Dec. 4, 1934. H. P. VAUGHAN 1,983,502

CONTROL MEANS

Filed Nov. 10, 1931

Fig. 1.

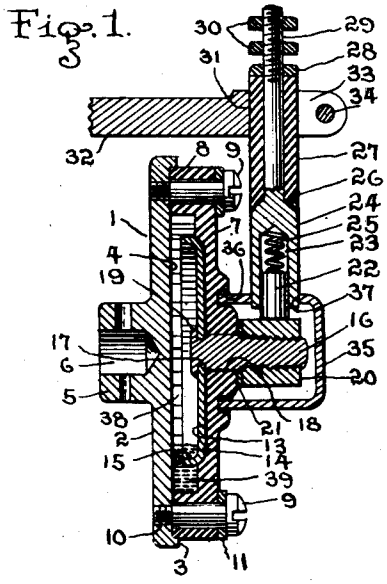


Fig. 2.

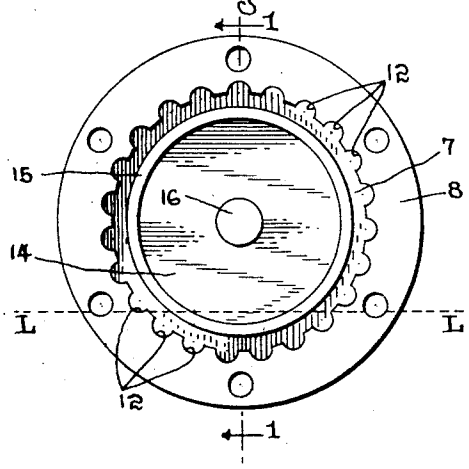


Fig. 4.

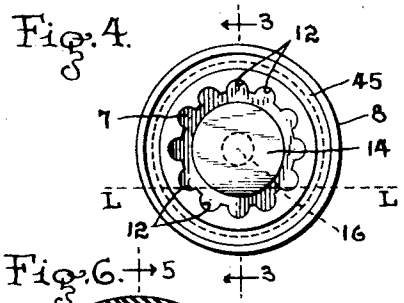


Fig. 3.

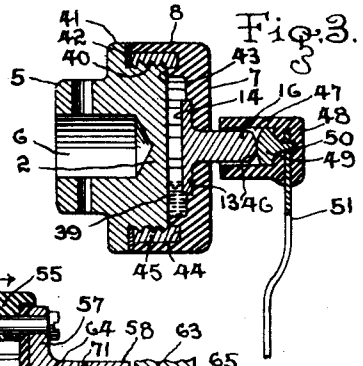


Fig. 6.

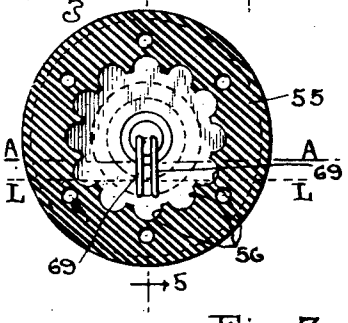


Fig. 5.

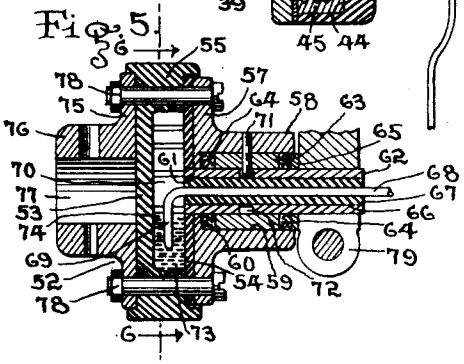
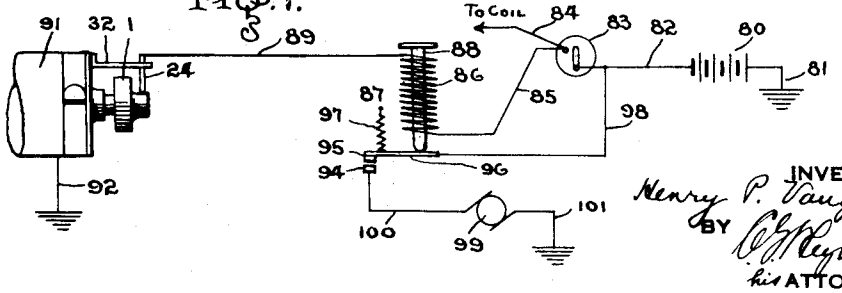


Fig. 7.



