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ELECTRIC CONTROL DEVICE

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Fig. 1.

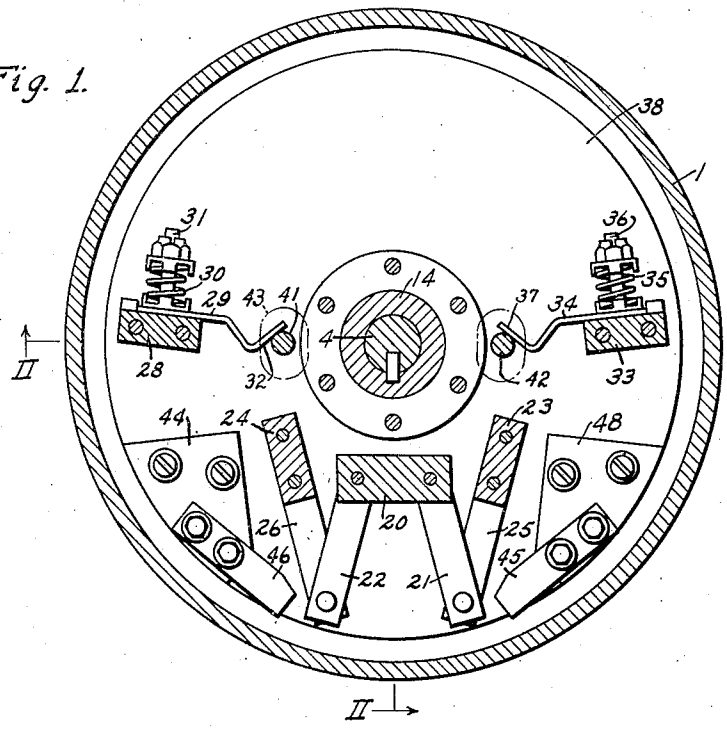
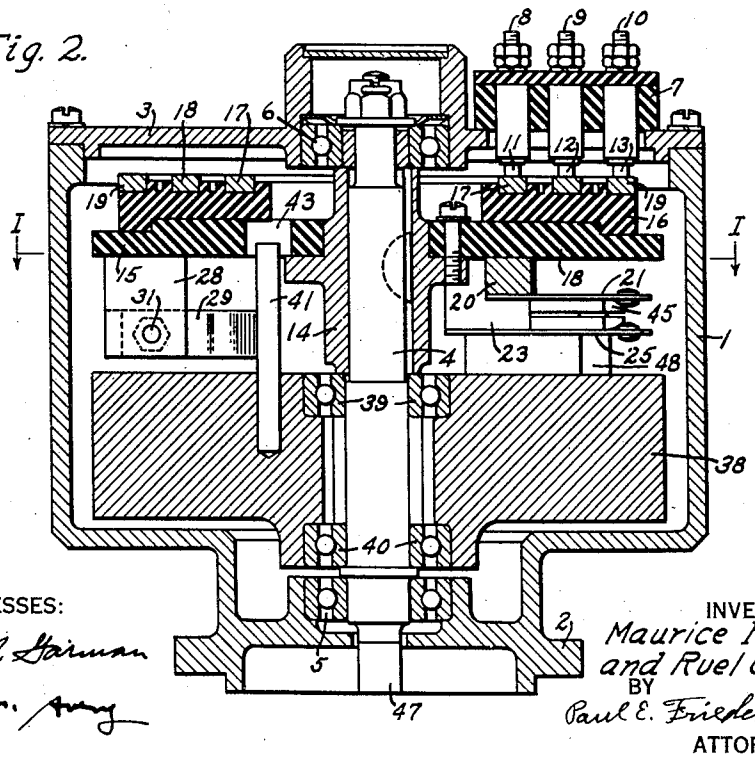


Fig. 2.



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ELECTRIC CONTROL DEVICE

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Our invention relates to electric control devices and has for its general object to provide control means which perform a control operation when the rate of acceleration or deceleration of a rotating machine part reaches a given value.

It is also an object of the invention to devise an acceleration or deceleration responsive switch which permits readily an adjustment, calibration or change of the critical value of the rate of speed change at which the switching operation is supposed to take place.

Another object, allied to the one just mentioned, is to render a switch, of the type referred to, capable of being separately adjusted for response to acceleration and deceleration, respectively, so that the corresponding critical values may be chosen differently if desired.

A further object of our invention is to provide a switch, as mentioned above, in which the response to rate of change in speed is due to the occurrence of relative motion between a driven rotatable member and a rotatable floating mass or flywheel member and wherein such relative motion is subject to frictional damping in order to prevent detrimental oscillatory or hunting effects.

In order to achieve these objects we design an electric contactor in accordance with the principles elucidated hereinafter with reference to the drawing, in which:

Figure 1 is a sectional top view of a switching apparatus according to the invention, the section being taken along the radial plane denoted in Fig. 2 by I—I, and

Fig. 2 is an axial section through the same apparatus taken along the dihedral cut denoted in Fig. 1 by II—II.

