

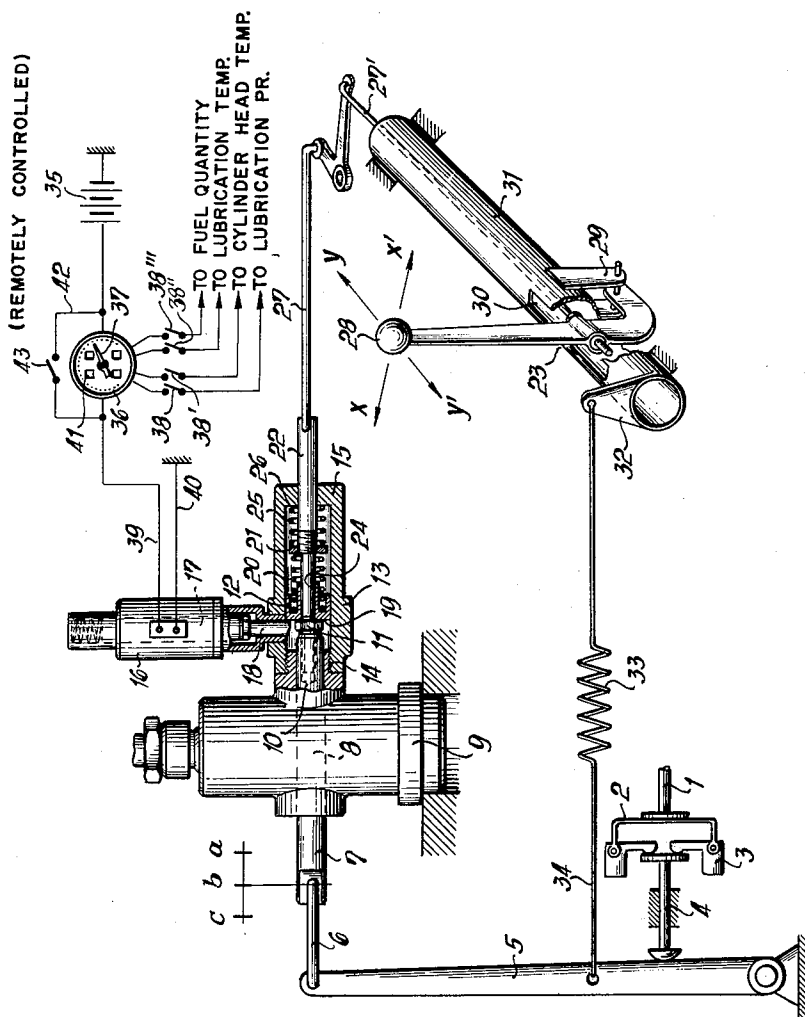
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CONTROL ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

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1

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CONTROL ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

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The present invention relates to a control arrangement for internal combustion engines, especially for fuel-injection internal combustion engines provided with a control member in which a lifting magnet operatively connected with the control linkage releases automatically an adjusting member in dependence on one or several operating magnitudes of the engine, for example, in dependence on the cylinder-head temperature which adjusting member thereupon adjusts the injection pump to the zero fuel-supply position thereof and which includes an adjusting device effective independently thereof which serves for purposes of adjusting the control rack into the start and stop position thereof as well as for the adjustment of the rotational speed of the engine during operation thereof.

Constructions are known in the prior art in which the regulating spring of an adjustable centrifugal governor abuts against a disk member connected with the control rack of the injection pump over an intermediate linkage. The control rack is thereby retained in the equilibrium thereof by a spring surrounding the control rack and by the regulating spring. A linkage controlled in dependence on the torque produced by the engine abuts thereby against the disk at a distance from the intermediate lever which linkage is operatively connected with an electric installation for energizing and thereby actuating a magnet. In case of excessive internal resistance of the engine, the linkage controlled by a cam disk abuts against the disk whereupon the energizing circuit is closed and the magnet thereby releases a spring-loaded plunger which also abuts against the disk and thereby adjusts the control rack to the zero supply position thereof while compressing the spring so that the engine comes to a standstill. Consequently, the automatic stoppage of the engine is dependent in such an arrangement on overcoming relatively large spring forces which affects disadvantageously the control installation. Furthermore, since all the levers and linkages influencing the fuel supply abut against the disk of the control rack on one side thereof, a relatively complicated and expensive installation results therefrom which additionally requires a careful and accurate adjustment.