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UNITED STATES PATENT OFFICE

1,983,502

CONTROL MEANS

Henry P. Vaughan, Detroit, Mich., assignor to Detroit Lubricator Company, Detroit, Mich., a corporation of Michigan

Application November 10, 1931, Serial No. 574,097

5 Claims. (Cl. 200—80)

My invention relates to new and useful improvements in control means, and more particularly to means for controlling the operation of an electric starting motor for an internal combustion engine.

An object of my invention is to provide means to stop a starting motor at a predetermined engine speed.

Another object is to provide a starting motor control means which is responsive to engine speed.

Another object is to provide an electric switch having contact means which are free from oxidation.

Another object is to provide in a rotary or centrifugal electric switch having a contact making liquid, means to aid in retaining the liquid out of contact making position.

Another object is to provide an apparatus or control system for an internal combustion engine automatically operable to crank the engine upon completion of the ignition circuit or upon decrease of engine speed below a predetermined minimum limit.

The invention consists in the improved construction and combination of parts and their aggroupment in operative relation, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawing to be taken as a part of this specification, I have fully and clearly shown several embodiments of my invention, in which drawing—

Figure 1 is a view in vertical, central section, taken on the line 1—1 of Fig. 2, of an electric switch means embodying my invention;

Fig. 2 is a view in end elevation of the means of Fig. 1, but having one end wall of the casing removed to show the internal construction;

Fig. 3 is a view in vertical, central section on the line 3—3 of Fig. 4 of another form of switch means embodying my invention;

Fig. 4 is a view in end elevation of the means of Fig. 3, but having one end wall of the casing removed to show the internal construction;

Fig. 5 is a view in vertical, central section of another form of switch means embodying my invention, and taken on the line 5—5 of Fig. 6;

Fig. 6 is a view in section on the line 6—6 of Fig. 5, and

Fig. 7 is a diagrammatic view of an apparatus or system embodying my invention.

Referring to the drawing by characters of reference, and particularly to Figs. 1 and 2, 1 designates, generally, a rotatable, hollow or chambered casing or body which is preferably substantially cylindrical. The casing has a metal end wall or closure plate 2 having a marginal and annular, laterally extending bead or flange 3 extending from the inner face 4 thereof and having on its outer face and centrally thereof a boss or extension 5 in which is a substantially cylindrical socket or bore 6 having its longitudinal axis transverse to the plane of the plate at its mid-point, and being substantially concentric with the flange 3. Spaced from and in opposed relation to the wall 2 is an end wall 7 of insulating material, such as a phenol condensation product, having a marginal and substantially annular, lateral flange 8 substantially rectangular in cross-section and of an external diameter to fit snugly within the flange 3 and join the end walls together. The flange 8 which is preferably of insulating material, such as a phenol condensation product, is also preferably formed integral with the wall 7 and forms therewith a substantially cup-shaped member, the flange 8 defining the side wall of the casing and being substantially internally cylindrical. The side and end walls are tightly clamped and sealed together by a plurality of machine screws 9, or the like, passed through apertures in the end wall 7 and flanges 8 and screw-threaded, as at 10, into internally threaded apertures in the end wall 2. The screws 9 are preferably provided with lock washers 11. The internal, cylindrical face of the side wall 8 has a plurality of longitudinal serrations or grooves 12 transverse to the end walls and which may be substantially semi-cylindrical and preferably substantially equally spaced and closely adjacent to each other, the grooves together with the end walls 2 and 7 forming cup-like cavities or recesses for a purpose to be described. The inside face of the end wall 7 has a substantially circular, central recess 13, concentric with the side wall 8 in which is seated a metal disc or circular plate 14 having a peripheral metal flange 15 extending into the casing and spaced from the wall 2, and substantially equidistantly spaced at all marginal points from the inner, circular face of said side wall. The end wall 2 serves as an electric contact means or switch terminal, particularly the circumferential or annular portion within the casing and adjacent the side wall 8, the remainder of the end wall serving as a current conducting means. The marginal edge portion and flange of the disc 14 serve as the other contact means or switch terminal and are in-

