

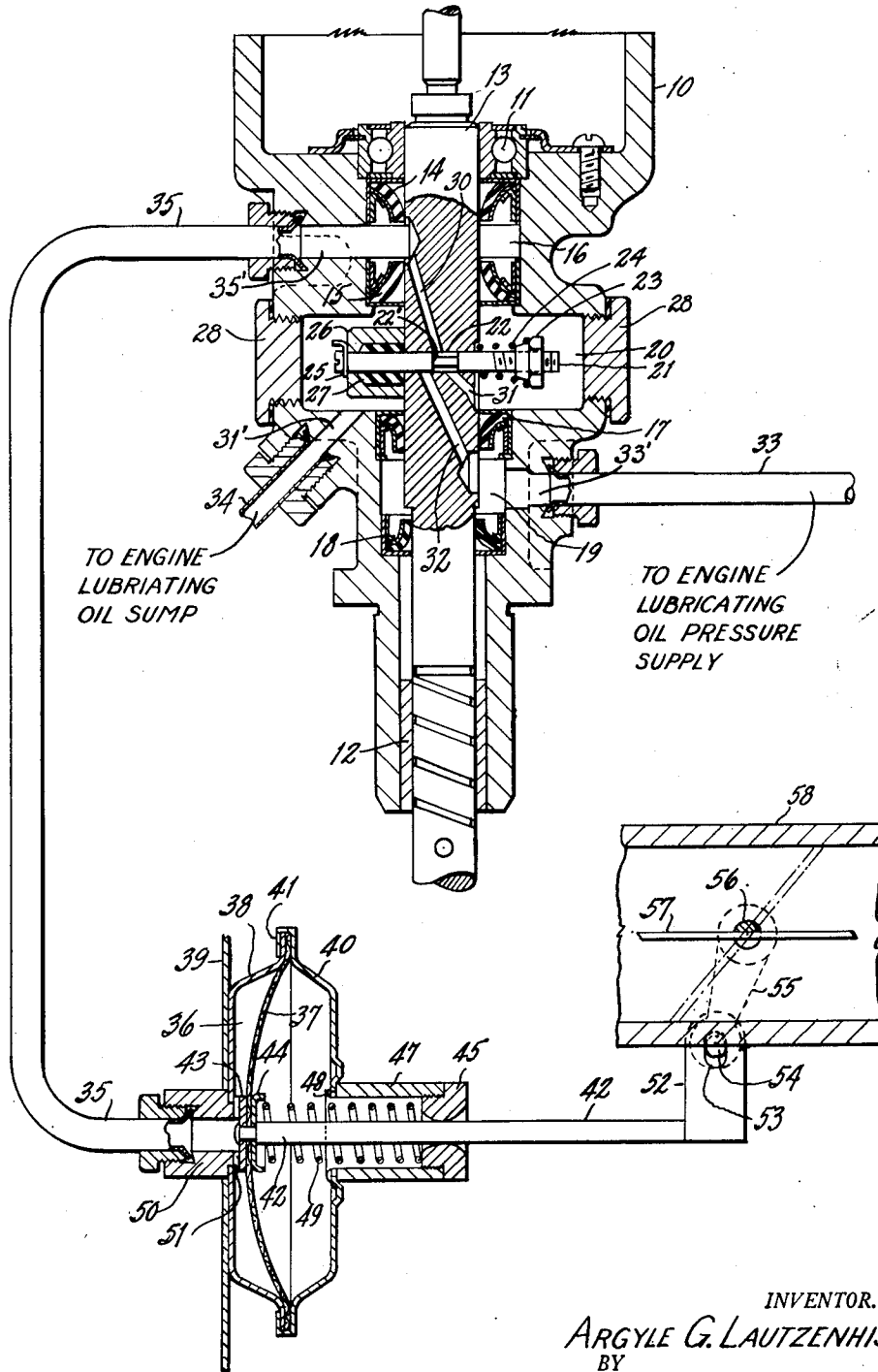
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ENGINE GOVERNOR

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ENGINE GOVERNOR

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This invention relates to controlling means and more particularly to speed controlling means for internal combustion engines.

