Feb. 21, 1939. R. S. SANFORD 2,148,305

THROTTLE CONTROLLING MECHANISM

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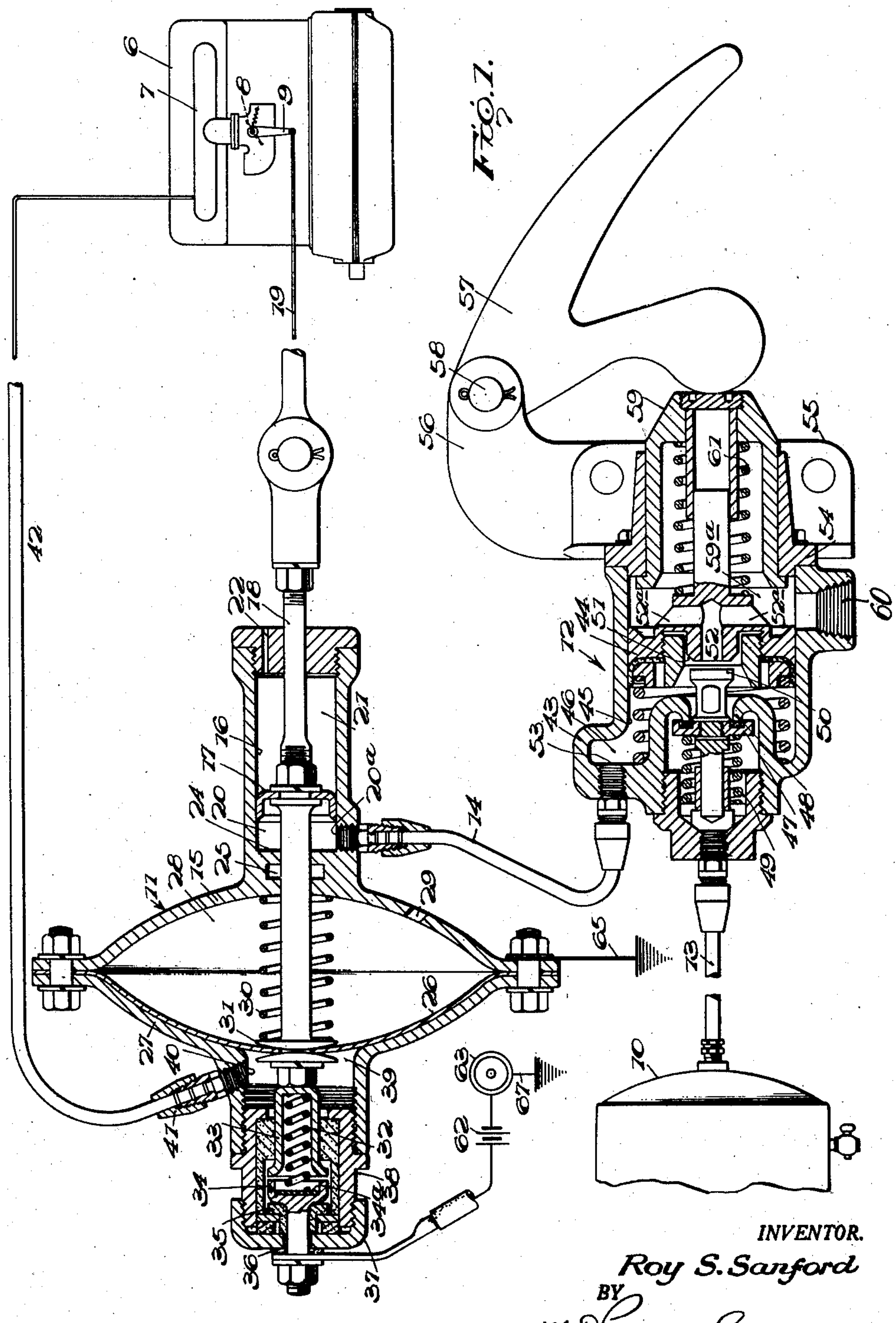

