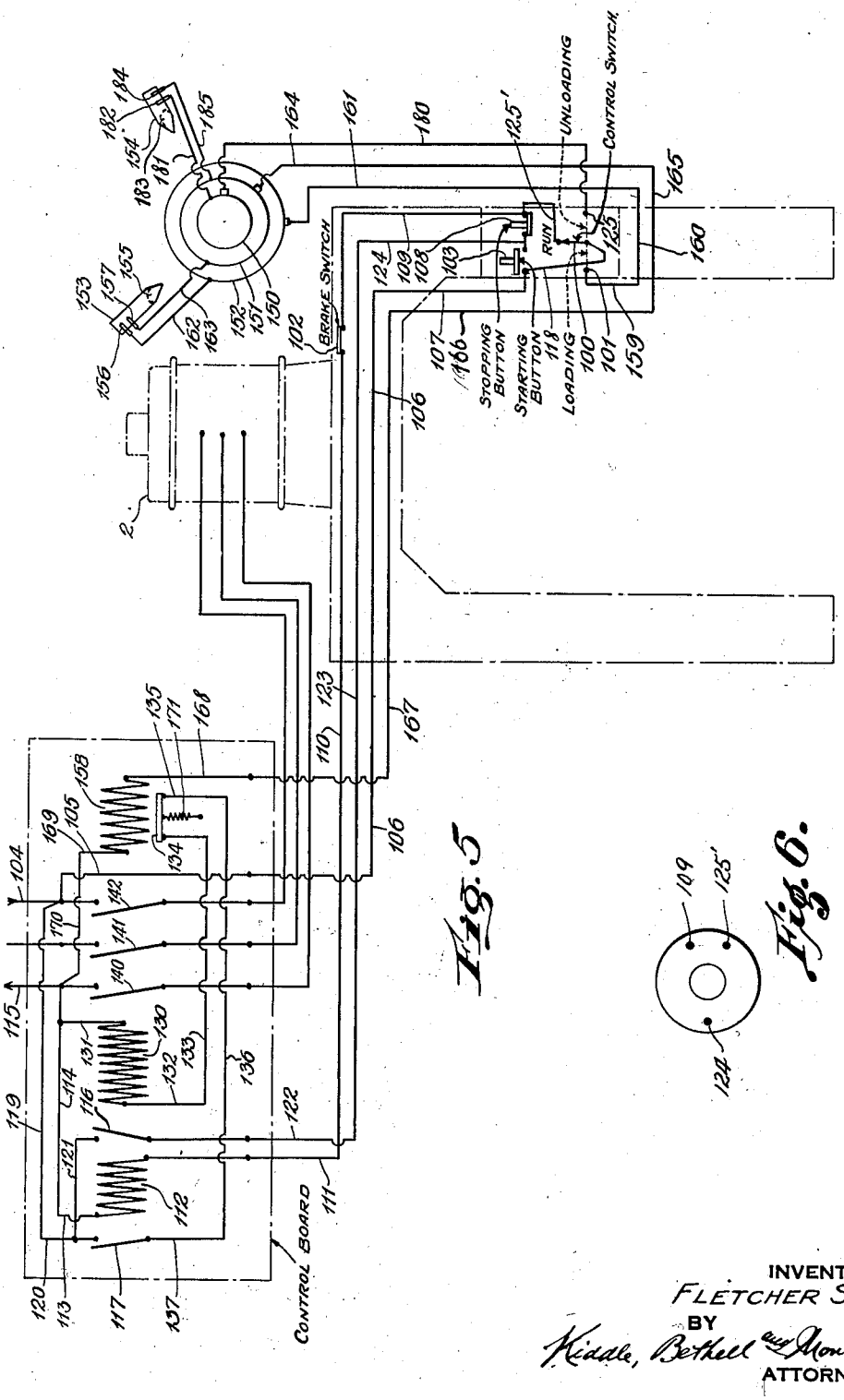


Fig. 5

Fig. 6.