Additionally, an installation is known in the prior art in which the magnet releases for purposes of adjusting the injection pump to zero supply position thereof a latch means arranged between the foot gas pedal and the pump lever shaft whereby the regulating spring becomes untensioned or released. In this arrangement, however, the regulating spring and the magnet have to be manually preset and pretensioned for purposes of initiating operation of the engine, and simultaneously therewith the selecting lever for the manual adjustment has to be pushed to the stop position thereof as otherwise the engine would continue to operate notwithstanding the unlatching of the magnet. The manipulation of the control installation of such prior art device is, therefore, relatively complicated and time-consuming. Furthermore, in this arrangement only one single operating rotational speed may be selected at any time. If the engine is to operate within another speed range, then the position of the latch mechanism has to be corrected accordingly with respect to the control linkages. Since, furthermore, for purposes of au-

2

tomatically stopping the engine, the frictional portion of the regulating spring has to be overcome, a relatively large-size magnet having a large volumetric dimension is required for the unlatching operation.

According to the present invention, the disadvantages encountered in the prior art devices are avoided by coordinating to the rotational-speed-responsive control regulation of the fuel supply one end of the control rack of the injection pump while coordinating the other end thereof to the stop mechanisms operative independently of one another. As a result of such an arrangement, any desired rotational engine speed may be selectively adjusted without having to undertake any adjustment or correction at the automatic stop mechanism and without making possible any servicing or actuating errors. By the use of an arrangement in accordance with the present invention, the pressure force required for the adjustment of the injection pump is relatively small and becomes practically zero with the engine operating, i.e., when the regulator and regulator spring are in equilibrium so that a relatively small magnet suffices which may be readily accommodated. By reason of the fact that the adjusting member retained by the magnet and the actuating member of the adjusting installation act directly on the control rack of the injection pump and are arranged coaxially with respect to each other, a compact structural unit is created thereby which may be readily connected to the injection pump itself. Consequently, all of the support and connecting means at the engine known in connection with the prior art devices are obviated by the present invention which represents a significant simplification in the control arrangement.

The adjusting member is constituted by a piston arranged coaxially to the control rack which piston slides within a cylinder supported at the injection pump whereby the cylinder also carries the magnet. As a result of such a construction and arrangement of the stop mechanism, relatively few and simply constructed parts suffice whereby manufacturing costs are kept relatively low. The adjusting piston is preferably spring-loaded and is retained by a pin member extending through the cylinder wall and operatively connected with the armature of the magnet. The actuating member operatively connected with the selecting lever of the adjusting mechanism extends through the adjusting piston which actuating member is under the influence of a compression spring abutting against the cylinder. Consequently, the actuating member together with the adjusting member may be accommodated within the smallest space. The actuating member consists of a bolt member which provided with an abutment disk constitutes the abutment for the compression spring cooperating with the adjusting piston. The actuating member is operatively connected through a linkage with a selecting lever which has several operating positions disposed in planes perpendicular to each other. As a result thereof, a simple manipulation of the adjusting mechanism is obtainable together with a simple construction thereof. In a control and regulating mechanism in which the magnet is controlled by responsive indicator means interconnected into the energizing circuit thereof which are responsive to temperature, pressure or the like, a stop mechanism, appropriate in particular for non-supervised stationary engines may be readily obtained by means of by-passing the energizing circuit between the indicator means and the magnet for the installation of a remote contact control.

Accordingly, it is an object of the present invention to provide an adjusting and control mechanism for an injection-type internal combustion engine which eliminates the disadvantages mentioned hereinabove normally encountered with the prior art devices.

Another object of the present invention is a regulat-

3

ing and control system for an internal combustion engine of the injection-type which is relatively uncomplicated in structure and involves relatively low expenditures for manufacture and assembly thereof.

Still a further object of the present invention resides in the provision of a regulating mechanism for an internal combustion engine of the fuel-injection-type in which there is no necessity to overcome relatively large spring forces and which does not require relatively large actuating mechanisms especially relatively large-sized magnets to overcome the large spring forces normally required in the prior art devices.

A further object of the present invention resides in the provision of an adjusting and regulating mechanism for an internal combustion engine which permits manual as well as automatic stoppage of the engine together with an adjustment of the engine to any desired operating speed without complicated adjustments and by simple manipulation of a selecting lever.

