

Nov. 5, 1946.

E. F. KOHL

2,410,663

CIRCUIT INTERRUPTING DEVICE

Filed May 16, 1942

3 Sheets-Sheet 1

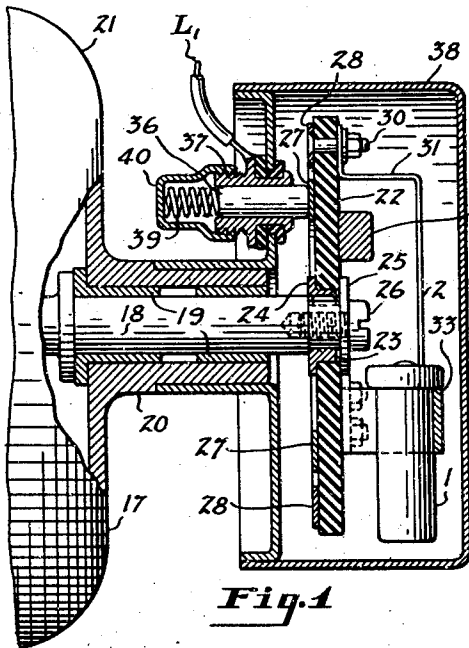


Fig. 1

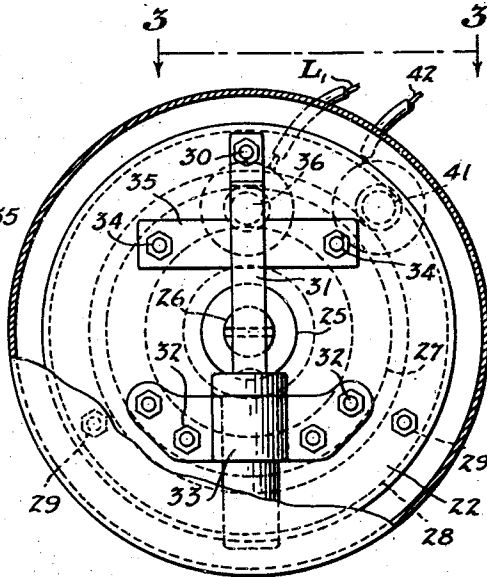


Fig. 2

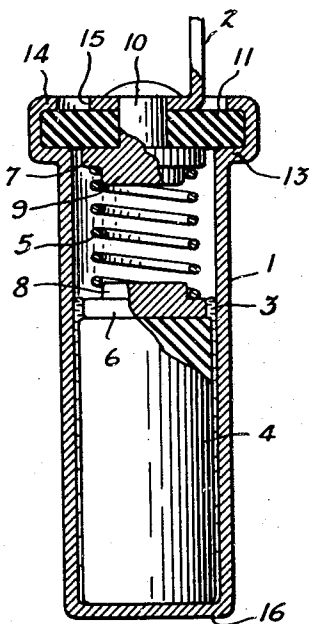


Fig. 4

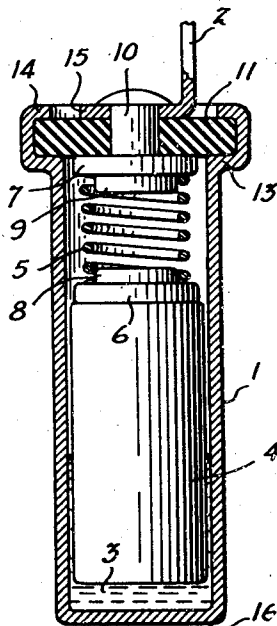


Fig. 5

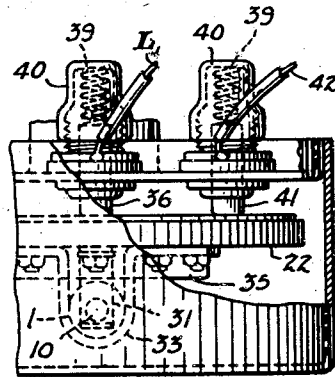


Fig. 3

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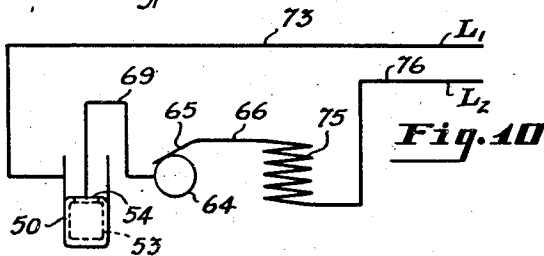
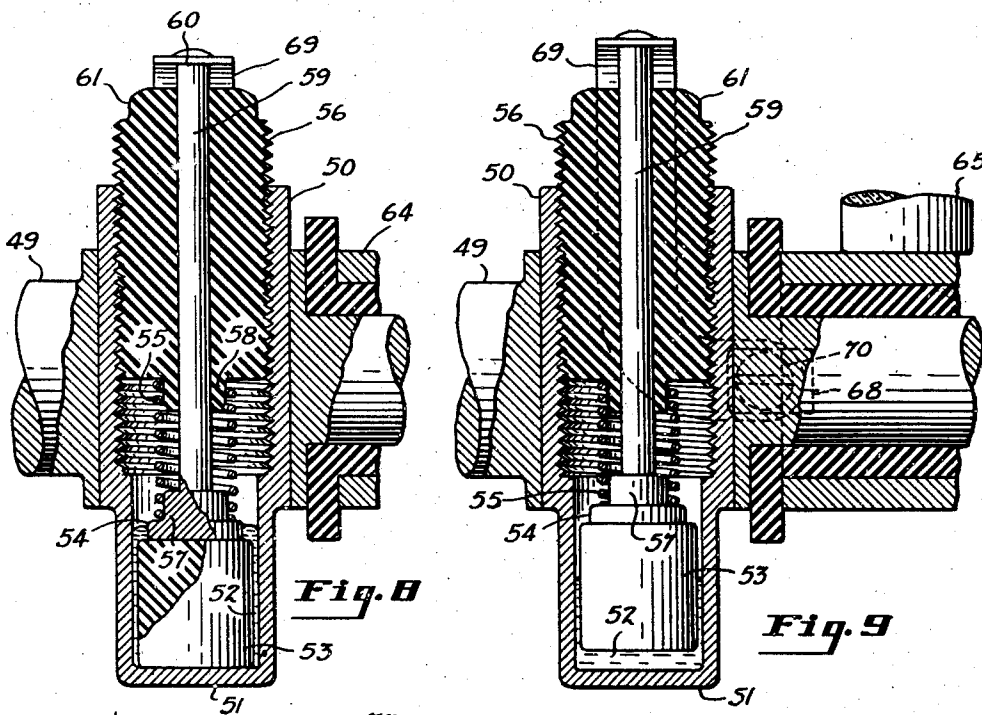
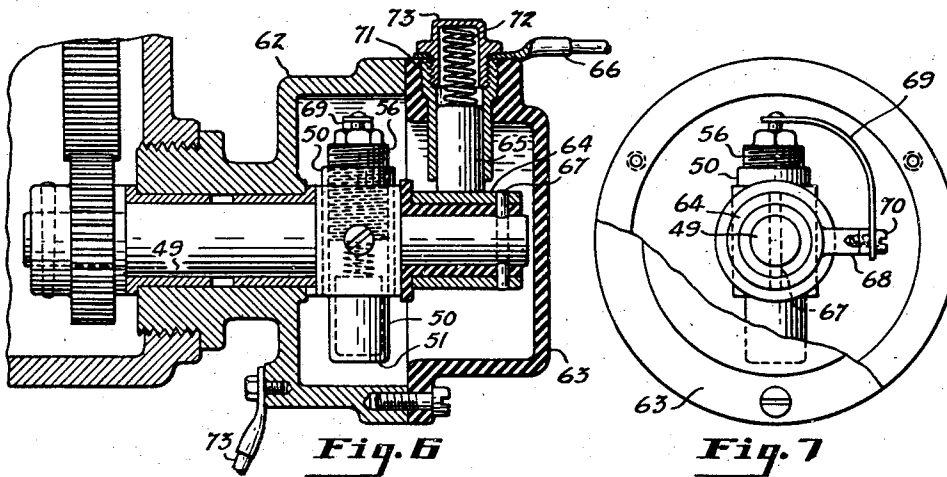
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