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UNITED STATES PATENT OFFICE

2,081,604

CENTRIFUGAL CIRCUIT BREAKER

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Application February 1, 1935, Serial No. 4,438

6 Claims. (Cl. 172—239)

This invention relates to circuit breakers and is particularly well adapted for use in connection with centrifugal machines wherein various speeds are desired. I shall, therefore, in the description of my invention refer specifically to circuit breakers in connection with centrifugals, although it is to be understood that I do not wish to be limited to the use of my improved circuit breaker on centrifugals, inasmuch as the same can be applied to many other devices wherein various speeds are desired.

In the operation of a batch centrifugal machine, such as disclosed in United States Patent No. 1,543,289, for example, when the centrifugal is started and reaches what is known as the "loading" speed of about 400 R. P. M., the charge is run into the basket. This charge usually consists of a sludge containing part liquid and part solid. At this loading speed the charge is distributed over the wall of the basket. After the machine has been charged the centrifugal is brought up to "running" speed, usually about 900 or 1200 R. P. M., to cause the liquid to be thrown out through the perforations in the basket and the solids to remain in the basket. After the material is sufficiently dry, the rotation of the basket is stopped and the cover over the openings in the bottom of the basket is removed. The basket is then again rotated at what is known as the "unloading" speed of about 100 to 150 R. P. M. and the unloader plow then dug into the material to scrape the material from the sides of the basket and discharge the same through the openings in the bottom of the basket. The basket is then stopped, the cover replaced over the openings in the bottom of the basket and the machine speeded up to "loading" speed of about 400 R. P. M. again and the cycle repeated.

In the operation of centrifugals as at present constructed these various speeds are usually obtained by having a two-speed motor, the high speed being used for drying the material and the low speed for charging the material. In such machines, however, during the unloading stage, for example, it is customary to have a jogging button connected with a contactor, the operator holding the jogging button in contact to complete the motor circuit until the approximate speed of 100 to 150 R. P. M. is reached. The button is then released by the operator, thereby breaking the circuit to the motor, whereupon the operator uses the unloader plow. In such constructions the basket will naturally slow down when the circuit to the motor is open; hence it becomes necessary to jog the motor occasionally to keep up the speed necessary for unloading.

One of the objects of the present invention is to provide a construction wherein a single-speed motor may be employed which by the use of the circuit breakers of the present invention is capable of being run at "running" speed, "loading" speed and "unloading" speed, as will be brought out hereinafter.

Another object of the invention is the provision of a device of the character indicated which will automatically operate at the various desired speeds without the constant attention of the operator.

Another object of the invention is the provision of circuit breakers commonly known as mercoids which are set at different angles relative to the shaft by which they are driven so that the motor circuit will automatically be broken when the desired speed corresponding to the angular setting of each breaker is reached.

A further object of the invention resides in mounting the circuit breakers adjustably so that their angular setting may be adjusted and hence their breaking or circuit opening speed.

Further objects of my invention will be manifest from the following description and the accompanying drawings in which drawings:

Fig. 1 is an elevational view of a centrifugal having my improved circuit breaker attached thereto;

Fig. 2 is a wiring diagram of the device;

Fig. 3 is a sectional elevation of the circuit breaker;

Fig. 4 is a plan view of the same;

Fig. 5 is a wiring diagram of another embodiment of my invention; and

Fig. 6 is a plan view of the stop button switch.

Referring to the drawings in detail, 1 designates a centrifugal support on which is mounted a driving motor 2 having a motor shaft 3 supporting a basket 4. To the lower end of the shaft 3 is secured a flexible shaft 5 which extends to the circuit breaker mechanism carried by a bracket 6 mounted on the support 1. The circuit breaker is mounted in a housing 7 and comprises a vertical shaft 8 connected to the flexible shaft 5, the end of the shaft 8 carrying a "loading" mercoid 9 and an "unloading" mercoid 10. These mercoids each comprise an elongated glass tube or casing containing electrical conductive fluid such as mercury. These mercoids 9 and 10 are mounted in holders 11 and 12 respectively which are secured to the shaft 8 by means of a bolt 13 in such a manner that the same can be

adjusted with respect to the vertical shaft 8 to vary the angle between the mercoid and the longitudinal axis of the shaft. A bushing 14 of insulating material is keyed to the shaft 8 within the housing and is provided with collector rings 15, 16 and 17. The ring 15 is common to both the mercoids in that a common conductor 18 extending from this ring terminates in conductors 19 and 20. The conductor 19 terminates in a contact 21 within the "loading" mercoid 9 and the conductor 20 terminates in a contact 22 within the "unloading" mercoid 10. A conductor 23 extends from the collector ring 16 and terminates in a contact 24 within the "loading" mercoid 9 and a conductor 25 extends from the collector ring 17 and terminates in a contact 26 within the "unloading" mercoid 10.