sulated from the wall 2 and the side wall 8, which may be of metal, by the annular, spacing portion of wall 7 between disc 14 and the wall 8. The disc 14 is held in central position by a current conducting post 16, or the like, which extends through alined, central apertures 17, 18 in the disc and end wall 7 respectively. The post is preferably rigidly fixed to the plate by sealing one face of the plate against an annular shoulder on the post and then flanging the end of the post over upon the other face of the plate, as at 19, as by burnishing, or the like. The plate or disc is preferably tightly clamped and fixed to the end wall 7 by an internally screw-threaded sleeve or nut 20 which is externally cylindrical and threaded onto the end of post 16 which projects through the end wall 7, a lock washer 21 being provided to prevent turning of the nut. Bearing against or on the cylindrical, external surface of the nut, is a current conducting brush or contact member 22 of carbon, or the like, which is slidably supported in a socket or bore 23 in the end of a current conducting metal post or supporting member 24. The brush 22 is normally urged against the nut 20 by resilient means 25, such as a coil spring positioned in the socket and held under compression between the base or end wall thereof and the inner end of the brush. Above the socket 23 the post is of reduced cross-section, providing a surrounding shoulder 26 on which is seated one end of a sleeve member 27 of insulating material which surrounds the reduced post portion, the member 27 being fixed thereon by a nut 28 screw-threaded on the end of the post and clamping the sleeve member against the post shoulder. The threaded end 29 of the post serves as a binding post to receive an electric lead or wire, not shown, which may be clamped thereto by the binding post nuts 30. The sleeve member 27 extends through an aperture 31 in a supporting arm or bracket 32 having an end slot 33, so that the diameter of the aperture may be reduced by a clamping bolt 34 to clamp tightly and rigidly the post within the aperture. The brush contact with the nut 20 is protected by a substantially cup-shaped cover or cap 35 having its rim extending into an annular groove 36 in the outer face of end wall 7 substantially concentric with post 16 and having through its side wall an aperture 37 through which the end of post 24 extends and in which the post is preferably fixed. The chamber 38 within the casing contains a quantity of electric current conducting liquid 39 which is preferably mercury, and which when the casing is at rest, that is, not being rotated, fills the casing to a level at which it will contact with or bridge the space between the wall 2 and the disc 14, for example, to the line L—L of Fig. 2, but not to such a height as to prevent centrifugal force upon rotation of the casing acting at a predetermined speed of rotation to flow or draw the liquid out of contact with the disc 14.

In the rotary switch of Figs. 3 and 4, the metal end wall 2 is substantially cylindrical and externally screw-threaded, as at 40, and provided with a circumferential flange 41 defining a marginal and preferably annular shoulder 42. The end and side walls 7, 8 respectively are of insulating material, the side wall 8 being internally stepped to provide an annular shoulder 43 for abutting engagement with the inside face of wall 2. The shoulder has a continuous groove 44, preferably annular, in which a hollow metal insert member 45 is seated and fixed, the member 45 being internally cylindrical and threaded onto the end wall threads 40 to clamp tightly and seal the shoulder against the inside face of wall 2. The disc 14 in this form does not have the marginal flange 15, but is of a thickness to project from the recess 13, the post 16 being integrally formed with the disc. The post and disc are preferably fixed in position by molding them into the wall 7. The external portion of the post is substantially cylindrical, but not threaded as in Fig. 1, and has a substantially convex end face 46. The post 16 extends into and is rotatable in a substantially cylindrical bore or socket 47 in a supporting member 48, preferably of insulating material, as a phenol condensation product. At the base or inner end of the socket 47 there is a metal contact member 49 having a substantially convex contact face engaging the face 46. The member 49 is rigidly secured in the socket as by molding the same therein, and is connected, as at 50, to an electric conducting member 51, also preferably molded in the member 48. The foregoing description of Figs. 3 and 4 points out the differences of this form of switch from that of Figs. 1 and 2, the remaining structure being the same as that of Figs. 1 and 2, so that the reference characters applied to the remaining structure of Figs. 3 and 4 are those applied to like parts in Figs. 1 and 2.