The principal object of the invention is to provide simple centrifugal control valve means adapted to be driven by a rotating element of an engine for controlling actuation of the engine throttle by means of a fluid pressure actuated device connected to the control valve means and to a source of fluid pressure preferably the engine lubricating oil system or other pressure source necessary for efficient operation of the engine.

The combined control valve and throttle actuating means by which this object is accomplished, together with other novel features of the invention, will become apparent by reference to the following detailed description and single drawing showing one form of the control system which is particularly adaptable to internal combustion engines provided with electrical ignition apparatus. However it will be recognized that the control and throttle actuating means may be modified to control engines of other types.

As illustrated in the drawing, the centrifugal control valve means is included within the housing 10 of the distributor of the electrical ignition system of the engine. The distributor housing 10 is mounted in conventional manner in an opening in the engine crankcase, not shown. The housing 10 is provided with an axial bore having a ball bearing 11 in the upper portion and a bushing 12 adjacent the lower end by which the distributor shaft 13 is rotatably supported. The lower end of the shaft 13, which is shown projecting outwardly of the housing 10, is driven in timed relation to the engine by conventional timing gears driven from the engine crankshaft, not shown.

Three cylindrical cavities are provided in the housing intermediate the shaft bearing 11 and bushing 12 and in coaxial relation therewith. Shaft seal assemblies 14 and 15 of conventional type are provided in the ends of upper housing cavity to form a separate pressure application and relief or a pressure controlling chamber 16 for controlling the pressure actuated throttle operating device.

Similar shaft seal assemblies 17 and 18 are provided in ends of the lower housing cavity to form a separate pressure supply chamber 19. The seals 15 and 17 adjacent the ends of the intermediate housing cavity form a separate pressure relief chamber 20 between the chambers 16 and 19.

A valve stem 21 is provided with an annular

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groove 22' intermediate the ends and is slidably mounted in a diametrically disposed bore 22 intermediate the ends of the intermediate pressure relief chamber 20. A self-locking adjusting nut 23 is threaded on one end of the valve stem shown projecting outwardly of one end of the shaft bore 22 and a helical compression spring 24 is located on the stem between the adjusting nut 23 and the adjacent side of the shaft 13 to urge the valve stem to the right in the shaft bore 22 as viewed in the drawing. A spring retaining clip 25 is insertable in a groove in the opposite end of the valve stem and engages the adjacent outer end face of a hollow cylindrical centrifugal flyweight 26 disposed on the end of the valve stem projecting beyond the end of the bore 22. The outer end of the flyweight 26 is provided with an axial bore slightly larger in diameter than the valve stem and an enlarged diameter counterbore in the end adjacent the shaft 13 and a synthetic rubber bushing 27 is located in this counterbore and is supported in compression on the valve stem 13. The valve stem 21, with the flyweight 26 and bushing 27 retained thereon, may be readily inserted into the shaft bore 22 through diametrically disposed threaded openings in the walls of the pressure relief chamber 20 in the distributor housing 10. These openings are shown to be closed by threaded plugs indicated by the numerals 28. The spring 24 and nut 23 for placing the spring under compression may be placed on the valve stem through these openings and spring adjusting nut 23 also may be adjusted to regulate the compression force of the spring to normally retain the weight 26 in engagement with one side of the shaft 13, to position annular groove 22' in the valve stem 21 intermediate the ends of the shaft bore 22 and to oppose movement of the weight radially outwardly of the rotating shaft by centrifugal force thereon.