Brushes 27, 28 and 29 are mounted within the housing 7 and adapted to engage the collector rings 15, 16 and 17, respectively.

It will be noted from Fig. 3 that the mercoids 9 and 10 are set at different angles with respect to the longitudinal axis of the shaft 8 so that upon rotation of the shaft 8 the mercury in mercoid 9 will be thrown outwardly by centrifugal force away from its contacts 21 and 24 at one speed while the mercury in mercoid 10 will be thrown outwardly by centrifugal force away from its contacts 22 and 26 at a different speed.

It will be appreciated, therefore, that the angularity at which the mercoids 9 and 10 are set is predetermined depending on the speed at which the circuit breakers are to operate. For example, the mercoid 10 is set at such an angle as to operate, i. e., open the circuit of the driving motor when the centrifugal reaches a speed of about 100 to 150 R. P. M. and the mercoid 9 is set so as to operate when the centrifugal has reached a speed of about 400 R. P. M.

Referring to the wiring diagram shown in Fig. 2 the switches 31 and 32, also the main motor switches 33, 34 and 35 are shown open while the brake switch 36 is shown closed. When the centrifugal is at rest and the brake "on" the brake switch 36 is open.

The circuits illustrated and their sequence of operation for a complete cycle are as follows: starting, holding, loading, running (full speed) and unloading.

In starting, the control switch 37 is thrown to the left as viewed in Fig. 2 to contact the "loading" terminal 38; the brake is released, closing the brake switch 36, and the starting button 39 is pressed to complete the starting circuit. This circuit may be traced as follows: From the source of supply through conductors 40, 41, 42, 43, starting button 39, conductor 44, brake switch 36, conductors 45 and 46, winding 47, conductors 48, 49, 50 to source of supply. The winding 47 now being energized the switches 31 and 32 will close. The closing of the switch 32 completes a holding circuit for the winding 47 and hence the starting button may be released. This holding circuit may be traced as follows: From source of supply through conductors 40, 51, 52, 53, 54, switch 32, conductors 55, 60, 61, "stopping" button 62, conductor 63, brake switch 36, conductors 45, 46, winding 47, conductors 48, 49 and 50 to source of supply. This circuit will, until broken, retain the switches 31 and 32 closed.

If, now, the control switch 37 be thrown to the left as viewed in Fig. 2 into engagement with contact 38 the circuit to the "loading" mercoid 9 is completed. This circuit may be traced as follows: From source of supply through conductors 40, 51, 52, 53, switch 31, conductors 64, 65, 66, 67, collector ring 15, conductors 18, 19, contact 21 of "loading" mercoid 9, mercury 30, contact 24, conductor 23, collector ring 16, conductors 68, 69, 70, control switch 37, conductors 72, 73, winding 74, conductors 75 and 50 to source of supply. The winding 74 now being energized the motor switches 33, 34 and 35 will close to close the motor circuit.

The motor now running will drive the centrifugal 4 and the shaft 8 on which the mercoids 9 and 10 are mounted. When the speed of rotation of the centrifugal reaches about 400 R. P. M. ("loading" speed) the mercury 30 in the "loading" mercoid 9 will be thrown out by centrifugal force away from the contacts 21 and 24 thereby breaking the circuit to the winding 74 to allow the motor switches 33, 34 and 35 to open. As the motor slows down due to the breaking of its circuit, the mercury 30 in the mercoid 9 will flow back by gravity to the lower end of its tube again to close the circuit across the contacts 21 and 24 thereby closing the circuit to the winding 74 again to close the motor switches 33, 34, 35. This "making" and "breaking" of the motor circuit will continue as long as the control switch 37 is in "loading" position. With the centrifugal running at "loading" speed as just described the charge is run into the centrifugal basket and distributed over the wall of the same as will be understood. When loading has been completed the operator throws the control switch 37 to vertical or "running" position to break the "loading" circuit and close the "running" circuit to drive the centrifugal at "running" speed (about 1200 R. P. M.) to dry the material in the basket in a well-known manner. This "running" circuit may be traced as follows: From source of supply through conductors 40, 51, 52, 53 and switch 31, conductors 64, 65, switch 37, conductors 72, 73, winding 74, conductors 75 and 50 to source of supply. This winding 74 now being energized the motor switches 33, 34 and 35 will close as above described thereby closing the circuit to the motor 2.

