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HYDRAULIC CONTROL FOR THROTTLE VALVES

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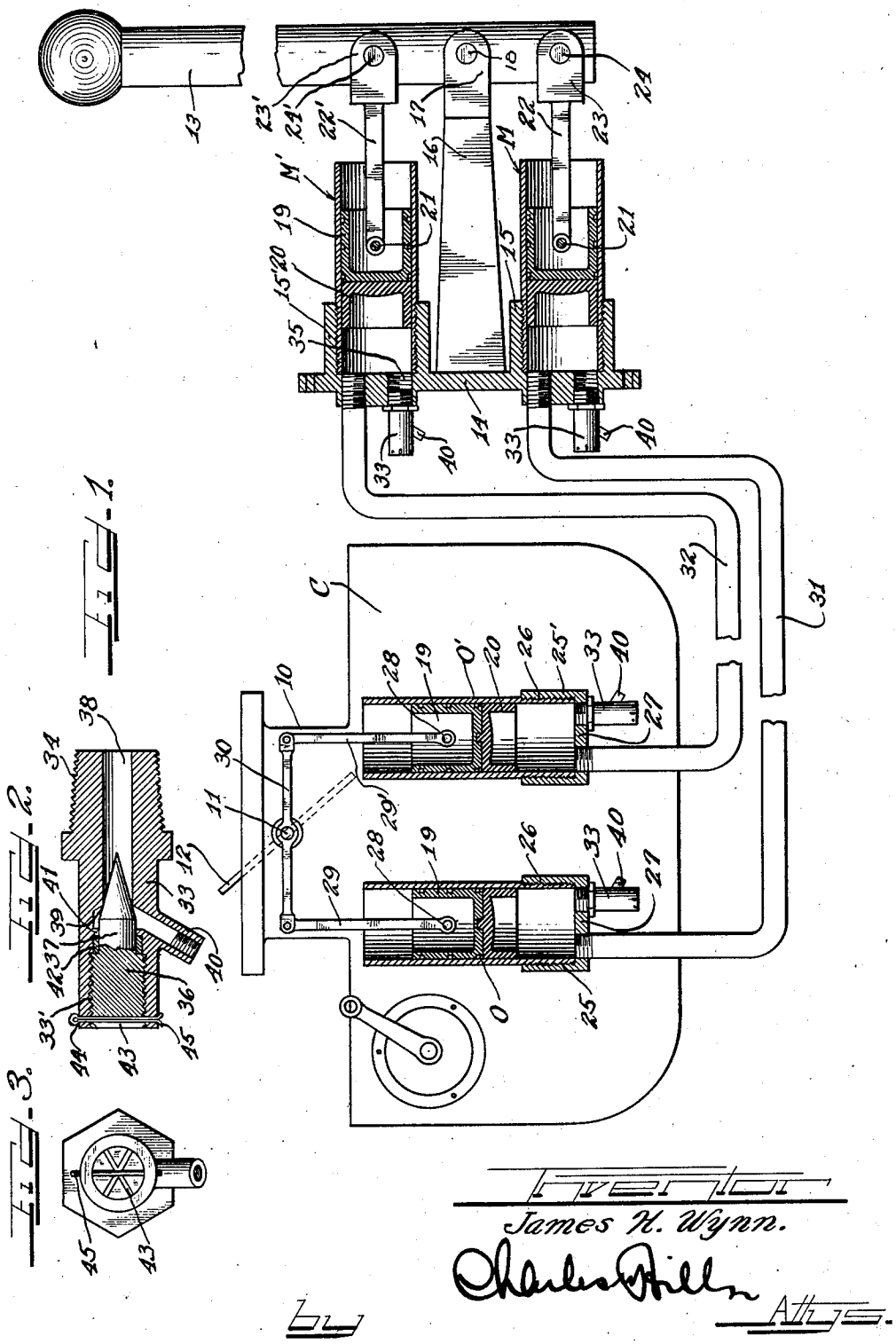


Fig. 1.

Fig. 2.

Fig. 3.

Inventor

James H. Wynn.

By Charles Fillon Atty.

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HYDRAULIC CONTROL FOR THROTTLE VALVES

James H. Wynn, Gary, Ind., assignor to Bendix Products Corporation, South Bend, Ind., a corporation of Indiana

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5 Claims. (Cl. 137—139)

This invention relates to hydraulic remote control for throttle valves, the invention being particularly useful in connection with the internal combustion engines of aeroplanes for securing accurate adjustment and maintenance of said adjustment of the throttle valves for supplying fuel to the engine.

An important object of the invention is to provide an improved hydraulic transmission between a control lever and the throttle valve of a carbureter which will positively and precisely translate the movement of the control lever into adjustment movement of the throttle valve and will accurately maintain such adjustment.