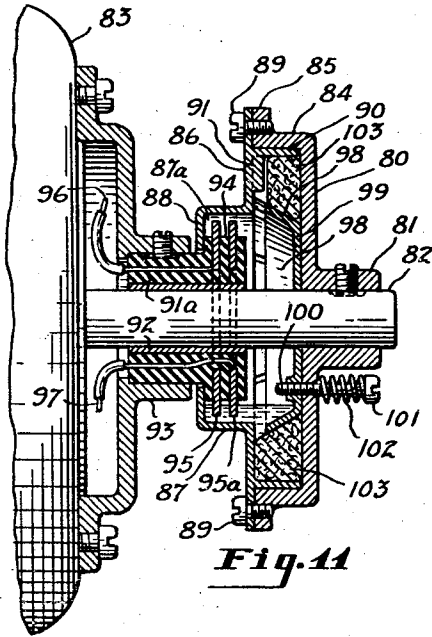


Fig. 11

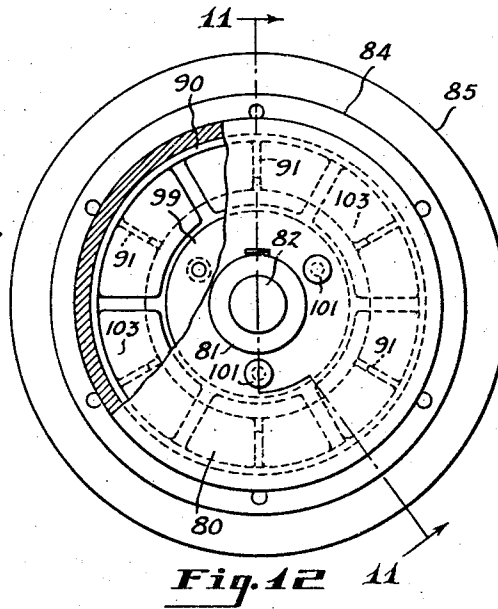


Fig. 12

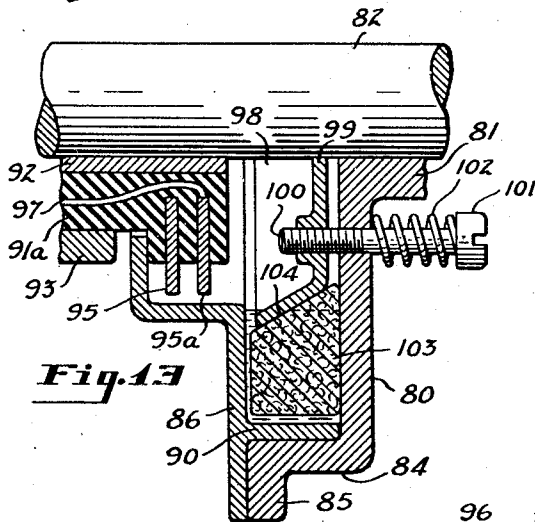


Fig. 13

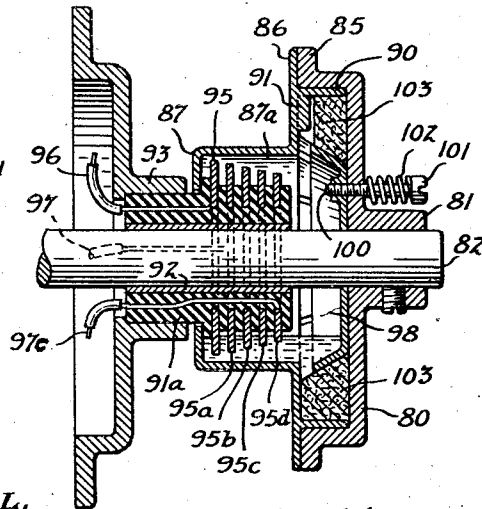


Fig. 14

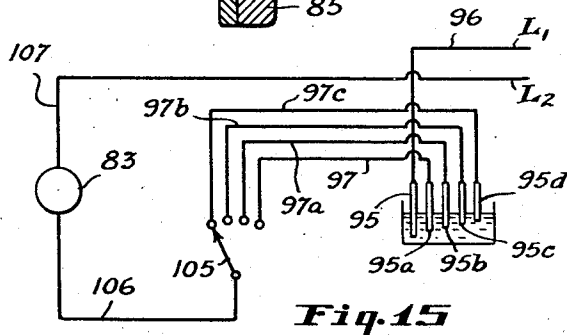


Fig. 15

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2,410,663

CIRCUIT INTERRUPTING DEVICE

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Application May 16, 1942, Serial No. 443,205

23 Claims. (Cl. 200—80)

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My invention relates to circuit interrupting devices and more particularly to an improved circuit interrupting device or governor for controlling the speed of motors or the operation of switches, relays, solenoids, or the like.

Governors which have heretofore been provided for controlling the operation of motors, and particularly motors of the series type to prevent excessive speed under no load conditions and to permit the production of substantially increased power when load is applied, depend upon the making and breaking of mechanical contacts which separate under centrifugal force to control the speed of the motor by controlling the mean value of the load current. In such governors, however, it is not only necessary to maintain the springs controlling the contacts in proper adjustment to provide proper speed regulation but it is also necessary to utilize condensers or other valve means to prevent excessive wear caused by arcing at the contacts.

It is the aim of the present invention to provide an improved circuit interrupting device or governor for controlling the speed of motors, or for establishing or interrupting circuits to auxiliary or associated devices when a rotatable member or shaft to which the governor is attached attains a predetermined speed. My improved circuit interrupting device is characterized by the fact that a liquid to metal contact is made over a comparatively large surface when the device is at rest or is rotated or revolved at a comparatively low speed which contact is broken when the device is rotated or revolved above a predetermined speed. The contact may therefore be broken without substantial arcing. My improved circuit interrupting device is also characterized by the fact that the electrically conductive liquid which is utilized is also heat conductive and, consequently, heat developed by the flow of electrical current while electrical contact is established or by back electromotive force when the contact is broken is conducted to the outside atmosphere.

It is therefore an object of my invention to provide an improved circuit interrupting device including means for interrupting an electrical circuit when a rotatable member with which the device is associated attains a predetermined speed.