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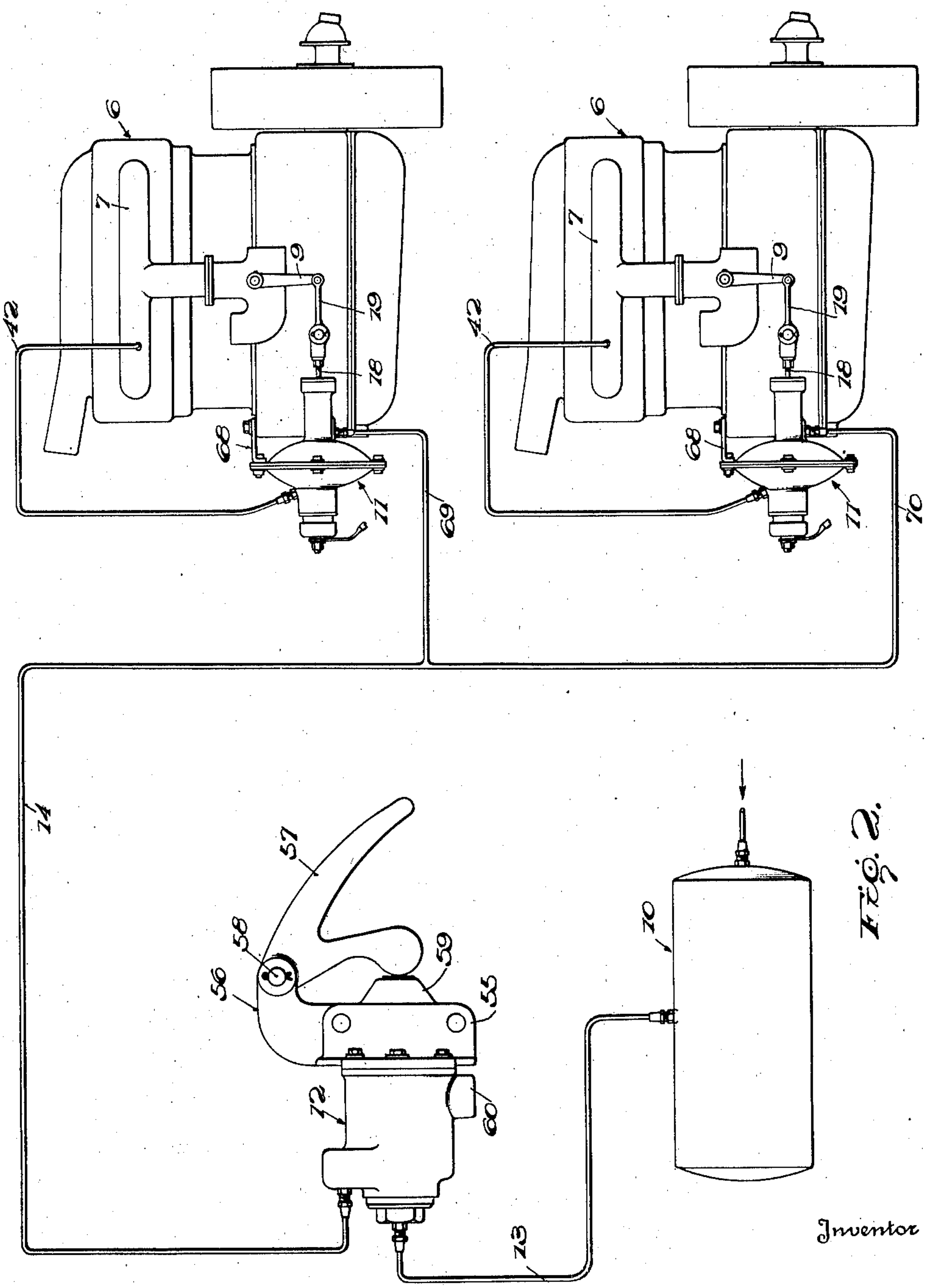

Fig. 2.

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THROTTLE CONTROLLING MECHANISM

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7 Claims. (Cl. 137—153)

This invention relates to speed-controlling mechanism and more particularly to mechanisms of this type especially adapted for internal combustion engines.

Various systems have been proposed previously for controlling the speed of engines, and particularly those of the internal combustion type, in such a manner as to automatically maintain the speed of one or a plurality of engines substantially constant regardless of changes in the load carried thereby. Many of these systems, however, have been complicated and costly due to the use of centrifugal governors of various types driven by the engine, and have been further complicated by mechanical linkage when adapted for operation from a remote control station.

