Nov. 15, 1949 J. E. WITZKY ET AL 2,488,361

HYDRAULIC CONTROL MEANS FOR INTERNAL-COMBUSTION ENGINES

Filed June 30, 1947 2 Sheets-Sheet 1

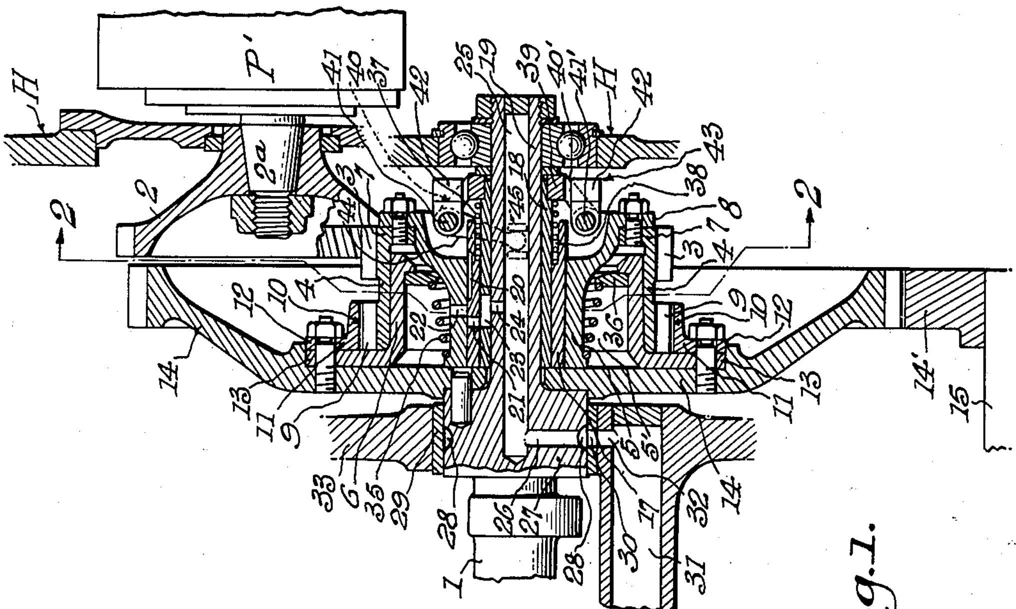


Fig. 1.

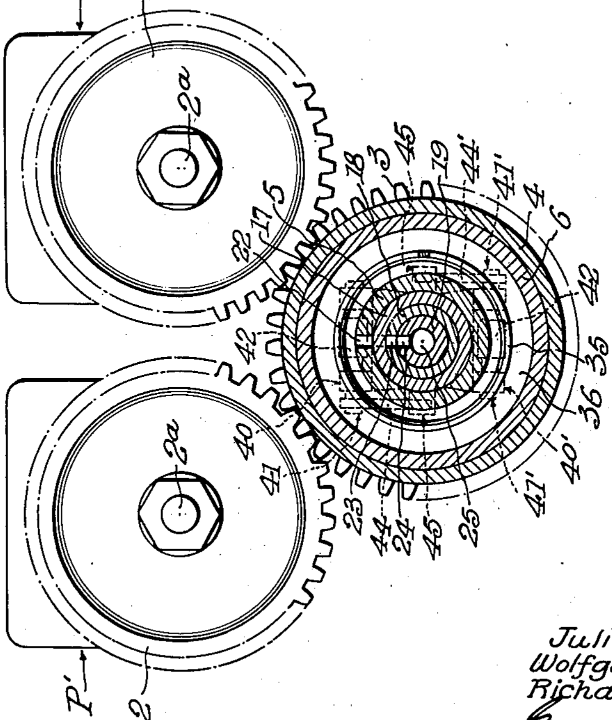


Fig. 2.

Inventors
Julius E. Witzky
Wolfgang S. Lang
Richard J. Jakob

By George W. Gardes.
Jeffrey N. Cross

Attorneys

HYDRAULIC CONTROL MEANS FOR INTERNAL-COMBUSTION ENGINES

Filed June 30, 1947 2 Sheets-Sheet 2

Fig. 4.