Still a further object of the present invention is the provision of a regulating and control mechanism for a fuel injection pump of an internal combustion engine which permits a relatively compact unit of the regulating mechanism, requiring relatively few parts that may be manufactured relatively inexpensively and which may be assembled and accommodated within a relatively small space.

These and other objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, in the single FIGURE thereof, a somewhat schematic view of a regulating installation for an internal combustion engine in accordance with the present invention.

Referring now to the drawing in which some parts are shown in cross-section while others are shown in perspective with still other parts shown only schematically, reference numeral 1 designates therein a shaft which is driven by the internal combustion engine (not shown) and which in turn drives a centrifugal governor 2 of any known construction. The flyweights 3 of the centrifugal governor 2 actuate a pin member 4 which, in turn, abuts against a pivotally supported control lever 5. The control lever 5 is pivotally secured over an intermediate linkage 6 to the end 7 of the control rack 8 of a fuel injection pump 9. An adjusting screw 11 is inserted into the opposite end 10 of the control rack 8 which may be threadably secured therein in a conventional manner. An adjusting piston 12 is adjacent the head of screw 11 which adjusting piston 12 slides within a cylinder 13. The piston 12 may be prevented from contacting the screw 11 by a pin member 18 as will be described hereinafter. The cylinder 13 is supported by means of a lateral projection 14 provided with external threads so that the cylinder 13 may be threadably secured over the projection 14. A magnet 16 is installed into the wall 15 of cylinder 13 the armature 17 of which is provided with a pin member 18. The pin member 18 extends through the cylinder wall 15 and abuts with the free end thereof against the end face 19 of the adjusting piston 12. The adjusting piston 12 is under the influence of a compression spring 20 which abuts at one end thereof against the right-hand end of the adjusting piston 12 and at the other end thereof against an abutment disk 21. The abutment disk 21 is arranged on the actuating member formed by a bolt member 22 of an adjusting mechanism 23. The bolt member 22 extends through a bore 24 in the adjusting piston 12 and is under the influence of a compression spring 25 which is inserted between the cylinder wall 26 and the abutment disk 21. A multi-partite linkage 27, 27' is pivotally connected at one end with the bolt member 22 and at the other end with a selecting lever 28 of the adjusting mechanism 23. The selecting lever 28 is adjustably supported on a support 29 within a sleeve member 31 provided with slots 30 which, in turn, is adapted to be

4

pivoted about the axis thereof. The sleeve member 31 is provided with a projection 32 for securing thereto one end of the regulating spring 33. The regulating spring 33 engages with the opposite end 34 thereof in the control lever 5 at a distance from the regulating pin member 4.

The electrical installation for the magnet 16 includes an indicator and switch apparatus 36 of known construction connected with battery 35 whereby the indicator and switch apparatus may be provided with a timing clock 37 for preselecting a predetermined desired operating time of the engine as well as with switching contacts 38, 38', 38'' and 38''' which respond, in a manner known per se, for example, to the lubricating oil pressure, to the cylinder-head temperature, to the lubricating oil temperature, and to the fuel quantity. The magnet 16 is connected over line 39 with the indicator apparatus 36 and over a second line 40 with ground to which the other terminal of the battery 35 is also connected.

Operation

The operation of the regulating installation in accordance with the present invention is as follows:

For purposes of starting the engine, the selecting lever 28 is displaced or moved within the shifting plane $x-x'$ in the direction of x' thereof corresponding to the full load position whereby the sleeve member 31 is pivoted in the clockwise direction as viewed in the drawing and thereby with pretensions the regulating spring 33 correspondingly. As soon as the full load position is attained, the lever 28 is then pulled in the shifting plane $y-y'$ in the direction y' toward the starting position thereof. As a result thereof, the bolt member 22 is withdrawn or retracted over linkage 27 and 27' while compressing spring 25 and correspondingly relieving the spring 20 of the adjusting piston 12. Simultaneously therewith, the lever 5 together with the control rack 8 of the injection pump 9 follows the withdrawn bolt member 22 by reason of the pretensioned control spring 33 which has been compressed by the pivotal movement of the control sleeve 31 in the clockwise direction thereof accompanied by simultaneous withdrawal of the adjusting piston 12 toward the right, whereby the control rack 8 reaches the starting position a thereof. As the engine now starts to operate, the selecting lever 28 is returned to the initial position thereof within the $y-y'$ plane whereby, by displacing the same within the shifting plane $x-x'$ thereof, any desired rotational operating speed b of the engine may be selectively adjusted at the control rack 8.