It is, therefore, an object of the present invention to provide a novel and simple control system for an engine which will maintain a substantially uniform engine speed under varying load conditions.

Another object is to provide a control system of the above type which may be readily adapted for controlling the speed of an engine from a remote point.

A further object is to provide a control system for a plurality of engines so constituted as to automatically synchronize their speeds regardless of load variations, the synchronizing speed being selected by a single control member.

The above and other objects will appear more fully from the following detailed description when taken in connection with the accompanying drawings illustrating one form of the invention. It is to be expressly understood, however, that the drawings are utilized for purposes of illustration only, and are not intended to constitute a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings, wherein similar reference characters refer to similar parts throughout the different views:

Fig. 1 is a diagrammatic view, partially in section, of an engine and control system therefor constructed in accordance with the principles of the present invention, and

Fig. 2 is a diagrammatic view of a similar system operable to control the speed of a plurality of engines.

Referring more particularly to Fig. 1, in which is shown an engine 6, preferably of the internal combustion type, having an intake manifold 7, a throttle valve 8 and a throttle-operating member 9, the present invention is illustrated therein as embodying in general a fluid pressure reservoir 10, a throttle control mechanism 11, and a control valve device 12, the latter being connected to the reservoir 10 by a conduit 13 and to the control mechanism 11 through a conduit 14.

It is well known that when engines are operated under varying loads, constant manipulation of the throttle valve by the operator is necessary to maintain the engine speed constant under such conditions, and in an internal combustion engine of the type which draws an explosive mixture of fuel and air through its intake manifold past a throttle valve, the pressure in the intake manifold between the throttle valve and the motor tends to vary appreciably in response to either a change in engine speed or a change in the throttle valve setting. For example, consider an engine operating under constant speed and load with the throttle half open. Under this condition, there will be a substantially constant vacuum in the intake manifold. If we now increase the load on the engine, it will tend to slow down, with a consequent rise in pressure in the manifold, since the capacity of the engine as a vacuum pump is decreased. If the throttle is now opened wider, the engine can draw in more fuel and maintain its former speed and pumping capacity under the increased load, but it will be readily apparent that with the increased throttle opening, it will be unable to maintain the degree of vacuum formerly obtained in the intake manifold, it being well known that at constant engine speed, the intake manifold pressure is a function of the throttle valve opening, the pressure increasing as the throttle is opened and decreasing as the throttle is closed. By the present invention, novel means are provided for substantially eliminating the necessity for constant manipulation of the throttle valve by the operator, and use is made of variations in manifold pressure to accomplish this end, as will appear more fully hereinafter.

In the embodiment illustrated, see Fig. 1, such means is constructed in such a manner as to maintain a substantially constant selected engine speed regardless of variations in engine load, it being understood that the operator may select any constant speed desired and rely on the control mechanism to maintain this speed. The throttle control mechanism 11 may comprise a body member 15 having a cylinder bore 16 and a piston 17 slidably mounted therein and connected to the throttle-operating member 9 by means of a piston rod 18 and a pivotally-connected rod 19.

The bore 16 is divided by the piston 17 into a pressure chamber 20 and an atmospheric chamber 21, the former having a port 20a and the latter being connected to atmosphere through a port 22 in a cylinder bore cover 23, the cover acting as a guide for the piston rod 18. The left end of the cylinder bore has an end wall 24 bored to receive the piston rod 18, a piston rod sealing device 25 being mounted within the bore, for sealing the said rod. The left end of piston rod 18 is suitably connected to a diaphragm 26, which when clamped at its outer edge between the flanged end of the body member 15 and a similarly flanged end cover 27 forms an atmospheric chamber 28 on the right side of the diaphragm communicating with the atmosphere by a port 29. The piston rod 18 is biased toward the left by a spring 30 interposed between the left face of the body member 15 and a flanged portion 31 on the piston rod. The leftward bias on the piston rod is opposed by a relatively strong spring 32 interposed between a hollow contact member 33 suitably attached mechanically and electrically to the left end of rod 18 and an insulating washer 34a carried by a second contact member 34 attached by means of insulating washers 35 and 36 to a cover 37, the latter being connected to cover member 27 through a hollow sleeve 38 to form a chamber 39 on the left side of the diaphragm 26. A port 40 is provided in the wall of the chamber and the latter is connected to the intake manifold 7 of the engine 6 as by means of a connector 41 and a conduit 42. It will be evident from the foregoing description that a novel throttle valve-controlling mechanism has been provided, wherein a diaphragm responsive to intake manifold pressure is operatively connected with the throttle valve, while a piston responsive to pressure from another source is also connected to the throttle and adapted for actuation thereof, the throttle being normally maintained in closed position by means of springs 30 and 32. It is pointed out that the springs 30 and 32 are so constituted as to normally maintain the contact members 33 and 34 in non-contacting relationship as shown, for reasons which will appear more fully hereinafter.