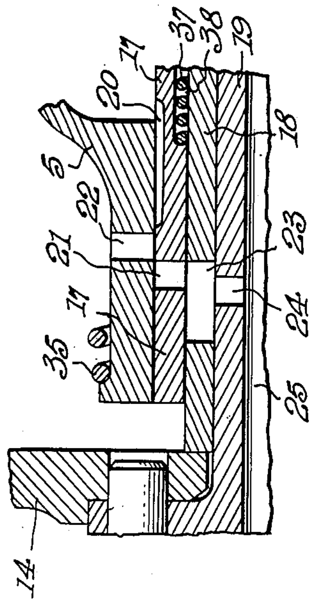


Fig. 6.

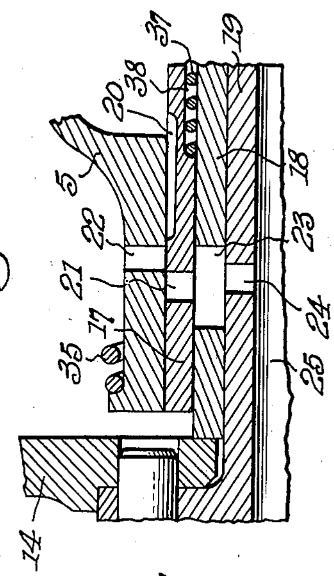


Fig. 3.

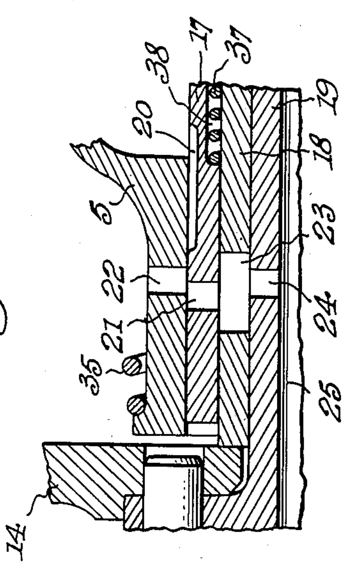
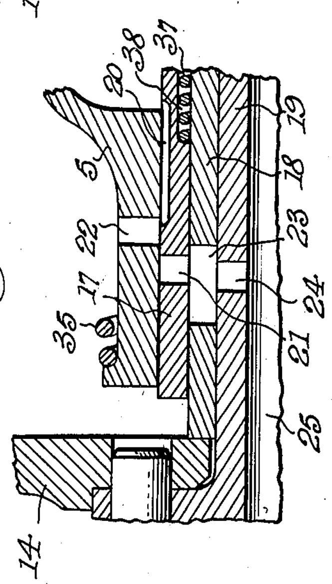


Fig. 5.



Inventors
Julius E. Witzky
Wolfgang S. Lang
Richard J. Jakob

By George W. Sardes
Jo[illegible] H Crown

Attorneys

Patented Nov. 15, 1949

2,488,361

UNITED STATES PATENT OFFICE

2,488,361

HYDRAULIC CONTROL MEANS FOR INTERNAL-COMBUSTION ENGINES

Julius E. Witzky, Stuttgart-Cannstatt, and Wolfgang S. Lang and Richard J. Jakob, Wendlingen-Neckar, Germany, assignors to the United States of America as represented by the Secretary of War

Application June 30, 1947, Serial No. 758,032

2 Claims. (Cl. 74—395)

1

This invention relates to a mechanism for controlling the operation of the fuel injecting pumps of Diesel and similar engines.

One of the objects of this invention is to provide an hydraulically controlled mechanism for varying the time of fuel injection of Diesel and other internal combustion engines in response to variations in engine speed.

Another object of this invention is to provide an hydraulically controlled fuel injection mechanism embodying a governor assembly operatively associated with a sleeve valve for automatically controlling the time of fuel injection in accordance with engine speed.