In Figs. 5 and 6 the reference character 52 designates, generally, the rotatable hollow casing or body having opposed end walls 53, 54 joined by an internally cylindrical side wall 55. The end wall 53 and side wall 55 are of insulating material, such as bakelite, and are preferably integrally formed, the wall 55 comprising a marginal, continuous, preferably annular flange projecting laterally from the end wall 53. The end wall 54 of insulating material, such as a phenol condensation product, seats on the flange and closes and seals the cup-like recess formed by the end and side walls 53, 55. The inner face of the side wall 55 has a plurality of adjacent, substantially equally spaced grooves or slots 56, preferably semi-circular in end elevation, extending transversely to the end walls. Seated against the outer face of wall 54 and substantially coextensive in area therewith, is a supporting member 57 having on its outer face an extension 58, preferably cylindrical, in which is an open bore 59 terminating at its inner end in a base or end wall 60, the bore 59 being cylindrical and concentric with the inside face of wall 55. Through the end walls 54 and 60 is a cylindrical aperture 61 concentric with bore 59 and in which is closely fitted for relative rotation, one end of a shaft 62 which extends through and projects from the bore 59. Within the bore 59 is an annular bearing block or sleeve 63 which surrounds and supports shaft 62, the bore preferably containing packing material 64 at the ends of sleeve 63 and surrounding the shaft. A packing material retaining disc 65 is carried by the shaft to close the open end of bore 59. The shaft 62 comprises a metal sleeve 66 containing a core 67 of insulating material, such as a phenol condensation product, through which extend spaced insulated conductors 68. The ends 69 of the conductors comprise contact means and extend into the casing chamber 70 laterally and substantially parallel to the casing end walls and in substantially parallel depending spaced relation, terminating adjacent to but

spaced from the side wall 55. The sleeve 63 and shaft 62 are held against longitudinal movement in bore 59 by a pin 71, or the like, which extends through the wall of the extension and through the sleeve 63 and into a circumferential groove 72 in the metal shaft sleeve 66, so that relative rotation is not prevented. Within the chamber 70 is a quantity of current conducting liquid 73, such as mercury, which when the casing is at rest, that is, not rotating, stands at a level which will immerse the contact means 69, for example, to the line L—L, Fig. 6. The chamber also preferably contains a quantity of oil, or the like, 74 at a level A—A which floats on the liquid 73 and serves to prevent oxidation when contact is broken between the conductor ends 69. Seated against the outside face of end wall 53 is a supporting plate member 75 having a boss or extension 76 in which is a cylindrical bore 77 concentric with shaft 62 and adapted to receive a driving shaft for rotating the casing. The member 75, end and side walls 53, 55, end wall 54, and supporting member 57 are rigidly and tightly clamped together by bolts and nuts 78 extending therethrough at spaced points around the periphery of the casing. A supporting bracket or arm 79 is clamped on the outer end of shaft 62 to hold the shaft against rotation, the bracket being fixed to any convenient base or supporting element.

In Fig. 7 is shown diagrammatically an electric circuit for the starting motor of an internal combustion engine, though it is apparent that the circuit may control other motors or other electrically operated means. A source of electric energy 80, such as a battery, has one terminal grounded, as at 81, and has the other terminal connected by a lead wire 82 to an ignition or other switch 83. From a common switch contact a lead wire 84 extends to the spark coil and ignition means, not shown, and a lead wire 85 extends to the solenoid winding 86 of a relay 87 having a core or plunger 88. The other end of the winding 86 is connected by a lead wire 89 to one terminal of any one of the foregoing rotary mercury switches which is mounted on a shaft rotatable at a speed proportional to the speed of rotation of the engine crank shaft, such, for example, as on the armature shaft of the generator 91 which is driven by the engine. Each of the switches of Figs. 1, 3 and 5 has a socket or bore 6, 6 and 77 respectively into which the generator shaft may extend and be rigidly fixed, as by a transverse pin, or the like. The other contact or terminal of the rotary switch is connected to ground either directly in the case of the switch of Fig. 5, or through the generator shaft and casing, as at 92, in the case of the switches of Figs. 1 and 3. The relay 87 includes a switch means having a fixed contact 94 and a movable contact 95, which may be carried by a switch lever 96 which is normally urged to circuit breaking position and which is held against plunger 88 by a spring 97. The lever 96 is connected to the battery or to the lead wire 82 by a wire 98, and the fixed contact 94 is connected to one of the brushes of the starting motor 99 by a lead wire 100. The other brush of the motor 99 is grounded, as at 101.