In the embodiment of the invention shown, it will be noted that with the throttle in closed position, the diaphragm 26 rests against the right wall of the end cover 27, and that in this position, the effective area of the diaphragm acted on by intake manifold vacuum is relatively small, but increases as the diaphragm moves to the right. It will thus be seen that the diaphragm has a variable effective area which increases as the throttle valve is opened wider, and due to the relatively low vacuum existing in the intake manifold for large throttle valve openings, it is sometimes desirable to have the control of the throttle valve by the diaphragm more sensitive under the above conditions, and use of the diaphragm arrangement described makes it possible to proportion and arrange the parts to obtain a throttle control that is adaptable to the particular characteristics of a given engine. It is to be understood, however, that a piston and cylinder may be used in place of the diaphragm actuator without departing in any way from the spirit of the invention, it being well known that different types of engines have different characteristics and operate under different conditions, and it is further pointed out that the invention herein described may be modified to meet such charactertistics and conditions.

In order that actuation of the throttle valve 8 by the piston 17 may be properly controlled, a reservoir or source of fluid pressure 10 and a control valve 12 have been provided and, as previously described, the control valve receives air from the reservoir 10 through conduit 13 and is connected to piston chamber 20 by means of conduit 14 and port 20a. The control valve, as illustrated, is of the well known self-lapping type and is preferably constructed in a manner similar to that shown in the application of R. S. Sanford, Serial No. 88,889, filed in the United States Patent Office on July 3, 1936. The valve 12 of this type is shown as comprising a body member 43 adapted to slidably receive a piston member 44 in a hollow bore 45 to form a chamber 46 on the left side thereof, said chamber being closed at the left end by an air intake valve member 47, the latter being normally urged to closed position against an intake valve seat 48 by a spring 49. An exhaust valve portion 50 formed at the right end of the valve member 47 is adapted on movement of the piston to the left to engage a seat 51 formed on the piston and close off an exhaust port 52 in the piston. It will be readily apparent from the foregoing description that further movement of the piston to the left will open the intake valve 47 and admit fluid from reservoir 10 to chamber 46 through the conduit 13 and the open valve 47, and it will be further noted that if the piston is moved slightly to the right, it can assume a position such that valves 47 and 50 are closed and no fluid can enter or leave the chamber past the valves, the only other outlet from chamber 46 being through a port 53 in the wall of the chamber. A cover 54 having a valve mounting bracket portion 55 and a control member bracket portion 56 carries a control member 57 pivotally mounted on the portion 56 by a pin 58 and adapted to actuate a hollow plunger 59 slidably mounted in the cover 54. The cover and the plunger act as a closure for the cylinder bore 45 and form, in connection with the piston 44, an exhaust chamber 59a having an exhaust port 60 connecting it to atmosphere, the chamber being connected to the piston exhaust port 52 by passages 52a. Interposed between the piston 44 and the plunger 59 is a graduating spring 61, said plunger and spring acting as a connecting means between the piston 44 and the control member 57. It will be evident from the above description that a slight clockwise movement of control member 57 about pivot 58 will act through the sleeve 59 and spring 61 to move piston 44 to the left to a point where seat 51 engages exhaust valve 50, and that further clockwise movement of the control member will move the piston further to the left, causing the intake valve 47 to open and admit air from the reservoir 10 to chamber 46 of the valve. If the control member is now held stationary, the intake valve will be held open until the pressure acting on the left side of the piston is sufficient to overcome the pressure of spring 61 on the other side, when the piston will move to the right allowing the intake valve to close, and the pressures on opposite sides of the piston will balance upon movement thereof, the intake and exhaust valves remaining closed. The valve is now in lap position and will maintain a pressure in the chamber 46 corresponding to the degree to which the graduating spring is compressed by movement of the control member. Further compression or decompression of the spring will correspondingly increase or decrease the pressure in chamber 46, and in like manner any change of pressure in the chamber due to leakage will unbalance the pressures on the piston, causing the latter to actuate the valves to compensate for the change.