Another object of the invention is to provide a hydraulic transmission system whose operation is entirely independent of valves and in which movement of a control member in any direction is positively transmitted hydraulically to the carbureter throttle valve for corresponding adjustment thereof.

A further object is to rigidly support directly on the carbureter the elements which respond to the hydraulic fluid displacement and to connect such elements directly with the throttle valve shaft so as to eliminate all unnecessary joints or connections.

Another object of the invention is to use light but strong material for the hydraulic elements and to so construct them that they may be readily assembled or disassembled and replaced when worn out.

Still another object is to construct and arrange the hydraulic fluid displacing elements so that they may be easily and accurately moved but will maintain a seal against leakage.

Still a further object is to provide an improved valve structure for readily permitting the connection with the transmission system of pump means for replenishing or refilling the elements with fluid.

The invention also includes other features of construction, arrangement and operation in addition to those referred to above.

Referring now to the drawing,

Figure 1 shows more or less diagrammatically a carbureter in side elevation, and a controlling lever, and the intervening hydraulic transmission structure of which the cylinders and pistons and their supports are shown in vertical section;

Figure 2 is an enlarged diametral sectional view of the valve structure for attachment of the replenishing or refilling apparatus; and

Figure 3 is an end view of the valve structure showing particularly the locking means therefor.

On the drawing C represents a carbureter having the outlet 10 thru which extends the shaft 11 bearing a throttle valve 12, the carbureter being located close to the engine to be controlled.

A control lever 13 is located at the point from which control of the carbureter is to be effected. In an aeroplane this lever will be in the cockpit.

The hydraulic transmission system between the control lever and the carbureter is shown as comprising a pair of master cylinders M and M' and a pair of operating cylinders O and O'. These cylinders may be all of the same construction, each being preferably in the form of a tube of strong metal such as steel or steel alloy.

A supporting base or plate 14 is provided for the cylinders M and M' and has the annular lugs 15 and 15' extending therefrom into which the respective cylinders thread at their inner ends, the plate 14 thus forming heads for the cylinders. The plate 14 may be secured to the instrument panel in the cockpit of an aeroplane or to any other convenient support. Extending from the plate 14 midway between the cylinders is the arm 16 having the yoke 17 at its outer end receiving the lever 13, a bearing pin 18 extending through the yoke sides and the lever so that the lever is fulcrumed for swinging movement.

The piston structures for the various cylinders are also all alike, each structure comprising a guide head 19 and a piston cup 20, the cups being preferably of soft rubber and each being secured by its base against the inner end of the respective guide head 19, these guide heads being hollow and preferably formed of some light metal such as aluminum.

Each of the guide heads in cylinders M and M' carries a cross pin 21, these cross pins forming fulcrum supports for the inner ends of connecting rods 22 and 22' terminating at their outer ends in yokes 23 and 23' which receive the control lever 13 and are pivoted thereto by pins 24 and 24', the axes of these pins being equidistant from the axis of the fulcrum pin 18 for the lever. With this arrangement when the control lever is swung the pistons in the cylinders M and M' will be shifted in opposite directions through equal distances.

The operating cylinders O and O' are rigidly mounted and supported directly on the carbureter structure. As shown lugs 25 and 25' extend from the carbureter frame and are preferably formed integral therewith and these lugs have the cylindrical pockets 26 into which the cylinders O and O' thread at their lower ends, the base walls 27 of the lugs then forming heads for the cylinders. The guide heads 19 in these cylinders have each a cross pin 28, these pins forming fulcrum supports for the lower ends of connecting rods 29 and 29' which, at their upper ends, are pivoted to a cross lever 30 secured to the throttle valve shaft 11. The axes of the cylinders O and O' are equidistant from the axis of the throttle valve shaft 11 so that shift of the piston structure in one of the cylinders in one direction will be accompanied by shift of the piston structure in the

other cylinder in the opposite direction, but through the same distance. The various connections between the connecting rods and the piston structures and the controlling levers are designed to reduce friction and wear to a minimum and to eliminate any lost motion.

Extending between the cylinders M and O and secured to the heads of the cylinders by suitable connections is a duct 31, and a similar duct 32 extends between the cylinders M' and O', and these ducts may be the ordinary brass or copper tubing well-known in the aviation or automobile vehicle art.