Another object of this invention is to provide an hydraulically controlled mechanism for adjusting the fuel injection pumps of Diesel and other internal combustion engines in a manner to automatically advance or retard fuel injection relative to valve action by imparting rectilinear movement to a helical driving gear in constant mesh with the driven gears of a pair of fuel injection pumps.

Another object of this invetion is to provide a gear mechanism responsive to variations in engine speed and in driving relation with the gears of a pair of fuel injection pumps, the gear mechanism being operable longitudinally as engine speed varies to effect adjustment of the fuel injection pumps relative to valve action.

Another object of this invention is to provide a gear mechanism responsive to variations in engine speed and in constant mesh with the gears of a pair of fuel injection pumps, the gear mechanism being operable longitudinally through the instrumentality of a governor assembly, hydraulic pressure and spring action to adjust the operation of the fuel injection pumps with respect to valve action.

With the above and other objects in view the instant invention consists in certain details of construction and operation of parts which will hereinafter be described and shown in the accompanying drawings in which:

Figure 1 is a fragmentary, vertical, longitudinal section through the improved hydraulically controlled fuel injection mechanism and illustrating the position of the components of such mechanism when the engine is idle or about to be started;

Figure 2 is a vertical, transverse, sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a fragmentary, sectional elevation showing details of the hydraulically controlled fuel injection timing mechanism and illustrating the relative position of the parts of the mechanism as the speed of the engine is increased;

2

Figure 4 is a view similar to Figure 3, but showing the relative position of the parts when the engine is operating at a constant maximum speed following the acceleration of Figure 3;

Figure 5 is a view similar to Figures 3 and 4, but showing the relative position of the parts responsive to a decrease in engine speed; and

Figure 6 is a view similar to Figure 4, but showing the relationship of the parts when the engine is operating at a constant decelerated speed.

Referring more specifically to the drawings, H represents the housing and P and P′ the fuel injection pumps of a Diesel or other type of internal combustion engine (not shown). Fuel injection pumps P and P′ are driven in accordance with variations in engine speed from cam shaft **1** and through helical gears **2** and **3**. Helical gears **2** are mounted on the shafts **2*a*** of pumps P and P′, as clearly shown in Figure 2 of the drawings. Helical gear **3**, which has a wide face, is formed exteriorly and at one end of an inwardly extending collar **4** carried by hub **5**. Collar **4** is slidably mounted on bushing **6** and is provided with an inwardly extending flange **7** at its outer end adapted to be attached by means of suitable fastening elements to the outwardly extending flange **8** of hub **5**, as clearly shown in Figure 1 of the drawings. This construction, in conjunction with elements hereinafter to be referred to, defines a chamber **5′** for the operating fluid.

Splines **9** are provided exteriorly of and adjacent to the inner end of collar **4**. These splines slidably engage keyways **10** formed on the inner periphery of annulus **11**, said annulus being provided with a flange **12** which in connection with upturned flange **13** of bushing **6** is secured to gear **14** which latter is in driving relation with gear **14′** carried by the drive shaft **15** of the engine.

Hub **5** is slidably mounted on the sleeve **17** which in turn is slidably positioned on bushing **18** fixedly mounted on the reduced portion **19** of cam shaft **1**. Sleeve **17** is provided on its outer periphery and substantially centrally thereof with a longitudinally extending groove **20** for a purpose hereinafter to appear. Sleeve **17** is also formed with a port **21** disposed adjacent its inner end. A port **22** is formed in hub **5** adjacent its inner end and out of alignment with port **21** in sleeve **17**. Port **21** in sleeve **17** throughout the movement of said sleeve is adapted to remain in communication with an elongated, longitudinally extending slot **23** formed in bushing **18** and also with port 24 formed in the reduced portion 19 of the cam shaft 1, as clearly shown in Figures 3 to 6 of the drawings. The reduced end portion 19 of cam shaft 1 is formed anteriorly with passageway 25 for the operating fluid. Passageway 25 at its inner end opens into a radially extending passage 26 formed in the hub 27 of cam shaft 1 (Figure 1). Passage 26 leads outwardly from passageway 25 to a circular groove 28 formed on the outer periphery of the hub. A bushing 29 for hub 27 is provided with a port 30 in communication with circular groove 28. A longitudinally extending duct 31 formed in the engine frame communicates with a suitable source of operating fluid such as oil, or the like. Duct 31 is in communication with port 32 which registers with port 30 in bushing 29.