From the foregoing, it will be evident that two separate control means are provided for the throttle valve, one such means including the diaphragm 26 and being adapted to actuate the throttle through rods 18 and 19 and lever 9 in response to pressures in intake manifold 7 transmitted to the diaphragm 26 through conduit 42, and the other including piston 17 operatively connected to the throttle through rods 18 and 19 and lever 9 and being controlled by the valve 12, which as described is so constituted as to establish and maintain a predetermined pressure in piston chamber 20 in accordance with the position of control member 57 as determined by the operator. For example, if it is desired to run the motor at half open throttle, the operator moves the control member 57 in a clockwise direction to admit a predetermined pressure to chamber 20. Piston 17 will thereupon be moved to the right to open the throttle valve. With the engine running, the piston 17 has to overcome the force of spring 30 and also the force exerted by manifold vacuum on diaphragm 26, and the control member 57 may be set in such a position that the above forces will balcance at a point where the throttle is half open, and if the motor is carrying a constant load, the above forces will continue to be balanced. If the load is now decreased, the engine will immediately tend to speed up, resulting in a higher vacuum in the intake manifold. This change in vacuum will immediately unbalance the forces acting on the throttle, the higher vacuum acting on diaphragm 26 to move it to the left and close the throttle, thus tending to prevent racing of the engine and maintain its speed constant. In the same manner, an increase in load will tend to lessen the engine speed with a resultant decrease in intake manifold vacuum, and the consequent decrease in force exerted by the diaphragm 26 on the throttle valve rod 18 will allow piston 17 to open the throttle wider, thus holding the engine speed constant under the higher load. It is to be pointed out that during the above action, the pressure acting on the throttle-actuating piston 17 is constant for a given setting of the control member 57, any change of pressure in the chamber 20 due to movement of the piston 17 in response to variations in intake manifold vacuum being immediately compensated for by the self-lapping action of the control valve 12 as hereinbefore described. It will thus be seen that novel, efficient and simple means have been provided whereby a given engine speed may be selected and maintained under varying loads through the setting of a single remotely-situated control member by the operator.

In order that the operator or other persons may be advised when the throttle is closed to idling position, see Fig. 1, electrical contacts 33 and 34 have been provided, and as previously described, when the engine is inoperative and chambers 20 and 39 are at atmospheric pressure, the contacts are slightly separated as illustrated in the drawings, and the throttle valve 8 is preferably slightly open in order that when the engine is started, sufficient gaseous mixture will be admitted thereto for easy starting. As soon as the engine starts, however, a high vacuum is built up in the intake manifold, and this vacuum acting on the diaphragm 26 will close throttle 8 and force contacts 33 and 34 together, it being understood that the engine is then provided with fuel through the customary idling jet or passage, not shown. The contacts 33 and 34 are associated with an electrical circuit having a battery 62 and a light or other suitable indicator 63 connected thereto by a wire 64, contact 33 being grounded to the engine or frame through piston rod 18, housing 15 and a connection 65, and contact 34 being connected to the battery 62 by a wire 66, it being evident that with the indicator 63 grounded through a wire 67, closure of the contacts 33 and 34 will complete the circuit and by the consequent operation of the indicator 63 advise the operator or other interested persons that the throttle is set in idling position with the engine running. It is pointed out in this connection that with the control member 57 in off position, stoppage of the engine will allow spring 32 to open the contacts, and under these conditions, inoperativeness of the indicator will advise the operator that the engine has stopped.