With the annular groove 22' in the valve stem 21 retained in the normal position by the spring 24 and weight 26, as shown, diagonal branch passages 30 and 31 formed in the distributor shaft 13 and opening into the shaft bore 22, are placed in communication at their inner ends. The outer end of the diagonal branch passage 30 in the shaft 13 opens into the upper pressure application and relief chamber 16 for the pressure actuated throttle operating device. The outer end of the diagonal branch passage 31 in the shaft 13 opens into the intermediate pressure relief chamber 20. Pressure is relieved from chamber 20 through a vent opening 31' shown extending diagonally downwardly and outwardly

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of the housing 10. Another diagonal branch passage 32 is shown provided in the shaft 13. The inner end of passage 32 opens into the shaft bore 22 between the passage 31 and the weight 27 and out of communication with the annular groove 22' when the shaft is rotating at less than a predetermined minimum speed. The outer end of this branch passage opens into the lower pressure supply chamber 19 in the distributor housing 10.

An engine lubricating oil pressure supply pipe 33 is connected between the engine oil pressure source, not shown, and a port 33' in the wall of the pressure supply chamber 19. A pressure relief pipe 34 is connected between the vent opening 31' in the pressure relief chamber 20 and the engine oil sump or reservoir, not shown, at substantially atmospheric pressure. The upper pressure application and relief chamber 16 is connected by a pressure application and relief pipe 35 connected at the upper end to a port 35' in the wall of this chamber. The lower end of the pipe 35 is connected to a chamber 36 of the pressure actuated throttle operating device formed by a one face of a flexible circular diaphragm 37 and an adjacent cup-shaped housing 38 having an outer annular flange shown in engagement with the diaphragm adjacent the outer periphery thereof. The housing 38 is mounted on a support plate 39 and another cup-shaped housing 41 is provided with an outer flange shown in engagement with the opposite face of the diaphragm adjacent the periphery thereof, which flange is shown crimped over the flange of the housing 38 to compress the diaphragm between these housing flanges.

A rod 42 having a reduced diameter end portion is shown extending through a central opening in the housing 40 and diaphragm 37 and washers 43 and 44 are placed on this reduced diameter rod portion either side of the diaphragm for compression thereof between these washers upon upsetting of this reduced diameter portion of the rod 43. The rod 43 extends outwardly of a central opening of the housing 40 and is slidably supported in a bushing 45 threaded in a sleeve 47 staked at 48 in the central opening of the housing 40. A helical compression spring 49 is placed on the rod 42 between the bushing 45 and washer and urges the rod 42 and diaphragm 37 to the left in the housings 38 and 40 as viewed in the drawing. Spring 49 also retains the washer 43 in engagement with the inner end face of a pipe fitting 50 having radial grooves 51 in the face adjacent the washer. The pipe fitting 50 is secured in a central opening in the housing 38 and extends through an adjacent opening in the support plate 39. The lower end of the pressure application and relief pipe 35 is connected to the pipe fitting 50 and communication is established between the pipe 50 and chamber 36 through the radial grooves 51 in the inner face of the fitting engaged by the washer 43 on the rod 42.

A yoke 52 is secured on the outwardly projecting end of the rod 42 and a slot 53 in the yoke receives a pin 54 secured on a throttle lever 55. The throttle lever 55 is mounted on a throttle shaft 56 rotatable in diametrically disposed openings in the engine intake pipe 58 and having a throttle butterfly valve 57 mounted thereon. With the rod 42 and diaphragm 37 normally urged to the left by the spring 49, the throttle valve 57 is normally retained in the wide open position as shown by full lines in the drawing.

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With the parts of the above control system in the normal position, as shown, and preferably with the pressure supply pipe 33 and chamber 19 in the distributor housing and the pipe 35 and chamber 36 in the pressure actuated device filled with engine lubrication oil, starting of the engine causes rotation of the distributor shaft 13 and engine lubricating oil pressure to be supplied to the pressure supply chamber 19 in the distributor housing 10 and the diagonal branch passage 32 in the distributor shaft 13 leading therefrom to the bore 22 in the shaft in which the valve stem 21 is normally positioned to block the inner end of this branch passage. With the valve stem 21 in the normal position the annular groove 22' therein registers the inner ends of the diagonal branch passages 30 and 31 and the pressure in the chamber 36 in the pressure actuating device is relieved through the pipe 35, the application and relief chamber 16 in the distributor housing, the diagonal branch passages 30 and 31, the relief chamber 20 in the distributor, vent opening 31' thereof and the pressure relief pipe 34 connected between this vent opening and the engine oil sump at substantially atmospheric pressure.