Another object of my invention is to provide an improved circuit interrupting device or governor including means for establishing an electric circuit when the device is at rest or is being revolved or rotated at low speed which circuit is automatically interrupted when the device is revolved or rotated at a predetermined high speed.

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A further object of my invention is to provide an improved circuit interrupting device or governor including means for making an electrical circuit when the device is at rest or is revolved or rotated at low speed which circuit is automatically interrupted when the device is revolved or rotated at a comparatively high speed, including adjustable means to regulate the speed at which the circuit is interrupted.

Another object of my invention is to provide an improved circuit interrupting device in which contact for establishing an electrical circuit is provided by an electrically conductive liquid when the device is at rest or is being revolved or rotated at a comparatively low speed and in which the buoyant force of the liquid becomes effective in interrupting the circuit when the device is revolved or rotated at a comparatively high speed.

Other objects and advantages of my invention will be apparent as the specification proceeds.

My invention will be better understood by reference to the accompanying drawings in which:

Fig. 1 is an elevational view of my improved circuit interrupting device, showing it associated with a disk attached to a motor shaft, a fragmentary portion of the motor being shown with parts in section and parts in elevation;

Fig. 2 is a side elevational view of the disk shown in Fig. 1 with my improved circuit interrupting device attached thereto and a fragmentary portion of the housing for the disk and device;

Fig. 3 is a plan view as seen from a plane passing through line 3—3 of Fig. 2, looking in the direction of the arrows with parts broken away to show underlying structure;

Fig. 4 is a cross sectional view of my improved circuit interrupting device, showing the parts in a circuit making position;

Fig. 5 is a view similar to Fig. 4 but showing the parts in a circuit interrupting position;

Fig. 6 is a side elevational view of a modified form of my improved circuit interrupting device mounted to rotate with a driven shaft, showing in cross section a housing for the device and driven shaft;

Fig. 7 is an end view of the apparatus shown in Fig. 6, the carbon brush being omitted and the major portion of the housing being broken away to show adjacent structure;

Fig. 8 is a cross sectional view of the circuit interrupting device shown in Figs. 6 and 7 with parts in circuit making position and showing adjacent parts of the shaft and slip ring partly in elevation and partly in section;