It will be apparent to those familiar with the operation of engines that it is often desirable to synchronize the speeds of a plurality of similar engines operating under varying loads, preferably keeping all the engines under control of one operator. It will be readily understood by those skilled in the art that the engine control system hereinbefore described is particularly adapted to this type of control. Referring particularly to Fig. 2, wherein are illustrated a pair of engines 6 having individual intake manifolds 7 and associated throttle valves, not shown, adapted to be operated through levers 9, separate throttle control mechanisms 11 are attached to separate engines as by means of brackets 68, and operatively connected to throttle levers 9 by rods 18 and 19. It will be understood that throttle control mechanisms 11 are constructed in a manner similar to the mechanism illustrated in Fig. 1, and that a common control valve 12 supplies air under pressure to piston chambers 20 in the mechanisms through conduit 14 and branch conduits 69 and 70, the control valve receiving its air supply from a fluid pressure source 10 through conduit 13, as heretofore set forth. In like manner each actuating mechanism has its chamber 34 connected to a corresponding engine manifold 7 through conduits 42, and there is thus provided for each engine a throttle valve control mechanism including throttle-actuating means responsive to the pressure of the intake manifold of the engine and a second throttle actuator responsive to pressure supplied by the single control valve 12. From the above, it will be seen that for a given engine load condition, the operator may set the control member 57 to select a predetermined engine speed, and that thereafter variations in load on each engine will cause corresponding variations in intake manifold pressures and that the vacuum-operated portions of the throttle valve control mechanisms will thereafter automatically vary the throttle valve openings on the engines to maintain their speeds substantially synchronous.

While one embodiment of the invention has been described in considerable detail, it will be understood by those skilled in the art that other forms and applications of the invention may be readily used without departing from the spirit of the invention. Reference will, therefore, be had to the appended claims for a definition of the limitations of the invention.

What is claimed is:

1. In a control system for an engine of the type having an intake manifold and a throttle valve associated therewith, a source of fluid pressure, a fluid motor for actuating said throttle, conduits connecting said motor and source and a control valve associated therewith for setting and controlling the pressure in said motor, resilient means for biasing the throttle toward closed position, a throttle valve actuator responsive to intake manifold pressure for varying the position of said throttle means independently of the setting of said control valve and means for overcoming said resilient means and holding the throttle valve in partially opened position when the engine is stationary.

2. In a control system for engines of the type having an intake manifold and a throttle valve associated therewith, fluid pressure means including a control device for establishing and maintaining a predetermined setting of the throttle valve, means responsive to intake manifold pressure for controlling said throttle valve setting independently of said first named means and other means independent of said first named means for automatically opening the throttle valve when the engine stops.

3. In combination with a throttle control system for an engine having an inlet passage and a throttle valve associated therewith, a throttle valve control element, a source of fluid pressure, a fluid motor for urging said element toward throttle opening position, means including a control valve operable at a predetermined setting thereof to establish and automatically maintain a corresponding pressure in said motor, and means including a pressure responsive member connected to said element having an effective area variable with the degree of movement thereof and responsive to variations in inlet passage pressure for urging said element toward throttle closing position.

4. In a control system for an engine of the type having an intake manifold and a throttle valve associated therewith, fluid pressure means including a control device for establishing and maintaining a predetermined setting of the throttle valve, and means responsive to intake manifold pressure and including a pressure responsive member having an effective area variable with movement thereof for controlling said throttle valve setting independently of said first named means.

5. A control system for an engine of the type having an inlet passage and a throttle valve associated therewith comprising throttle valve actuating means and control means therefor, means for biasing said throttle toward open position when the engine is stationary, and means including a member responsive to inlet passage pressure for opposing the action of said biasing means and urging said throttle toward closed position on starting of the engine.

6. A control system for an engine of the type having an inlet passage and a throttle valve associated therewith, comprising throttle valve actuating means and control means therefor, means including a member responsive to inlet passage pressure for urging the throttle toward closed position, and means effective on an increase of pressure in said passage for partially opening said throttle valve.

7. In a control system for an engine of the type having an inlet passage and a throttle valve associated therewith, means including a member responsive to inlet passage pressure for biasing and moving said valve toward closed position, a fluid actuator for biasing and moving said throttle valve toward open position, and self-lapping control valve means operable for establishing and maintaining a predetermined pressure in said actuator regardless of the action of said first named means.

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