Upon an increase in the speed of the distributor shaft 13 driven by the engine to a value sufficient to cause the centrifugal fly-weight 26 on the valve stem 21 to move radially outwardly of the shaft 13 against the force of the spring 24 on the valve stem which is adjusted by the spring adjusting nut, the valve stem groove 22' will be moved initially into momentary register with the inner ends of all three diagonal branch passages 30, 31 and 32 in the distributor shaft, and then will be finally moved into register with the branch passages 30 and 32. When the valve stem groove 22' initially registers momentarily with all three branch passages, lubricating oil pressure from the pressure supply chamber 19 will be applied momentarily to the pressure relief chamber 20 and the pressure relief and application chamber 16 through the three branch passages in the shaft 30, 31 and 32 and when the valve stem groove 22' finally registers with only the branch passages 30 and 32 full lubricating oil pressure will be applied to the application and relief chamber 16 and pipe 35 to the diaphragm chamber 36 in the pressure operated throttle actuating device. The momentary application of pressure to both the pressure relief chamber 20 and application and relief chamber 16, the latter of which being connected by the pipe 35 to the diaphragm chamber 36 in the pressure actuated device, limits the increase of pressure in the diaphragm chamber 36. When the pressure on the diaphragm 37 increases to a value to overcome the spring 49 on the diaphragm and rod 42 connected thereto, the diaphragm will move the rod to the right and cause counterclockwise closing movement of the throttle lever 55, shaft 56 and butterfly valve 57 toward the closed position thereof shown in dash-and-dot lines in the drawing. This movement of the throttle valve limits further increase in the engine speed and occurs shortly after the centrifugal flyweight 26 moves the valve stem 21 from the normal position to prevent overshooting closing movement of the throttle valve 57 and when the engine speed falls to the limiting value substantially equal to that which caused outward movement of the flyweight 26, the weight and valve stem 21 will be returned to the normal position of the spring 24. Return movement of the valve stem 22 likewise causes the valve stem

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groove to register momentarily with all three of the diagonal branch passages 30, 31 and 32 in the shaft 13 and to finally register with the diagonal passages 30 and 31 extending from the application and relief chamber 16 and from the relief chamber 20 and limit the relief of pressure from the diaphragm chamber 36 in the pressure actuated throttle device to again prevent overshooting opening movement of the throttle valve 57 by action of the diaphragm return spring 49.

The torsional vibration applied to the distributor shaft 13 by the engine and by the conventional cam means provided thereon, not shown, and operating the ignition primary breaker contact points materially reduce the frictional and inertia forces between the valve stem 21 and wall of the shaft bore 22, in which this stem is mounted, and the synthetic rubber bushing 27 retained in compression between the valve stem and inner wall of the centrifugal flyweight 26 cushions and prevents torsional oscillations of the shaft from reaching this weight and also reduces bending of the valve stem, thus insuring free sliding movement and long life of the valve stem. The lubricating oil passing through the chambers 16, 19 and 20 in the distributor housing 10 and through the shaft bore 22 in which the valve stem 21 is mounted and through the diagonal branch passages 30, 31 and 32 provides adequate lubrication of the valve stem.

It will be noted that equal values of oil pressure are applied to the opposite annular wall surfaces of the groove in the valve stem 21 to provide balanced valve operation thereof and sliding movement of the valve stem from the normal position is caused only by action of the centrifugal flyweight 26 against the force of the return spring 24.