Fig. 9 is a view somewhat similar to Fig. 8,

showing the parts of the device in a circuit interrupting position;

Fig. 10 is a wiring diagram of an electric circuit in which the circuit interrupting device shown in Figs. 6 to 9, inclusive, is connected;

Fig. 11 is a cross sectional view of a modified form of my improved circuit interrupting device taken on the line 11—11 of Fig. 12, showing the device attached to a motor shaft and a fragmentary portion of the motor in elevation;

Fig. 12 is an end view of the device shown in Fig. 11, with parts broken away to show adjacent structure;

Fig. 13 is an enlarged detail view of a portion of the device shown in Fig. 11;

Fig. 14 is a cross sectional view of a modified form of the circuit interrupting device shown in Fig. 11; and

Fig. 15 is a wiring diagram showing the electrical connections of the circuit interrupting device illustrated in Fig. 14.

Broadly stated, my improved circuit interrupting device comprises a casing containing an electrically conductive liquid which is adapted to establish an electrical circuit when the device is at rest or when rotated or revolved at low speed and which is adapted to interrupt the circuit when the device is rotated or revolved at high speed. It may, for instance, be associated in any desired manner with a motor to control its speed in which case it acts as a governor, or it may be connected or associated with a driven shaft and be utilized to establish or interrupt a circuit to an auxiliary device, such as a solenoid, electrical switch, or to another motor when the driven shaft attains a predetermined speed.

Figs. 1 to 5 of the drawings illustrate one form of my improved circuit interrupting device, Figs. 1 and 2 showing the device associated with and adapted to govern the speed of a motor to be driven and while the motor may be of any desired type, my improved device is particularly adapted to be utilized to control or govern the supply of current to motors of the series type which have the tendency to develop exceedingly high speed under no load conditions.

As shown more particularly in Figs. 4 and 5, my improved circuit interrupting device acts as a switch to form an electrical circuit between a casing 1 and a terminal 2. For this purpose, the casing contains an electrically conductive liquid 3 which also preferably has a high specific gravity, such as mercury. The casing also contains a plunger 4 which fits loosely in the casing and is preferably composed of light material having a lower specific gravity than the liquid and a comparatively high heat and electrical resistance, such as lava. Plunger 4 is normally maintained at one end of the casing when the device is at rest or rotated or revolved at low speed by means of a spring 5 disposed between a pair of contacts 6 and 7 provided with annular abutments 8 and 9, respectively, which serve to hold the spring in place. When mercury is utilized as the conductive liquid, the contacts and metal portion of the casing should of course be formed of metals which do not readily amalgamate with mercury.

As illustrated, contact 6 bears against one end of plunger 4 and is of less peripheral extent than the plunger to provide a space for an annular layer of the conductive liquid and contact 7 is provided with a shank 10 which extends through a layer of insulating material 11 supported upon and held in place by an annular shoulder 13 and an intumed flange 14 of the casing. Shank 10

also extends through a flange 15 on terminal 2 and is peened or riveted over flange 15 to maintain the flange in engagement with insulating layer 11. As illustrated in Fig. 4 it will be noted that current conducted to casing 1 flows through the mercury to contact 6 and from thence through spring 5, contact 7, and shank 10 to terminal 2. When the device, however is rotated or revolved about an axis which is normal to the longitudinal axis of the casing and is closer to the terminal 2 than end 16, the liquid is centrifugally thrown to the end 16 as illustrated in Fig. 5 and buoyantly forces plunger 4 inwardly compressing spring 5 and providing a chamber at the end of casing 16 to receive the liquid. Since the plunger 4 is formed of an electrically insulating material, it will be apparent that when the mercury is in the position shown in Fig. 5, the circuit between the casing 1 and terminal 2 is interrupted.

While my improved circuit interrupting device or governor may be associated with a motor to be driven of any desirable type to control its speed, or connected to a driven shaft to control the speed or operation of an associated or auxiliary device, in Figs. 1, 2 and 3 of the drawing it is shown connected in the load circuit of a motor 17 to be driven which as shown is provided with an armature shaft 18 rotatably mounted in bearings 19 formed in a tubular extension 20 of motor casing 21. For the purpose of conducting current from a line to the casing 1 and transmitting it to the motor through the circuit interrupting device, a disk 22 formed of a suitable insulating material, such as molded or laminated material, is affixed to armature shaft 18 by any suitable means. As illustrated, a bushing 23 keyed to a reduced portion of the shaft has an annular flange 24 arranged on one side of the disk 22 and a washer 25 is secured firmly against the opposite side by a bolt 26 threaded in the end of the shaft.

Disk 22 rotates with the motor shaft and is provided on one side with electrically conductive slip rings 27 and 28, the outer ring 28 being connected to disk 22 by suitable means, such as bolts 29 and a bolt 30 passing through an extension 31 of terminal 2. Slip ring 27 is connected to disk 22 by means of bolts 32 passing through flanges of a bracket 33 formed of a conductive metal which supports and is in electrical contact with casing 1 of the current interrupting device and by bolts 34 passing through a counterweight 35.

To supply current to the motor through the circuit interrupting device, a carbon brush 36 is slidably arranged in an externally threaded bushing 37 which bushing is insulatingly mounted in the cover of a housing 38 supported by the motor casing and is electrically connected to lead L1. Brush 36 is held in engagement with slip ring 27 by means of a spring 39 interposed between the carbon brush and a cap 40 threaded on the bushing. A carbon brush 41 provided with a terminal 42 leading to the motor is forced against slip ring 28 in a similar manner.