When the drying operation has been completed the rotation of the basket is stopped and the cover over the openings in the bottom of the basket is removed for unloading. The stopping of the basket is accomplished by pressing the stopping button 62 which breaks the holding circuit previously described and deenergizes the winding 47 causing switch 31 to open to deenergize winding 74 to allow main motor switches 33, 34 and 35 to open.

The machine may now be started for the unloading operation during which the unloader plow is dug into the material in the basket to scrape the material from the sides and discharge the same through the openings in the bottom of the basket as is usual.

In starting the machine for the unloading operation the starting button 39 is pressed to close the starting circuit and to complete the holding circuit as hereinbefore described. The control switch 37 at this time is moved to the right as viewed in Fig. 2 or to unloading position to complete the circuit to the "unloading" mercoid 10, which circuit may be traced as follows: From the source of supply through conductors 40, 51, 52, 53, switch 31, conductors 64, 65, 66, 67, collector ring 15, conductors 18, 20, contact 22, mercury 30 of mercoid 10, contact 26, conductor 25, collector ring 17, conductors 80, 81, contact 82, switch arm 37, conductors 72, 73, winding 74, conductors 75

and 50 to source of supply. This circuit as in the case of the "loading" circuit will close the motor switches 33, 34 and 35 to complete the motor circuit.

The unloading mercoid 10 it will be noted is set at a smaller angle with respect to the shaft 8 than the mercoid 9; consequently the mercury 30 in the "unloading" mercoid 10 will be thrown out by centrifugal force at a lower speed of rotation than the mercury in "loading" mercoid 9. The angularity of the mercoid is determined by the speed desired. In the unloading operation it is desired to have the "unloading" mercoid 10 operate at a speed of about 100 to 150 R. P. M. When the speed of rotation exceeds the speed for which the mercoid is set, the mercury is thrown out of contact with the contacts 22 and 26 to break the "unloading" circuit in the same manner as the "loading" circuit is broken and as hereinbefore described. As the speed drops below 100 R. P. M. the mercury will flow back again into contact with the contacts 22 and 26 again to complete the circuit. This making and breaking of the unloading circuit will continue as long as the control switch remains in "unloading" position.

In the form shown in the wiring diagram of Fig. 5 the mercury when thrown out by centrifugal force closes a circuit across the contacts in the casing to energize a winding which in turn breaks the holding circuit for the motor switches as distinguished from the form above described wherein the mercury opens a circuit across the contacts to break the motor circuit.

In starting the device of Fig. 5, the operator follows the same procedure as in the preferred form and the sequence of operation of this form is the same as in the wiring diagram of Fig. 2, namely, starting, holding, loading, running (full speed) and unloading.

In starting, the control switch 100 is thrown to the left as viewed in Fig. 5 to contact "loading" terminal 101, the brake is released closing the brake switch 102 and the starting button 103 is pressed to complete the starting circuit. This circuit may be traced as follows: From source of supply through conductors 104, 105, 106 and 107, starting button 103, stopping button 108, conductor 109, brake switch 102, conductors 110 and 111, winding 112, conductors 113, 114 and 115 to the source of supply. The completion of this circuit will energize the winding 112 to close switches 116 and 117. The closing of the switch 116 will complete a holding circuit for the winding 112 which may be traced as follows: From the source of supply through conductors 104, 119, 120 and 121, switch 116, conductors 122, 123 and 124, stop switch or stopping button 108, conductor 109, brake switch 102, conductors 110 and 111, winding 112, conductors 113, 114 and 115 to the source of supply. This circuit will remain closed until the stopping button 108 is pressed to break the same.