The cylinders and tubes are entirely filled with a suitable fluid whose co-efficient of expansion under temperature changes is substantially negligible and which will not freeze in any of the temperatures to which it may be subjected while in service. In the arrangement shown the control lever 13 is in a vertical or midway position and the throttle valve 12 is in substantially half open position and the piston structures are in intermediate position in their respective cylinders. If the control lever 13 is now shifted or swung in clockwise direction, the piston structure within the cylinder M will be shifted inwardly to displace the fluid between the piston cup 20 and the head 14 and force it to flow through the tube 31 into the cylinder O so that the piston structure in cylinder O is raised and the lever 30 rotated in clockwise direction to cause further opening movement of the throttle valve 12. At the same time the piston structure in cylinder M' will be shifted outwardly with the control lever and the piston structure in cylinder O' will be shifted downwardly by the lever 30, the fluid being displaced from the cylinder O' and flows through the duct 32 into the cylinder M'. As the distances between the lever fulcrum axis 18 and the axes of the connecting rod connections 24, 24' with the lever are the same and of the same length as the distances from the axis of the throttle valve shaft 11 to the connections of the lever 30 with the connecting rods 29 and 29', the piston structure in cylinder M' will move outwardly in accordance with the flow of fluid into the cylinder M' from the cylinder O' and the piston structures in these cylinders will therefore be subjected neither to pressure nor to suction.

If the control lever 13 is swung in counter clockwise direction, the fluid will be positively displaced out of the cylinder M' to flow through the duct 32 into the cylinder O' for positive rotation of the shaft 11 and adjustment of the throttle valve 12, the fluid then flowing from the cylinder O through duct 31 and into cylinder M as the piston structure in cylinder M moves outwardly and the piston structure in cylinder O moves at the same rate inwardly. I thus provide a perfectly balanced hydraulic transmission by means of which any movement of the control lever is positively transmitted to the carburetor throttle valve and an adjustment once made will be maintained under all conditions of vibration, variations of temperature, or other conditions affecting present types of throttle control, and the system is self-braking.

The cup-shaped pistons 20 being of soft rubber will intimately fit in the cylinders and will prevent any leakage, the heads 19 of light material such as aluminum serving merely to support the piston cups and assist in guiding them during reciprocation therein. Repairs or replacements can very readily be made. An entire cylinder structure can be readily unscrewed from its supporting base, and by pulling out any of the pivot pins at the outer ends of the connecting rods, the corresponding piston structure can be withdrawn from its cylinder. To facilitate filling of the piston with the hydraulic fluid after installation of the piston, or for refilling at any time, a preferred form of valve structure is provided for the cylinders. This valve structure is best shown in Figures 2 and 3 and comprises a cylindrical body 33 having the threaded end 34 for fitting the openings 35 one of which is provided in the head of each of the cylinders. The outer end of the body 33 has the bore 33' for receiving the head 36 of a needle valve 37, the head having threaded connections in the bore so that by turning thereof the needle valve may be shifted axially in the bore. At its inner end the body has the bore 38 of smaller diameter and between the bores is provided the valve seat 39 for the needle end of the valve. A nipple 40 extends from the body 33 and communicates with the inner end of the valve chamber 33' and this nipple is threaded at its outer end for attachment to a conductor.

Between the valve head and point the body 33 has the annular internal shoulder 41 between which and the valve head is interposed a rubber gasket or bushing 42 forming a seal against the escape of fuel past the valve head. In its outer end the valve head has a number of diametrally extending slots 43 for engagement by a suitable tool such as a screw driver for turning and adjusting the valve, the body at its outer end having a series of openings 44 for receiving a cotter pin 45 for extending through one of the screw driver slots to thus lock the valve in adjusted position.

A valve structure is provided on each cylinder, and by means of a suitable pump structure (not shown) hydraulic fluid is pumped into the cylinders. For example, the cylinders O and M may first be filled and to do this the lead from the pump is connected with the nipple 40 of the valve for the cylinder M and this valve and the valve for the cylinder O are opened, the latter valve being preferably opened only a small distance. As the pump is now operated, fluid will be pumped to fill the cylinders and the duct 31 and any air will be forced out through the nipple of the valve for the cylinder O. A pipe might be connected with the nipple 40 of the valve of cylinder O and extended into a vessel into which the fluid will flow, and, as soon as there are no longer any air bubbles rising in the vessel, the operator knows that the cylinders and duct are entirely filled with fluid. The valves are then closed and the pump mechanism is disconnected and applied to the other cylinders M' and O' for filling in the same manner.

I have thus produced a reliable and efficient system adapted particularly for remote control of aircraft engine carbureter throttles and which permits of a positive adjustment of engine speeds for purposes of synchronization where the aircraft has more than one engine, the adjustment being with minimum effort, and when once made being maintained under all conditions of vibration, torsional weave, variations of temperature, or other conditions which might tend to disturb the adjustment. I have furthermore provided a system in which no valves are depended upon for adjustment operation, and a system in which the number of connections has been reduced to a

minimum and in which wear is reduced to a minimum.