The apparatus illustrated in the drawing is provided with a casing 1 which forms the supporting structure for the other parts and is provided at one side with a mounting flange 2. The other side of casing 1 is closed by a cover plate 3. A shaft 4 is revolvably mounted by means of ball bearings 5 and 6 in the flange portion and cover plate, respectively. The cover plate 3 carries an insulating block 7 which supports three terminals 8, 9 and 10, each forming a holder for a contact brush 11, 12 and 13, respectively.

A hub 14 is keyed to shaft 4 and carries a disk 15 of insulating material. This disk is provided with an annular insulator 16. Three slip rings 17, 18 and 19 are mounted on the insulator 16 for engagement by the contact brushes 11, 12 and 13, respectively. Disk 15 is further equipped with a support 20 for two leaf spring contacts 21 and

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22. Two further supports denoted by 23 and 24 are also mounted on disk 15 and carry two leaf spring contacts 25 and 26, respectively. The four leaf spring contacts extend substantially in axial planes relative to the rotation of shaft 4, and contacts 21 and 22 are axially spaced from the corresponding contacts 25 and 26, respectively. Contacts 21 and 22 are electrically connected with one of the slip rings, while contacts 25 and 26 are in connection with the remaining two slip rings, respectively.

The insulating disk 15 carries further a support 28 for an adjustable stop or calibrating mechanism which comprises a finger 29, a helical compression spring 30 and an adjusting screw 31. One end of finger 29 rests normally against the support 28 and abuts against a projection of the support so as to be capable of pivotal motion in opposition to the biasing force of spring 30. This force can be adjusted by means of screw 31. The other end 32 of finger 29 is bent to an angular shape.

Another support 33 also mounted on disk 15 carries a finger 34, a helical compression spring 35 and an adjusting screw 36. One end of finger 34 is pivoted on support 33 while the other end, denoted by 37, is of angular shape. Support 33 and the parts attached thereto form a second stop or calibrating mechanism arranged symmetrically to the one described in the foregoing.

A flywheel 38 is revolvably mounted on shaft 4 by means of ball bearings 39 and 40. Two drive pins 41 and 42 project from flywheel 38 toward disk 15 and enter freely into elongated openings of disk 15, such as the opening denoted by 43 in Fig. 2. The above-mentioned angular ends 32 and 37 of fingers 29 and 34 are so located relative to pins 41 and 42, respectively, that each finger is normally in contact engagement with the adjacent pin. The contact surfaces of finger ends 32 and 37 extend at an angle to the radius which passes through the point of engagement between finger and appertaining drive pin. Flywheel 38 is normally held in a given position relative to disk 15.

Two supports 43 and 44, respectively, are firmly attached to the flywheel and carry each a bar-shaped and slotted bridging contact 45 and 46, respectively, consisting of silver or the like highly conductive material. The bridging contacts are located so that they enter between the adjacent pair of contact springs 21 and 25, or 22 and 26 when the flywheel rotates relative to disk 15.

It will be recognized from the foregoing that the shaft 4 with its hub 14 and the insulating disk

15 with all parts attached thereto form a drivable member while the flywheel 38 and the appertaining parts represent a floating member. The squared or flattened end 47 of shaft 4 serves to connect the drivable member with a rotating machine part whose acceleration or deceleration is intended to control the switching performance. When the driven member is rotating at constant speed, the two stop mechanisms described in the foregoing hold the floating flywheel in midposition relative to the driven member. When the driving speed accelerates, the flywheel 38, due to its inertia, tends to lag behind the driven member. One of the pins 41 or 42 will then exert a force on the adjacent contact finger. However, as long as the acceleration stays within a limit value determined by the adjustment of the appertaining biasing spring 30 or 35, the biasing force of the stop mechanism will prevent the occurrence of relative motion between driven member and floating member. If the rate of acceleration increases beyond the limit value, the stop mechanism will yield so that one of the contact bars 45 or 46 enters between the adjacent pair of leaf spring contacts and closes a control circuit between two of the contact terminals of the apparatus.

When the driven assembly decelerates, the same performance is obtained, except that now the other stop mechanism is operative so that the other contact bar closes a circuit between the appertaining two leaf spring contacts. In this manner, an electrical control function can be performed by the apparatus in dependence upon the occurrence of predetermined rates of acceleration and deceleration.

As explained in the foregoing, the two adjustable stop mechanisms operate independently of each other, one being active in response to acceleration and the other responsive to deceleration. That is, only one of the two resilient stops here represented by the contact fingers 29 and 34 is in operation at a time. This has the advantage that the biasing force of each stop can be changed or calibrated independent of the other stop mechanism. Hence, the apparatus can be made to respond to one rate of acceleration and to another rate of deceleration, or it permits a very accurate calibration of the two stop mechanisms if they are to become effective at the same rate of speed change regardless of the direction of the change.