The operation of my improved apparatus will now be apparent. When the motor is at rest or is being rotated at low speed, current supplied to brush 36 from a suitable source of supply is conducted through bolts 32 to the casing 1 of the circuit interrupting device and from thence through the device to terminal 2, conductor 31 and bolt 30 to carbon brush 41, from whence it is conducted to the motor 17 and back to the source of supply. When the motor speed increases beyond a predetermined amount, however, such as when the load is reduced, the electrically conductive liquid

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is thrown by centrifugal force to the end 16 of the casing and buoyantly forces plunger 4 inwardly, thus interrupting the supply of current to the motor. In view of the large contact area between the mercury and contact 6, it will be apparent that no sparking will occur when the current is interrupted and any mercury that is vaporized will be quickly condensed. Any heat developed will also be conducted through the mercury to the outside atmosphere. When the motor slows down to the desired extent, spring 5 overcomes the buoyant force of the mercury and electrical contact is again made. It will therefore be apparent that the motor may be maintained at almost a constant predetermined speed, irrespective of the load, the speed depending upon the force of spring 5.

Another form of my improved circuit interrupting device or governor is shown in Figs. 6 to 9, inclusive, and while a circuit interrupting device of this type may be utilized to control or govern the supply of current to a motor in the same manner as the apparatus illustrated in Figs. 1 to 5, in which case the speed at which the circuit is broken is adjustable, as illustrated, the device is attached to a driven shaft 49. The circuit interrupting device comprises a casing 50 having a closed end 51 which contains an electrically conductive liquid 52, such as mercury, a movable plunger 53 formed of light material having a high electrical and heat resistance, such as lava, and a contact 54 which is normally held in engagement with plunger 53 by a spring 55 interposed between contact 54 and a plug 56 formed of a molded insulating material, such as asbestos or wood flour bound together by a phenolic condensation product, which is threaded into the open end of the casing. As shown, the spring is held in place by abutments 57 and 58 extending from contact 54 and plug 56, respectively, and a conductor 59 extends from contact 54 through and beyond plug 56 and forms a terminal 60 to which a suitable conductor may be attached.

As illustrated in Fig. 8 when current is conducted to casing 51, it passes through the mercury 52 to contact 54 and from thence through conductor 59 to terminal 60. When shaft 49, however, is rotated at a comparatively high speed, the mercury is centrifugally thrown to the end 51 of casing 50 and buoyantly forces plunger 53 inwardly against the force of spring 55, breaking the contact. The rotative speed of the driven shaft at which the mercury in casing 50 forces plunger 53 inwardly is determined by the compression of spring 55 which may be varied by the extent to which plunger 56 is threaded into the casing and for this purpose plug 56 is provided with an angular head 61 which may be readily engaged by a suitable tool for adjusting the position of the plug.

In Figs. 6 to 9 of the drawings, means are shown associated with the circuit interrupting device for supplying current to an auxiliary device, such as a solenoid, relay or a motor, when the driven shaft is at rest or rotating at a low speed and for interrupting the supply of current to the auxiliary device when the driven shaft attains a predetermined speed. For this purpose, the shaft 49 is provided with a housing 62 having a removable cap 63 which housing forms a chamber for the device, a slip ring 64, and a carbon brush 65 having a terminal 66 electrically connected to the brush outside the housing.

Slip ring 64 is connected to the shaft by a fiber pin 67 and is provided with an extension 68 to which a conductor 69 is secured by any suitable

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means, such as screw 70, the other end of conductor 69 being secured to terminal 60. The carbon brush 65 is slidably mounted in a threaded bushing 71 and is held in engagement with slip ring 64 by a spring 72 interposed between the brush and a cap 73 threadingly mounted in the bushing.

While the circuit interrupting device disclosed in Figs. 6 to 9, inclusive, may be utilized to control any electrically operated device associated with the governor, such as switches, relays, motors or the like, as illustrated diagrammatically in Fig. 10, it is shown associated with a solenoid which is adapted to be deenergized when the driven shaft attains a predetermined speed. As illustrated more particularly in Figs. 6 and 10, current is supplied to the casing 50 of the circuit interrupting device from line L₁ and when the device is in the position shown in Fig. 8, the current passes from the casing through conductors 59 and 69, slip ring 64, carbon brush 65 and conductor 66 to solenoid 75 and from solenoid 75 through conductor 76 to line L₂. When the shaft, however, is rotated above a predetermined speed, the circuit to solenoid 75 is interrupted. The deenergization of the solenoid may of course be utilized to actuate a switch to open or close the current supply to apparatus of any desired type. When mercury is utilized as the conductive liquid, the contacts and other metal parts should of course be formed of conductive metal which does not amalgamate with mercury.

Figs. 11 to 13 of the drawings illustrate another form of my improved circuit interrupting device, which as shown, acts as a governor for controlling the supply of current to a motor although obviously the device may be associated with a driven shaft and may be utilized to establish or interrupt an electric circuit to an auxiliary device in the manner shown in Figs. 6 to 10. As illustrated, the circuit interrupting device comprises a casing, including a side 80 having a central hub 81 bored to receive the shaft 82 of a motor 83 and a peripheral portion 84 which terminates in an upstanding flange 85 to which is secured a cover 86 having an outwardly extending offset portion 87 which terminates in an annular flange 88 providing a central opening. The cover may be secured to the body portion by suitable means, such as by welding, or to provide ease of assembly by bolts 89, which as shown extend through the cover and flange 85. Although it is not essential, the cover may also be provided with a peripheral flange 90 in telescopic engagement with peripheral portion 84, and a plurality of inwardly extending lugs 91 for purposes to be subsequently described.