The operation of my apparatus and the rotary switches, is as follows: When it is desired to start the engine, the ignition switch 83 is closed, which completes a circuit through the relay 87 and the rotary switch, the circuit being from source 80 through lead wire 82, switch 83, wire 85, solenoid winding 86 and wire 89, to the rotary switch. If the rotary switch is as in Fig. 1, the wire 89 connects to post 29 and the circuit continues through support 24, brush 22, contact sleeve 20, and post 16 to contact means 15, thence through the body of mercury 39 to the end wall contact means 2, and via the generator shaft and casing to ground at 92. If the rotary switch of Fig. 3 is employed, the circuit will be continued from wire 89 through conductor 51, member 49, post 16 to contact means 14, through the body of mercury 39 to end wall contact means 2 and thence through the generator shaft and casing to ground at 92. If the switch of Fig. 5 is employed in the circuit, the wire 89 will be connected to one of the conductors 68, and the other of the conductors 68 will be directly connected to ground, and then the circuit will continue from wire 89 through one of the conductors 68 to one of the contact means 69, through the immersing mercury 73, the other contact means 69 and its conductor 68 to ground. From the foregoing, it will be noted that in each case the winding 86 will be energized, which will depress the core or plunger 88 and lever 96, overcoming spring 97 to make contact between switch terminals 94, 95, thus completing a circuit from the source 80 through the armature of motor 99 to energize the same. Rotation of motor 99 will through any of the well known devices rotate the crank shaft of the internal combustion engine to crank the same. The rotation of the crank shaft will drive the shaft of the generator 91, but the speed of rotation of the generator shaft and therefore of the driven rotary switch will be insufficient to exert sufficient centrifugal force on the mercury 39 or 73 to overcome the force of gravity acting thereon, so that the circuit between the rotary switch contact means will not be broken. However, as soon as the engine fires and is operating under its own power, or as soon as the speed of the engine in R. P. M. reaches a predetermined minimum limit, the generator speed being proportional, the centrifugal force in conjunction with the serrations 12 or 56 acting on the mercury, will overcome the force of gravity and spread or flow the mercury out around the circumference of the side wall of the casing chamber, which, due to the predetermined quantity of mercury in the chamber, will separate the mercury from one or both of the rotary switch contact means and break the circuit through winding 86 at the rotary switch. Deenergization of winding 86 permits spring 97 to separate contacts 95, 94 and break the circuit through the starting motor 99. As long as the engine speed is above the predetermined minimum limit, which preferably is the minimum speed at which it can be run, the mercury 39 or 73 will be held out of contact with either or both of the contact means within the rotary switch casing, and the starting motor circuit will be maintained broken. However, should the engine speed decrease below the desired minimum limit, the force of gravity acting upon the mercury will overcome the centrifugal force due to rotation of the casing, and the mercury will collect at the bottom of the casing chamber to make contact in the switch of Fig. 1 between contact means 15 and 2, in the switch of Fig. 3 between the contact means 14 and 2 and in the switch of Fig. 5 between the similar spaced contact means 69 to complete the circuit as above described through the solenoid winding 86 and

thereby cause energization of the starting motor 99.

In the switches of Figs. 1 and 3, the joint between the side wall 8 and the end wall 1, or flange 41, respectively, is tight, so that the chambers 38 are sealed air-tight to prevent "breathing" of air into and from the chambers, due to changes of temperature, which "breathing" causes oxidation of the contacts and the liquid conductor within the chambers. The chambers 38 are made air-tight by the use of a soft metal gasket 42, as in Fig. 3, or by employing an accurately ground joint, or by the use of some joint sealing medium such for example as shellac, or the like. In either of the switches of Figs. 1 and 3, the chambers 38 are preferably evacuated of air and then charged with an inert gas by any well known means, after which the chambers are hermetically or otherwise sealed, so that oxidation of the annularly related contact members 1 and 14 of Fig. 1, and 2 and 14 of Fig. 3 and of liquid conductor 39, is effectively prevented.