If the engine is now to be operated, for example, for four hours with a predetermined adjusted operating rotational speed, then the timing clock 37 is adjusted to the desired operation time. After expiration of the preset operating time, a contact between battery 35 and line 39 is made within the switching apparatus 36 by the timing clock 37 in any known conventional manner whereby the control winding of magnet 16 is energized and the armature 17 of the magnet 16 is attracted. As a result thereof, the pin member 18 connected with the armature 17 releases the adjusting piston 12 so that the latter under the effect of compression spring 20 pushes the control rack 8 to the stop position c thereof. As a result thereof, the fuel supply to the engine is interrupted so that the engine is brought to a standstill.

If within the preset time period selected by the adjustment of the timing clock 37, damage occurs within the engine whereby, for example, the lubricating pressure drops below a predetermined pressure, for example, to 0.5 atmospheres, then the contacts of the responsive switch means 38 are closed. As a result thereof, the line 39 is energized through the switching apparatus 36 so that the magnet 16 is again energized and in turn again releases the adjusting piston 12 which thereupon pushes the control rack 8 into the stop position c thereof. A flap or window 41 arranged within the switching apparatus 36 and of any well known construction thereby indicates

5

that the engine has been brought to a standstill as a result of insufficient lubricating oil pressure. In a corresponding manner the control installation of the present invention also responds to the indicator means 38' and 38'' which are responsive to the temperature of the cylinder head and of the lubricating oil. Of course, a similar operation is also true of the indicator means 38''' responsive to the fuel quantity.

For purposes of remote control of the engine, the by-pass line 42 by-passing the switching apparatus 36 is provided between the battery 35 and the line 39 connected with the magnet 16. A contact switch 43 is inserted into the by-pass line 42 which, for example, may be closed through a suitable pulse-control from a central control panel or station whereby upon closure of switch 43 the engine again is brought to a standstill in the same manner.

If the engine is to be stopped manually, then the selecting lever 28 is displaced within the shifting plane $x-x'$ in the direction x which corresponds to the idling position and thereupon within the shifting plane $y-y'$ in the direction y . As a result thereof, the regulating spring 33 is relieved or untensioned by the counterclockwise rotation of the sleeve member 31 as viewed in the drawing, and simultaneously therewith the bolt member 22 is moved in the direction toward the control rack 8. During such movement, the bolt member 22 extends through bore 24 in the adjusting piston 12 and pushes the control rack 8 into the stop position c thereof whereupon the engine again comes to a standstill.

While we have shown and described one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of many changes and modifications within the spirit and scope of the present invention. The adjusting mechanism itself may be constructed in any suitable known manner as long as an actuating member is present for the displacement of the injection pump control rack.

Thus, it is quite obvious that the present invention is susceptible of many changes and modifications within the spirit and scope of the present invention and we, therefore, do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

We claim:

1. A control installation for an internal combustion engine, especially for a fuel injection type internal combustion engine, comprising control rack means for the injection pump, speed-responsive means responsive to the engine speed and operatively connected with one end of said control rack means, and adjusting means operatively connected with said control rack means, said adjusting means including first means provided with an actuating member operatively connected with said control rack means, said first means selectively adjusting said control rack means to the start and stop positions, second means including a normally ineffective adjusting member including a spring-loaded adjusting piston arranged coaxially with respect to said control rack means and operative independently of said actuating member and operative upon being rendered effective to selectively adjust said control rack means to said stop position, and third means including a cylinder secured to the injection pump and having an electromagnet supported therein for normally rendering said adjusting member ineffective and operative to release said adjusting member to become effective in response to a control effect representing an operating condition of the engine, said electromagnet including an armature provided with a pin member extending through a wall of said cylinder and normally retaining said adjusting piston in the ineffective position thereof, said actuating member extending through said adjusting piston, and spring means within said cylinder normally pretensioning said actuating member.