The closing of switch 117, above referred to, will in turn complete a circuit to winding 130 which circuit may be traced as follows: From the source of supply through conductors 104, 119 and 120, switch 117, conductors 137, 136 and 135, switch 134, conductors 133 and 132, winding 130, conductors 131 and 115 to the source of supply. The energizing of this winding 130 will close motor switches 140, 141 and 142 whereby the motor 2 is set in operation driving the shaft carrying collector rings 150, 151 and 152 and "loading" mercoid 153 and "unloading" mercoid 154. These mercoids as in the case of the form already described are mounted for angular adjustment with respect to the shaft 8.

When the speed of rotation of the centrifugal reaches about 400 R. P. M. (loading speed), the mercury 155 in the loading mercoid 153 will be thrown out by centrifugal force into bridging relation with respect to contacts 156 and 157. The bridging of these contacts closes a circuit to a winding 158 which when energized will open switch 134 to break the circuit of the winding 130 whereby the motor switches 140, 141 and 142 will be opened. The circuit to this winding 158 may be traced as follows: From source of supply through conductors 104, 105, 106, 107 and 118, control switch arm 100, conductors 159, 160 and 161, collector ring 152, conductor 162, contact 156, mercury 155, contact 157, conductor 163, collector ring 151, conductors 164, 165, 166, 167 and 168, winding 158, conductors 169, 170 and 115 to the source of supply.

It will be obvious that upon the energization of this winding 158 and the opening of the circuit to the winding 130 that the motor will cease operation and the shaft 8 likewise will stop rotating whereupon the mercury 155 will move by gravity to the bottom of its casing 153 away from the contacts 156 and 157, thereby breaking the circuit to the winding 158 permitting the switch 134 by means of spring 171 to return to its original position to again close the circuit to the winding 130 which in turn closes the motor switches to again start the motor operating.

After the loading operation has been completed the control switch 100 is moved to vertical or running position as shown in Fig. 5 to break the "loading" circuit and close the "running" circuit to drive the centrifugal at running speed, about 1200 R. P. M., to dry the material in the basket as hereinbefore described. This "running" circuit may be traced as follows: From source of supply through conductors 104, 105, 106, 107 and 118, switch arm 100, conductors 125' and 109, brake switch 102, conductors 110 and 111, winding 112, conductors 113, 114 and 115 to source of supply.

As will be seen from Fig. 6, the connections 109 and 125' are spaced from each other so as to make separate contact with the stop button 108.

When the drying operation has been completed the rotation of the basket is stopped by pressing the stopping button 108 which breaks the holding circuit previously described and deenergizes the winding 112 causing the switches 116 and 117 to open; the opening of switch 117 which is in the circuit of the winding 130 causing the winding 130 to be deenergized whereby the motor switches 140, 141 and 142 will be opened.

The machine may now be started for the unloading operation during which the unloader plow is dug into the material in the basket as described with respect to the other form of my invention. In starting the motor for the unloading operation the starting button 103 is pressed to close the starting circuit and complete the holding circuit as hereinbefore described. The control switch 100 at this time is moved to the right as viewed in Fig. 5 or to unloading position so that when the motor attains unloading speed a circuit will be closed through "unloading" mercoid 154. This circuit may be traced as follows: From source of supply through conductors 104, 105, 106, 107 and 118, control switch arm 100, contact 125, conductor 180, collector ring 150, conductor 181 and contact 182, mercury 183, contact 184, conductor 185, collector ring 151, conductors 164, 165, 166,

167 and 168, winding 158, conductors 169, 170 and 115 to the source of supply. It will be obvious that energization of the winding 158 by the completion of this circuit as just described will open the switch 134 to break the circuit of the winding 130 whereby the motor switches 140, 141 and 142 will be opened to break the motor circuit.

When the unloading operation has been completed and the basket prepared for the next run the cycle of operation above described is repeated.

It is obvious that the number of speeds can be increased by increasing the number of mercoids each of which will be set at a different angle with respect to the shaft 8 depending upon the speed desired.

It will be appreciated that with the present invention the necessity of the operator constantly pressing a jogging button to maintain the desired speed during loading and unloading is entirely eliminated, the device operating at the desired speed automatically depending upon the position of the control switch.