As in previous modifications, means are provided for establishing a circuit between a conductive liquid, such as mercury, and a metal contact to establish an electric circuit when a rotatable member with which the device is associated is at rest or is rotated at low speed, which circuit is adapted to be interrupted when the rotatable member attains a predetermined speed. For this purpose, a sleeve 91a formed of electrical insulating material is mounted upon a bearing 92 surrounding shaft 82 and is prevented from rotating therewith by means of a set screw extending through a tubular extension 93 of the bell ring of the motor into a recess formed in the sleeve. Sleeve 91a extends through the central opening in cover 86 and terminates within the casing in an enlarged portion 94 having annular recesses to receive contacts 95 and 95a.

As illustrated, hub 81 is secured to shaft 82 and the casing contains an electrically conductive liquid, such as mercury which, as shown, is present in an amount sufficient to bridge contacts 95 and 95a when the motor is at rest or is rotating at low speed to establish a circuit between a conductor 96 leading from a suitable source of electrical energy to contact 95 and a conductor 97 connected to contact 95a and leading to motor 83 and from thence back to the source of supply. The conductors may be connected to the contacts in any suitable manner. As illustrated, they are molded in insulating sleeve 91a.

To control the speed of the motor, means are provided to interrupt the supply of current to the motor when it rotates above a predetermined speed. For this purpose, an adjustable member 98 having a conical portion inclined upwardly within the casing and a base 99 is secured to side portion 89 by a plurality of bolts 100 threaded into the side portion and the base, each of which is provided with a compression spring 102 interposed between its head 101 and side portion 80, and a plurality of segmental blocks 103 are arranged between the conical portion of the adjustable member and the periphery of the casing, each of which has an inner portion 104 having the same degree of inclination as the conical portion of the adjustable member. When the motor is at rest or is rotating at low speed, springs 102 maintain base 99 in engagement with side portion 89 and segmental blocks 103 in engagement with the inner periphery of the casing. Segmental blocks 103 are spaced sufficiently from each other to permit radial movement but otherwise substantially fill the chamber between the conical portion of adjustable member 98 and the inner periphery of the casing, and consequently only a small amount of mercury is present in this chamber when the motor is at rest or is rotating at low speeds while sufficient mercury is present in chamber 87a formed by offset portion 87 to bridge the contacts.

When armature shaft 82 is rotated at a predetermined speed, however, depending upon the compression of springs 102, the mercury seeps between cover 85 and segmental blocks 103 and forms an annulus around the inner periphery of the casing which buoys blocks 103 radially inwardly with a force depending upon the rotative speed of the motor and the depth to which the segmental blocks are immersed. The inward movement of blocks 103 in turn forces adjustable member 98 axially inwardly providing a chamber between segmental blocks 103 and the inner periphery of the casing to which the mercury flows from chamber 87a, thereby interrupting the circuit to the motor. When the rotative speed of the shaft decreases to a predetermined extent, springs 102 move adjustable member 98 to the position shown in Fig. 11, forcing segmental blocks 103 outwardly against the inner periphery of the casing, thereby displacing the mercury which flows back into chamber 87a and again establishes a circuit to the motor. The rotative speed of the armature shaft at which the circuit is broken is of course dependent upon the amount and type of conductive liquid which is utilized, the composition of segmental blocks 103, and the compression of springs 102. When a predetermined amount of a liquid, such as mercury, is utilized and the segmental blocks are formed of light molded material, the speed at which the circuit is interrupted may be varied by adjusting

bolts 100 to vary the compression of springs 102. When mercury is utilized as the conductive liquid, the contacts should be formed of a metal that does not readily amalgamate with mercury, such as platinum or tungsten. Lugs 91 may be provided for rotating segmental blocks 103 with the casing although they are not essential.

The apparatus disclosed in Fig. 14 is similar to that shown in Figs. 11 to 13 with the exception that means independent of springs 102 are also provided to vary the speed at which the circuit to the motor is interrupted. For this purpose, contact 95 is arranged in the outer recess of sleeve 91a as illustrated in Fig. 11 to which conductor 96 is connected, and contacts 95a, 95b, 95c and 95d, are arranged in spaced relation to contact 95 and to each other and are disposed in additional recesses formed in the sleeve. The distance of the outer periphery of contacts 95a, 95b, 95c and 95d to the inner periphery of chamber 87a varies in accordance with their distance from contact 95, the outer periphery of contact 95 being closest to the inner periphery of the casing, and the outer periphery of contact 95d being the most remote. As shown diagrammatically in Fig. 15, conductors 97, 97a, 97b and 97c lead, respectively, from contacts 95a, 95b, 95c and 95d to a switch 105 which is connected to the inlet terminal of the motor by conductor 106, the outlet terminal of the motor being connected by a conductor 107 to line L₂.

The operation of the circuit interrupting device or governor shown in Fig. 14 is similar to that shown in Fig. 11 but the interruption of the circuit to the motor will take place at speeds depending upon the setting of switch 105. For instance, if switch 105 is set to connect conductor 97c leading to contact 95d in circuit with conductor 96 leading to contact 95, as shown, it will be apparent that the circuit will be interrupted at a lower speed than when the switch is connected to conductor 97b leading to contact 95c. In a like manner, it will require a higher speed to interrupt the circuit when switch 105 is connected through conductor 97a to contact 95b than when it is connected to contact 95c, the highest speed at which interruption takes place being attained when switch 105 is connected through conductor 97 with contact 95a. It will thus be seen that by the arrangement shown in Fig. 14, the speed at which the circuit to the motor is interrupted may be varied according to the setting of switch 105 and may also be additionally varied by the compression of springs 102 as explained in connection with the description of Figs. 11 to 13.