I claim:

1. In a speed controlling mechanism for an engine, a control valve housing having separate pressure supply, pressure relief and pressure controlling chambers, a shaft extending through the chambers and adapted to be rotated therein by the engine, said shaft having a bore extending diametrically through the shaft and separate pressure passages leading therefrom to each of the separate chambers, centrifugally unbalanced, fluid pressure balanced valve means slidable in the bore of said rotatable shaft to establish fluid communication between the pressure controlling chamber and each of said other chambers through the shaft passages, and spring means normally positioning the centrifugally unbalanced valve means to establish fluid communication between the pressure controlling chamber and one of said other chambers and opposing movement of the valve means from the normal position to establish fluid communication between the pressure controlling chamber and the other chamber.

2. A governor mechanism for an engine having a throttle, a fluid pressure source driven by the engine, and a pressure responsive device operatively connected to actuate said throttle, said governor mechanism comprising in combination a control valve housing, a rotatable shaft driven in accordance with the speed of said engine in said housing, said shaft having a diametrical bore defined therein and a number of separate passages including a pressure supply passage, a pressure control passage and a pressure relief passage communicating with said bore, a centrifugally actuated pressure application and relief control

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valve slidable in said bore and cooperating with the said shaft passages to establish fluid communication between said pressure control passage and each of said other two passages, adjustable resilient means on said valve means to oppose movement thereof by centrifugal force to one controlling position and normally urging the valve means to the other controlling position, said valve means being movable between pressure application and relief controlling positions solely by centrifugal action opposing the bias of said adjustable spring means, means for connecting said pressure control passage to said pressure responsive device and means for connecting said pressure supply passage to said engine fluid pressure source.

3. A governor mechanism for an engine having a throttle, a fluid pressure source driven by the engine, and a pressure responsive device operatively connected to actuate said throttle, said governor mechanism comprising in combination a control valve housing having a separate pressure supply chamber, a pressure control chamber and a pressure relief chamber, a shaft driven in accordance with the speed of said engine and rotatable in said housing relative to said chambers, said shaft having a diametrical bore in one of said chambers and separate passages leading from the bore to each of said chambers, a centrifugally actuated pressure application and relief valve slidable in said bore and cooperating with the said shaft passages to establish fluid communication between said pressure controlling chamber and each of said other two chambers through the said shaft passages communicating therewith, adjustable resilient means on said valve means to oppose movement thereof by centrifugal force to one controlling position and normally urging the valve means to the other controlling position, said valve means being movable between pressure application and relief controlling positions solely by centrifugal action opposing the bias of said adjustable spring means, means for connecting said pressure control chamber to said pressure responsive device and means for connecting said pressure supply chamber to said engine fluid pressure source.

4. A governor mechanism for an engine having a throttle, a lubricating oil sump and a source of lubricating oil pressure at a value above that of the sump, a pressure actuated device connected to the throttle for moving the latter toward closing position and including a spring normally urging the throttle toward open position and a pressure application and relief valve control means controlling the movement of the said throttle valve between the open and closed positions by said pressure actuated device, the combination wherein said pressure application and relief valve control means comprises a housing, a shaft rotatable in the housing in accordance with engine speed and having a diametrically disposed cross-bore therethrough, a centrifugally unbalanced valve stem extending through and slidable in said bore, said valve stem having an annular control groove intermediate the ends thereof, a governor weight on one end and a balance spring on the other end thereof, said housing and shaft having defined therein a separate connecting pressure supply passage, a pressure relief passage and a pressure application passage, said pressure application passage and said pressure relief passage being in continuous communication with the said valve control groove, said housing having an opening therein for connection of the said

pressure supply passage with the source of lubricating oil pressure, an opening enabling communication of the said pressure relief passage with the engine oil sump and a still further opening for connection of said pressure application passage with the pressure actuated device.

5. The combination in accordance with claim 4 above wherein said spring means on said valve stem is biased to position the control valve groove into communication with the pressure relief passage and opposes centrifugal movement out of communication with the relief passage and into communication with the pressure supply passage at a pre-determined value of engine speed to control the increase in pressure applied to the pressure actuator device and prevent overshooting during closing movement of the engine throttle.