It is to be understood that various modifications and changes may be made in the construction and arrangement of the various cooperating parts herein shown and described without departing from the spirit and scope of my invention.

What I claim is:

1. A circuit breaker comprising in combination a motor, a circuit therefor, a rotatable shaft driven by said motor, a casing mounted on said shaft at an angle thereto, fixed spaced contacts in said casing, and an electrically conductive body in said casing cooperable with said contacts, said body being moved relatively to said contacts by centrifugal force when said shaft is rotating at a predetermined speed to break said motor circuit, said casing being adjustable with respect to said shaft to vary the angle which the casing makes with the shaft thereby to vary the shaft speed at which the body will be moved in said casing.

2. In combination a centrifugal machine, a motor for driving the same, a motor circuit, a motor shaft, a circuit breaker comprising a shaft, a flexible connection between said motor shaft and said circuit breaker shaft, a plurality of elongated casings, a bracket for each of said casings, said brackets being mounted on said circuit breaker shaft and being adjustable angularly with respect thereto, spaced contacts in the end of each of said casings adjacent said circuit breaker shaft, a circuit for each pair of contacts for controlling said motor circuit, a body of electrically conductive fluid in each of said casings adapted to bridge the contacts thereof, the fluid in said casings being thrown by centrifugal force upon the rotation of said shafts at predetermined speeds out of engagement with said contacts thereby to open the motor circuit and prevent rotation of said centrifugal at speeds other than said predetermined speeds.

3. In combination a centrifugal machine, a motor for driving the same, a circuit for said motor, a motor shaft, a circuit breaker comprising a shaft, a flexible connection between said motor shaft and said circuit breaker shaft, a plurality of elongated casings mounted on said circuit breaker shaft, said casings being adjustable angularly with respect to said circuit breaker shaft and set at different angles thereto, a pair of spaced contacts in the end of each of said casings, a body of electrically conductive fluid in each of said casings adapted to contact with the spaced contacts of each of said casings, an electric circuit for each pair of contacts adapted to control the motor circuit, a central switch for selecting any of said circuits, the rotation of said shaft at predetermined different speeds throwing the fluid out of engagement with its respective contacts to break the circuit selected, thereby to hold the centrifugal to different speeds.

4. In combination a centrifugal machine, a motor for driving the same, a circuit for said motor, a motor shaft, a circuit breaker for controlling the circuit of said motor and comprising a shaft, a flexible connection between said motor shaft and said circuit breaker shaft, a plurality of elongated casings mounted on said circuit breaker shaft, said casings being adjustable angularly with respect to said circuit breaker shaft and set at different angles thereto, spaced contacts in the end of each of said casings, an electric circuit for each pair of contacts for controlling said motor circuit, a body of electrically conductive fluid in each of said casings normally in contact with the spaced contacts of said casings, the fluid in said casings being thrown out of normal position by centrifugal force upon the rotation of said shafts at predetermined speeds thereby to hold the motor speed and hence the centrifugal speed to said predetermined speeds.

5. In combination a centrifugal machine, a motor for driving the same, a circuit for said motor, a motor shaft, a circuit breaker comprising a shaft, a flexible connection between said motor shaft and said circuit breaker shaft, a plurality of elongated casings mounted on said circuit breaker shaft said casings being independently adjustable angularly with respect to said circuit breaker shaft, spaced contacts in the end of each of said casings, a body of electrically conductive fluid in each of said casings normally in contact with the spaced contacts thereof, an electric circuit for each pair of said contacts for controlling said motor circuit, the fluid in said casings being thrown out of normal position by centrifugal force upon the rotation of said shafts at predetermined speeds, whereby the speed of the motor and hence that of the centrifugal are held to said predetermined speeds.

6. In combination an electric motor, a starting circuit therefor including a winding, a pair of switches closed by the energizing of said winding, a holding circuit for said winding including one of said switches, a main switch for said motor, a winding for closing the same, said winding being controlled by the other of said pair of switches and a centrifugal switch in series with the last-mentioned switch and with the winding for the main motor switch, whereby winding for the main motor switch will be automatically deenergized upon the motor exceeding a predetermined speed and automatically reenergized upon the speed of the motor decreasing below said predetermined speed.

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