From the foregoing description, it will be apparent that I have provided an apparatus which will prevent stalling or stopping of the engine as long as the ignition switch is closed, and which also operates to start the engine upon the closing of the ignition switch.

It is also to be noted that the electrical switches of Figs. 1 to 6 inclusive are adapted for other uses in addition to the control of an internal combustion engine starting motor, which is merely one application thereof, which application is illustrative of the operation of the switches in one particular system.

What I claim and desire to secure by Letters Patent of the United States is:

1. An electric switch of the character described, comprising a rotatable hollow casing having opposed end walls joined by a substantially internally cylindrical side wall, one of said end walls being of insulating material, a metal disc in said casing in concentric spaced relation to said side wall, a current conducting post fixed centrally to said disc and extending through said one end wall, means external of said casing and acting on said post to clamp said disc tightly to said one end wall, the other of said end walls being of metal and having an external socket concentric with said post and adapted to receive a supporting and driving shaft, and a current conducting liquid in said casing operable when said casing is at rest to make contact between said disc and said other end wall.

2. An electric switch of the character described, comprising a rotatable hollow casing including a body member of electric insulating material having a vertical end wall and a laterally projecting circumferential side wall, a metal closure member engaging the end face of said side wall, means clamping said body member and said closure member together to provide a sealed chamber, said end wall having an internal circular recess concentric with said side wall, a circular metal contact plate fitting in said recess, a current conducting post rigid with said plate and extending through said end wall, a current conducting liquid in said chamber completing a circuit between said plate and said closure member when said body member is at rest, a plurality of internal radial recesses in said side wall operable upon rotation of said body member to carry said liquid out of contact with said plate, and an external boss on said closure member having a socket concentric with said post for securing said casing to a rotatable driving member.

3. An electric switch of the character described, comprising a rotatable hollow casing including a body member of insulating material having a vertical end wall and a laterally projecting circumferential side wall, said end wall having a circular recess concentric with and spaced from said side wall, a metal contact plate fitting in said recess, a current conducting post rigid with said plate and extending through said end wall, said side wall having an internal annular shoulder, an internally screw-threaded metal ring embedded in said side wall outward of said shoulder, a metal closure member screw-threaded into said ring, a circumferential flange on said closure member engaging the end face of said side wall, and a current conducting liquid in said casing operable to complete a circuit between said plate and said closure member when said casing is at rest.

4. An electric switch of the character described, comprising a rotatable hollow casing having opposed end walls joined by a substantially internally cylindrical side wall, one of said end walls being of insulating material, a metal disc in said casing in concentric spaced relation to said side wall, a current conducting post fixed centrally to said disc and extending through said one end wall, a cylindrical nut screw-threaded on the external end of said post and clamping said disc tightly to said one end wall, said one end wall having an annular groove in its outer face concentric with said post, a cylindrical housing capping said nut and extending into said groove, a current conducting brush member extending through the side wall of said housing and engaging said nut, the other of said end walls being of metal and having an external socket concentric with said post and adapted to receive a supporting and driving shaft, and a current conducting liquid in said casing operable when said casing is at rest to make contact between said disc and said other end wall.

5. An electric switch of the character described, comprising a rotatable hollow casing including a body member of insulating material having a vertical end wall and a laterally projecting circumferential side wall, a circular metal contact plate carried by said end wall within said casing and having its periphery spaced equally from the inner periphery of said side wall, a current conducting post rigid with said plate and extending through said end wall, said side wall having an internal annular shoulder, an internally screw-threaded metal ring embedded in said side wall outward of said shoulder, a metal closure member screw-threaded into said ring, a circumferential flange on said closure member engaging the end face of said side wall, and a current conducting liquid in said casing operable to complete a circuit between said plate and said closure member when said casing is at rest.

HENRY P. VAUGHAN.