In the modifications shown in Figs. 11 to 13, inclusive, and Figs. 14 and 15, it will be noted that the chamber containing segmental blocks 103 has a considerably larger diameter than chamber 87a containing the contact discs and consequently a very slight displacement of segments 103 produces a relatively large displacement of the electrically conductive liquid. The electric circuit will therefore be quickly interrupted when motor shaft 82 rotates above the desired speed and quickly established when the motor falls below the desired speed. My improved device is therefore sensitive in service.

What I claim is:

1. Apparatus of the class described comprising a casing containing an electrically conductive liquid, a plunger formed of an electrical insulating material slidably mounted in said casing, a contact engaging said plunger, said contact be-

ing spaced from said casing and being in electric circuit with said liquid when the casing is at rest and said plunger being displaceable by the centrifugally developed buoyant force of said liquid to interrupt said circuit when said casing is moved at a predetermined speed about an axis of said casing.

2. Apparatus of the class described comprising an electrically conductive casing containing an electrically conductive liquid, a terminal insulated from said casing, a plunger formed of electrical insulating material slidable in said casing, a contact spaced from said casing and supported by said plunger, resilient means engaging said contact and in electric circuit with said terminal for maintaining said plunger at one end of said casing, said contact being normally in electric circuit with said liquid and said plunger being displaceable by the centrifugally developed buoyant force of the liquid to break the circuit between said liquid and contact.

3. Apparatus of the class described comprising a casing having a closed end portion and containing an electrically conductive liquid, a plunger formed of an electrically insulating material slidable in said casing, a contact supported on said plunger and in electrical circuit with said liquid when the casing is at rest and the outer periphery of which is spaced from said casing, resilient means for maintaining said plunger in engagement with the end portion of said casing, and said casing being movable to centrifugally throw said liquid to the end portion of said casing to buoyantly displace said plunger and said contact from said liquid to interrupt said circuit.

4. Apparatus of the class described comprising a casing containing an electrically conductive liquid, a contact arranged in but spaced from said casing, means for normally maintaining said contact in electrical circuit with said liquid, said contact being displaceable to break said circuit by the centrifugally-developed buoyant force of said liquid, and means for adjusting said maintaining means to vary the force required to displace said contact.

5. Apparatus of the class described comprising a casing containing an electrically conductive liquid, a contact arranged in but spaced from said casing, resilient means for normally maintaining said contact in electrical circuit with said liquid, said liquid being centrifugally separable from said contact, and means for adjusting said maintaining means to vary the centrifugal force required to displace said liquid.

6. Apparatus of the class described comprising a casing having a closed end portion containing an electrically conductive liquid, a plunger formed of electrically insulating material slidable in said casing, a contact supported on said plunger, means for maintaining said plunger against the closed end of said casing, and means for revolving said casing about an axis spaced from the closed end portion at sufficient speed to centrifugally throw the liquid to the closed end portion of said casing and the centrifugally developed buoyant force of the liquid being adapted to move said plunger and displace said contact from said liquid.

7. Apparatus of the class described comprising a casing having a closed end portion containing an electrically conductive liquid, a plunger formed of electrically insulating material slidable in said casing, a contact supported on said plunger, resilient means engaging said contact for normally maintaining said plunger

at the end of said casing, means for rotating said casing at sufficient speed about an axis to centrifugally throw said liquid to the end of said casing to buoyantly move said plunger and displace said contact from the liquid, and means for adjusting the tension on said resilient means to vary the speed at which said liquid is capable of displacing said plunger.

8. Apparatus of the class described comprising a casing containing a conductive liquid, an electrically conductive contact in electrical circuit with said liquid when said casing is at rest, and a displaceable element arranged within said casing and movable by the centrifugally-developed buoyant force of said liquid for interrupting said circuit when said casing is moved at a predetermined speed about one of its axes.

9. Apparatus of the class described comprising a casing containing a conductive liquid, a contact in electrical circuit with said liquid when said casing is at rest or is moved about one of its axes at low speed, means arranged within said casing and movable by the centrifugally developed buoyant force of said liquid for interrupting said circuit when said casing is moved at a predetermined speed about said axis, and resilient means for maintaining said contact in electric circuit with said liquid until said casing attains its predetermined speed.

10. Apparatus of the class described comprising a casing containing a conductive liquid, a contact in electrical circuit with said liquid when said casing is at rest, means arranged within said casing and movable by the centrifugally-developed buoyant force of said liquid for interrupting said circuit when said casing is moved at a predetermined speed about one of its axes, and adjustable means for maintaining said contact in electric circuit with said liquid until said casing attains its predetermined speed.

11. Apparatus of the class described comprising a casing containing a conductive liquid, a contact in electrical circuit with said liquid when said casing is at rest, means arranged within said casing and movable by the centrifugally-developed buoyant force of said liquid for interrupting said circuit when said casing is moved at a predetermined speed about one of its axes, and adjustable resilient means for maintaining said contact in electric circuit with said liquid until said casing attains its predetermined speed.

12. Apparatus of the class described comprising a casing containing an electrically conductive liquid, an electrically conductive contact arranged in said casing, resilient means for maintaining said contact in electrical circuit with said liquid when said casing is at rest or is moved about one of its axes at low speed, and said liquid being centrifugally separable from said contact when said casing is moved about said axes at sufficient speed to cause the liquid to overcome the force of said resilient means.