6. In combination, a housing having a separate pressure supply chamber, a pressure relief chamber and a pressure controlling chamber defined therein, an engine driven shaft rotatable in the housing and having a diametrical bore extending therethrough in one of said chambers and a plurality of separate fluid passages each leading from said bore to respective ones of said housing chambers, a centrifugally unbalanced pressure balanced control valve movable in said shaft bore to pressure application controlling position and pressure relief controlling position, said control valve co-operating with said shaft passages to establish fluid communication between the said pressure controlling chamber and each of the said other chambers through certain of the said shaft passages and spring means opposing movement of said valve by centrifugal force to one controlling position and normally urging the valve means to the other controlling position.

7. In a control device for an engine having a throttle and a source of engine developed fluid pressure, resilient means retaining the throttle in open position, a pressure actuated device to close the throttle and centrifugally unbalanced valve means between said source of engine developed fluid pressure and said pressure actuated device, the combination wherein said centrifugally unbalanced valve means comprises a housing having a pressure supply passage adapted to communicate with said pressure source, a pressure application passage adapted to communicate with said pressure actuated device and a pressure relief passage contained therein, an engine driven pressure balanced centrifugal control valve cooperating with the said passages to control fluid communication therebetween and resilient means normally positioning said valve to relieve pressure from said pressure actuated device.

8. In a centrifugal control valve mechanism including a housing having a plurality of axially spaced chambers therein, a rotatable shaft extending axially of the housing and through said chambers, said shaft containing a walled valve bore extending generally transversely therethrough in one of said housing chambers and at least three fluid passages one end of each of which passages communicates with the valve bore and the other end with a respective one of said housing chambers, and a fluid pressure balanced centrifugal control valve extending through and slidable on the walls of the valve bore, said valve comprising a valve stem having a passage connecting groove intermediate the ends thereof, a governor weight on one end thereof and a balance spring on the other end thereof opposing movement of said valve by said weight.

9. In a centrifugal control valve mechanism, a housing, a shaft rotatable therein, said shaft hav-

ing a diametrically disposed valve bore extending therethrough, a valve stem slidable in the said bore of said shaft, said stem having an annular control groove intermediate the ends thereof, a centrifugal weight on one end of said stem and spring means on the other end thereof to oppose outward movement of the centrifugal weight relative to said shaft, said housing having a separate pressure supply passage, a pressure relief passage and a third passage adapted to be placed in communication with said pressure supply passage and said pressure relief passage, said shaft having a passage in communication with said third housing passage and with the said bore of said shaft continuously registering with said valve stem groove for all positions of movement of the stem, said shaft further having a separate supply passage and a relief passage communicating with the said bore of said shaft at spaced points therein and in separate communication with the said pressure supply passage and said pressure relief passage in the housing to establish communication between the said third passage and said relief passage in the housing and said shaft by action of the valve spring stem, to establish communication between the said third passage and the said pressure supply passage in the housing and said shaft upon maximum outward movement of said centrifugal weight and to establish communication between all of said housing passages and said shaft passages for intermediate positions of the valve stem and the centrifugal weight thereon.

10. In a speed control system for an engine having a throttle, a lubricating oil pump driven by the engine and an oil sump, a pressure responsive device operatively connected to actuate said throttle, a governor control mechanism connected between said lubricating oil pump and said pressure responsive device, said governor mechanism comprising in combination a control valve housing having defined therein a separate pressure supply chamber, a pressure control chamber and a pressure relief chamber, a shaft driven in accordance with the speed of said engine and rotatable in said housing relative to said chambers, said shaft having a diametrical bore therethrough located in one of said chambers and a number of separate passages leading from the bore to each of said chambers, a fluid pressure balanced centrifugal governor valve slidable in said bore and cooperating with the said shaft passages to establish fluid communication between said pressure controlling chamber and each of said other two chambers through the said shaft passages communicating therewith, said housing having an opening therein to permit connection of said pressure control chamber to said pressure responsive device, another opening therein to permit connection of said pressure supply chamber to said engine fluid pressure source, and a further opening therein to permit connection of said pressure relief chamber to said engine oil sump.

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