2. A control installation for an internal combustion

6

engine, especially for a fuel injection type internal combustion engine, comprising control rack means for the injection pump, speed-responsive means responsive to the engine speed and operatively connected with one end of said control rack means, and adjusting means operatively connected with said control rack means, said adjusting means including first means provided with an actuating member operatively connected with said control rack means, said first means selectively adjusting said control rack means to the start and stop positions and including a manual lever, second means including a normally ineffective adjusting member operatively connected with said manual lever and including a piston slidably accommodated within a cylinder, said adjusting member being operative independently of said actuating member to selectively adjust said control rack means to said stop position, and third means provided with an electromagnet normally rendering said adjusting member ineffective and operative to release said adjusting member to become effective in response to a control effect representing an operating condition of the engine, said actuating member extending through said piston, and spring means pretensioning said actuating member and said piston.

3. A control installation for an internal combustion engine, especially for a fuel injection type internal combustion engine, comprising control rack means for the injection pump, speed-responsive means responsive to the engine speed and operatively connected with one end of said control rack means, and adjusting means operatively connected with said control rack means, said adjusting means including first means provided with an actuating member operatively connected with said control rack means, said first means selectively adjusting said control rack means to the start and stop positions, second means including a normally ineffective adjusting member operative independently of said actuating member and operative upon being rendered effective to selectively adjust said control rack means to said stop position, third means provided with an electromagnet normally rendering said adjusting member ineffective and operative to release said adjusting member to become effective in response to a control effect representing an operating condition of the engine, said actuating member including a bolt member provided with an abutment disk, said adjusting member being constituted by an adjusting piston, spring means operatively connected between said piston and said abutment disk, said first means including an actuating lever, link means operatively connecting said actuating lever with said actuating member, said actuating lever being adapted to be manipulated in a plurality of planes disposed essentially perpendicularly to each other.

4. A control installation according to claim 3, wherein said third means includes an energizing circuit for said electromagnet, switch means in said energizing circuit and operative in response to at least one of the temperature, pressure and quantity in the cooling lubricating and fuel supply systems, and remote control means connected in parallel with said last-mentioned means to enable energization of said electromagnet by remote control.

5. A control installation for an internal combustion engine, especially for a fuel injection type internal combustion engine, comprising control rack means for the injection pump, speed-responsive means responsive to the engine speed and operatively connected with one end of said control rack means, and adjusting means operatively connected with said control rack means, said adjusting means including first means provided with an actuating member operatively connected with said control rack means, said first means selectively adjusting said control rack means to the start and stop positions, second means including a normally ineffective adjusting member operative independently of said actuating member and operative upon being rendered effective to selectively adjust said control rack means to said stop position, third means provided with an electromagnet

7

normally rendering said adjusting member ineffective and operative to release said adjusting member to become effective in response to a control effect representing an operating condition of the engine, said first means including a manual control lever operative to be displaced in orthogonally disposed planes, link means operatively connecting said manual control lever with said actuating member, said speed-responsive means including a centrifugal governor and a control lever pivotally secured at one end thereof to a relatively fixed part and with the other end thereof to said first-mentioned end of said control rack means, said centrifugal governor acting on said control lever intermediate the two ends thereof, and spring means operatively connecting said manual control lever with said second-mentioned control lever to transmit the control movements of the former in at least one of the orthogonal planes to the latter, said spring means being connected with said second-mentioned control lever at a greater distance from the pivotal connection thereof with the relatively fixed part than centrifugal governor.

6. A control installation according to claim 5, wherein said injection pump includes a cylinder supported thereon, said adjusting member being formed by an adjusting piston provided with an aperture through which extends said actuating member, an abutment disk on

8

said actuating member, spring means interposed between the cylinder and said abutment disk and further spring means interposed between said abutment disk and said adjusting piston.

7. A control installation according to claim 6, wherein said electromagnet includes an armature having a pin extending through the wall of said cylinder into the path of said adjusting piston, and energizing circuit means for selectively energizing said electromagnet including switch means for closing the energizing circuit.

8. A control installation according to claim 7, wherein said switch means include a plurality of individual switches disposed in parallel to each other for closing said circuit selectively after lapse of a predetermined time, in response to at least one of the temperature of the engine, the temperature of the cooling system, the temperature of the lubricating system, the pressure of the lubricating system, the fuel quantity, and of auxiliary control means for enabling remote control of said energizing circuit.

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