13. Apparatus of the class described comprising a metallic casing containing an electrically conductive liquid, an electrically conductive contact of substantially disc shape having its outer peripheral portion spaced from but arranged in proximity to said casing and said liquid being in bridging relation with the entire outer periphery of said contact and with the inner portion of said conductive casing to form an electrical circuit between said casing and said contact over a comparatively large area, and said casing being movable about one of its axes to centrifugally displace said liquid from said contact.

14. Apparatus of the class described comprising a cylindrical metallic casing having a closed end and containing an electrically conductive liquid, a cylindrical plunger formed of electrical insulating material slidably mounted in said casing with its outer periphery arranged in proximity to the walls of said casing but spaced sufficiently therefrom to form a chamber for a narrow annulus of the conductive liquid between said plunger and said casing, a contact of substantially disc shape supported on said plunger and having its outer periphery spaced from said casing but in close proximity thereto, said casing and contact being bridged by said liquid when said casing is at rest, and said casing being movable about one of its axes to centrifugally force the liquid to the closed end of the casing to interrupt the circuit between said casing and contact.

15. Apparatus of the class described comprising a rotatable shaft, a casing containing a conductive liquid associated with and adapted to be driven by said shaft, an electrically conductive contact in circuit with said liquid when said shaft is at rest, and a displaceable element arranged within the casing and movable by the centrifugally-developed buoyant force of said liquid for interrupting said circuit when said shaft is rotated at a predetermined speed.

16. Apparatus of the class described comprising a shaft, a casing mounted on said shaft and rotatable therewith, said casing containing a conductive liquid and having a contact chamber and an enlarged segment chamber, a pair of electrically conductive contacts arranged within the contact chamber which are bridged by said liquid to form an electric circuit when the casing is at rest or is being rotated at low speed and a plurality of segments maintained in engagement with the inner periphery of the segment chamber when said shaft is at rest, and means for rotating said shaft, said liquid being thrown outwardly by centrifugal force to buoyantly force said segments radially inwardly to form a space for said liquid in the segment chamber to thereby interrupt said circuit when said shaft is rotated above a predetermined speed.

17. Apparatus of the class described comprising a movable casing containing a conductive liquid and being shaped to provide a contact chamber communicating with a second chamber of greater peripheral extent than the contact chamber, an electrically conductive contact arranged in the contact chamber which is in electrical circuit with said liquid when said casing is at rest, and means arranged in the second chamber and displaceable by the centrifugally-developed buoyant force of said liquid to provide a space in the second chamber for said liquid when said casing is moved about one of its axes at a predetermined speed to thereby interrupt the circuit between the contact and said liquid.

18. Apparatus of the class described comprising a casing containing a conductive liquid, said casing being shaped to provide a contact chamber and a second communicating chamber of greater peripheral extent than the contact chamber, a pair of electrically conductive contacts arranged in the contact chamber which are in electrical circuit with said liquid and each other when the casing is at rest, movable means arranged in the second chamber, adjustable resilient means for maintaining the movable means at the inner periphery of the casing forming the second chamber when the casing is at rest, and said casing

being movable about one of its axes to centrifugally throw said liquid into the second chamber and force the movable means radially inwardly against the force of the resilient means to provide a space for the liquid in the second chamber, thereby interrupting the circuit between the contacts and said liquid.

19. Apparatus of the class described comprising a casing containing mercury, an electrically conductive contact in circuit with said mercury when said casing is at rest, and a displaceable element arranged within said casing having a lower specific gravity than the mercury which is movable by the centrifugally-developed buoyant force of said mercury for interrupting said circuit when said casing is moved at a predetermined speed about one of its axes.

20. Apparatus of the class described comprising a rotatable casing containing an electrically conductive liquid, a pair of contacts arranged in but spaced from said casing, said contacts being in electrical circuit with said liquid when the casing is at rest or is being rotated at low speed and at least one of said contacts being spaced from said liquid to interrupt the circuit when the casing is rotated at a predetermined speed, and resilient means for preventing interruption of said circuit until the casing has acquired its predetermined speed.

21. Apparatus of the class described comprising a rotatable casing containing an electrically conductive liquid, a pair of contacts arranged in but spaced from said casing, said contacts being in electrical circuit with said liquid when the casing is at rest or is being rotated at low speed and at least one of said contacts being spaced from said liquid to interrupt the circuit when the casing is rotated at a predetermined speed, and adjustable means for preventing interruption of said circuit until the casing has acquired its predetermined speed.

22. Apparatus of the class described comprising a rotatable casing containing an electrically conductive liquid, a pair of contacts arranged in but spaced from said casing, said contacts being in electrical circuit with said liquid when the casing is at rest or is being rotated at low speed and at least one of said contacts being spaced from said liquid to interrupt the circuit when the casing is rotated at a predetermined speed, and adjustable resilient means for preventing interruption of said circuit until the casing has acquired its predetermined speed.

23. Apparatus of the class described comprising a casing containing a conductive liquid and being shaped to provide a contact chamber and a second chamber which communicates with the contact chamber and which has a greater peripheral extent than the contact chamber, and said casing being rotatable about its axis to centrifugally displace the liquid from the contact chamber into the second communicating chamber, a plurality of electrically conductive contacts arranged in the contact chamber including a main contact having its outer periphery spaced from the inner periphery of said casing and a plurality of auxiliary contacts spaced from each other and the main contact, and the distance of the outer periphery of each of said auxiliary contacts from the inner periphery of the casing being greater than the main contact and being variable with respect to each other and said contacts being bridged by said liquid when said casing is at rest.