It should be noted that in the system shown there is a remarkable factor of safety in that, should a leak or break occur in one side of the system, proper and safe control of the carbureter valve can be accomplished by the other side of the system until repairs can be made. For example, suppose that the line or duct 32 should become leaky or broken, then swing of the control lever 13 in clockwise direction will, as before, shift the piston in master cylinder M to displace the fluid for movement of the piston in operating cylinder O and corresponding opening movement of the throttle valve, and when the lever is swung in the opposite direction the piston in cylinder M, when pulled outwardly, will cause suction on the fluid in line 31 and downward movement of the piston in cylinder O for closing movement of the throttle valve.

I do not desire to be limited to the exact construction, arrangement and operation shown and described as changes and modifications may be made without departing from the scope or spirit of the invention as defined in the appended claims.

I claim as follows:

1. In combination, a throttle valve for an internal combustion engine, said valve including a casing, an operating cylinder rigidly mounted on said valve casing and having a pressure responsive structure connected with said throttle valve for opening said throttle valve, a second operating cylinder rigidly mounted on said valve casing and having a pressure responsive structure connected with said throttle valve for closing said throttle valve, a pair of master cylinders at a point remote from said valve each having a pressure creating structure, a control lever connected with both of said master cylinder piston structures, conduits connecting each of said master cylinders with one of said operating cylinders, said cylinders and conduits being filled with hydraulic fluid, whereby movement of said control lever in either direction and the pressure creating structures connected therewith will be transmitted by said fluid positively to the pressure responsive structures of said operating cylinders for positively moving said valve in both directions.

2. In combination, a throttle valve having a casing, an operating lever for said valve, a pair of operating cylinders both secured to said casing and each having a piston connected with a separate end of said lever, a pair of master cylinders each having a piston, a pivoted control lever connected on opposite sides of its pivot with both of the pistons of said master cylinder, and a conduit connecting each of said master cylinders with one of said operating cylinders, said cylinders and conduit being filled with hydraulic fluid whereby movement of the master cylinder pistons by said control member will be transmitted by said fluid to the pistons of the operating cylinders and to said operating lever for actuation of said valve.

3. In combination, a throttle valve having a casing and having a shaft, a lever secured to said shaft for rotating said shaft to open and close said valve, a pair of equal dimension fluid motors mounted rigidly on said casing and having their axes respectively offset on opposite sides of the axis of said shaft, pistons in said cylinders, piston rods pivotally connected to said cylinders and to opposite ends of said lever at points equally distant from the axis of said shaft, a pair of master cylinders each being of the same dimension as said fluid motors and both being located at points removed from said fluid motors, a support for said master cylinders, an arm extending from said support between said master cylinders, a hand throttle control lever pivoted on said arm, pistons for said master cylinders, piston rods connected pivotally to each of said master cylinder pistons and at their opposite ends pivotally connected to said control lever at points on opposite sides of and equally distant from the pivotal connection of said control lever with said arm, and conduits connecting each of said master cylinders respectively with one of said fluid motors, said cylinders, motors and conduits being filled with hydraulic fluid, whereby movement of said control lever in either direction will be positively transmitted by the hydraulic link to cause a corresponding movement of the valve lever.

4. In combination, a throttle valve having a casing and provided with a valve shaft, a pair of fluid motors mounted rigidly on said casing and each having a piston connected with said valve shaft, a pair of master cylinders both located at points removed from said casing, a pivoted control lever, a pair of pistons for said master cylinders each connected with said control lever and arranged to be moved in opposite directions in said master cylinders when said lever is moved about its pivot, conduits connecting said master cylinder with said fluid motors, said cylinders, motors and ducts being filled with hydraulic fluid, whereby fluid displaced by inward movement of one of the pistons in its master cylinder upon operation of said control lever in either direction will cause corresponding movement of one of the pistons in its operating cylinder and corresponding movement of said valve shaft and valve, and controlled inlets and outlets for each of said cylinders arranged to be connected with pump structure for supplying fluid to said cylinders or to be connected for the outflow of air and superfluous fluid from said cylinders.

5. In combination, a throttle valve having a casing and provided with a valve shaft, a pair of fluid motors mounted rigidly on said casing and each having a piston connected with said valve shaft, a pair of master cylinders both located at points removed from said casing, a pivoted control lever, and a pair of pistons for said master cylinders each connected with said control lever and arranged to be moved in opposite directions in said master cylinders when said lever is moved about its pivot, conduits connecting said master cylinder with said fluid motors, said cylinders, motors and ducts being filled with hydraulic fluid, whereby fluid displaced by inward movement of one of the pistons in its master cylinder upon operation of said control lever in either direction will cause corresponding movement of one of the pistons in its operating cylinder and corresponding movement of said valve shaft and valve.

JAMES H. WYNN.