Due to the fact that the contact surface of each finger 29 and 34 lies at an angle to the radius of rotation with reference to the point of engagement between finger and appertaining drive pin, any relative motion between the driven member and the floating member will cause the contact surface of the yielding finger to drag along the pin. This sliding motion produces friction which tends to dampen any oscillation apt to occur at sudden changes in rate of speed. The ends of the contact bars 45 and 46 are wedge-shaped, so that they enter between the adjacent spring contacts with a minimum increase in effort. This construction has further the advantage that it provides a double break in the circuit. The friction occurring between the contact bar and the leaf springs provides additional sliding friction which assists in the suppression of undesirable oscillations. The sloping approach on the bridging contact has the advantage over a straight contact that contact pressure and friction decrease when the bar, under the biasing effect of the stop mechanisms, withdraws from the leaf spring contacts. This reduces the tendency of the contacts to stay closed at reduced rates of change in speed and, therefore, reduces the difference between the pickup and dropout rating of the switch. Another advantage of the contact structure is the fact that no flexible shunts are required.

The elongated holes of the disk 15, such as the hole denoted by 43 in Fig. 2, co-operate with the ends of the pins 41 and 42 in preventing an excessive deflection of the calibrating springs 30 and 35. The pins are normally out of engagement with the edges of the holes, except when the relative motion between driven member and floating member is far in excess of the normally expected deflection. This allows freedom of movement over the required range but prevents detrimental overtravel.

Apparatus according to the invention are of advantage in control or regulating arrangements in which an electric control function is to be performed in dependence upon the occurrence of a given rate of speed change, or in cases where a machine is supposed to accelerate or decelerate at a high rate which, however, is intended not to exceed such a value as to incur mechanical or electrical overloads. It will be understood that when only an acceleration responsive or only a deceleration responsive control is required, only one of the stop mechanisms need be adjustable. It will also be obvious to those skilled in the art that various other modifications can be applied within the gist of our invention and without departing from the essential features of the invention as set forth in the claims annexed hereto.

We claim as our invention:

1. An electric control device comprising a rotatable drivable member, a floating mass member coaxially rotatable relative to said drivable member, an adjustable spring device for imposing on said members a bias of selective magnitude for causing them to normally maintain a given angular position relative to each other, and electric contact means having two co-operative parts mounted on said two members respectively so as to perform a switching operation in response to the relative motion occurring between said two members when the rate of speed change of said drivable member exceeds a value determined by the selected adjustment of said spring device.

2. An electric switch comprising a rotatable drivable member, a floating mass member coaxially rotatable relative to said drivable member, a resilient stop mechanism disposed between said two members for biasing them in one direction of relative rotation toward a position of rest relative to each other, an adjustable resilient stop mechanism also disposed between said two members for biasing them in the other direction toward said position of rest, and electric contact means having two co-operative parts mounted on said two members respectively so as to perform a switching operation in response to the relative motion occurring between said two members when the rate of speed change of said drivable member exceeds a value determined by the bias of either of said stop mechanisms depending upon whether said drivable member accelerates or decelerates.

3. An electric switch comprising a rotatable drivable member, a floating mass member coaxially rotatable relative to said drivable member, one of said members having a pin extending substantially in parallel to the axis of rotation and the other member having an opening freely sur-

rounding said pin for limiting the relative rotation of said members, and a calibratng mechanism mounted on said other member and having a resilient stop engaging said pin for biasing it in one direction of said relative rotation toward a position of rest relative to said one member, and electric contact means having two co-operative parts mounted on said two members respectively so as to perform a switching operation in response to the relative motion occurring between said two members when the rate of speed change of said drivable member exceeds a value determined by the calibration of said mechanism.

4. An electric switch comprising a rotatable drivable member, a floating mass member coaxially rotatable relative to said drivable member, one of said members having a pin extending substantially in parallel to the axis of rotation and the other member having a resilient stop engaging said pin, said stop having an engaging surface extending at an angle to the radius of rotation at the point of engagement whereby frictional sliding motion is caused between surface and pin when said two members rotate relative to each other, and electric contact means having two cooperative parts mounted on said two members respectively so as to perform a switching operation in response to the relative motion occurring between said two members when the rate of speed change of said drivable member exceeds a given value.

5. An electric switch comprising a rotatable drivable member, a floating mass member coaxially rotatable relative to said drivable member,

biasing means disposed between said members for causing them to normally assume a given angular position relative to each other, two insulated contacts resiliently mounted on one of said members in axially spaced relationship, and a bridging contact mounted on said other member so as to enter between and electrically bridge said spaced contacts under frictional sliding motion when said two members rotate relatively to each other due to the occurrence of an excessive rate of change in speed of said drivable member.

6. An electric switch comprising a rotatable drivable member, a floating mass member coaxially rotatable relative to said drivable member and having a pin extending substantially in parallel to the axis of rotation, said drivable member having a resilient stop for engaging said pin, said stop comprising a rigid support, a finger having one end pivoted on said support and the other end bent so as to form a surface for contacting said pin at an angle to the radius of rotation at the point of contact, a spring for biasing said pivoted finger end toward said support, and an adjusting screw for adjusting the biasing force of said spring, and electric contact means having two co-operative parts mounted on said two members respectively so as to perform a switching operation in response to the relative motion occurring between said two members when the rate of speed change of said drivable member exceeds a value determined by the setting of said adjusting screw.

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