A compression spring 35 encircles hub 5 and at one end contacts ring 36 mounted in the outer end of bushing 6. At its opposite end spring 35 is attached to the inner end of hub 5 so that the latter when moved outwardly under the influence of hydraulic pressure does so against the action of spring 35 for a purpose which will hereinafter appear. Another compression spring 37 encircles the outer end of bushing 18 and is adapted to engage at its inner end in a groove 38 formed in the inner periphery and at the outer end of sleeve 17. The outer end of spring 37 bears against a ring 39 located at the outer end of bushing 18. Spaced arms 40 and 40' extend outwardly and inwardly from the upper and lower portions respectively of ring 39. These arms 40 and 40' at the outer ends provide bearings for upper and lower shafts 41 and 41'. Each of the shafts 41 and 41' carries a counterweight 42. The two counterweights constitute components of a governor assembly 43 including operating levers 44 and 44' and ears 45. One end of operating lever 44 is fixedly secured to one end of upper shaft 41, which lower shaft 41' is fixedly attached to one end of operating lever 44'. Levers 44 and 44' are enlarged at their free ends and are adapted to extend into the ears 45 provided on opposite sides of slidable sleeve 17 for a purpose hereinafter to appear.

Having described the structural details of the subject invention, its operation is as follows:

As engine speed develops, counterweights 42 of governor assembly 43 move outwardly and in so doing rotate shafts 41 and 41' and oscillate the free ends of levers 44 and 44' engaging ears 45 carried by sleeve 17. This oscillatory movement of the levers causes sleeve 17 to slide outwardly on bushing 18 against the action of spring 37 until port 21 in said sleeve 17 is brought into communication with port 24 of hub 5. Registration of the ports in this manner permits operating fluid to flow from the source of supply through ducts 31 and 32, port 30 of bushing 29 and into circular groove 28 formed in hub 27 of cam shaft 1 from whence it passes through radially extending passageway 26 to the longitudinally extending passageway 25 in the reduced portion 19 of shaft 1. From passageway 25 the operating fluid flowing through aperture 24 in the reduced end portion 19 of cam shaft 1, port 23 in bushing 18 and port 21 in the slidable sleeve 17 enters chamber 5' through port 22 formed in the hub 5. Operating fluid entering chamber 5' under pressure causes hub 5 to be moved outwardly on sleeve 17 against the action of spring 35. This movement of hub 5 effects outward actuation of collar 4 with consequent outward movement of spiral gear 3. The spiral wide face of the helical gear 3 moving outwardly in mesh with the helical gears 2 advances the position of said gears for different longitudinal positions of helical gear 3 and thus changes fuel injection timing relative to the valve action of the engine as will be understood without further discussion.

In response to the pressure exerted by the operating fluid within chamber 5', hub 5 continues to move outwardly until port 22 in said hub 5 and port 21 in sleeve 17 are disaligned (Figure 4), whereupon movement of the hub and the helical gear carried thereby terminates and in consequence the fuel injection timing is maintained constant until a change of engine speed occurs. As engine speed decreases sleeve 17 actuated by the governor is positioned so as to establish communication between port 22 in hub 5 and the groove 20 in sleeve 17 (Figure 5). As port 22 and groove 20 are placed in communication, the fluid in chamber 5' is permitted to escape. This bleeding process reduces the pressure within said chamber 5' sufficiently to permit spring 35 to move hub 5 inwardly thus retracting helical gear 3 relative to gear 2 and retarding the operation of the fuel injection pumps as will be understood without further discussion.

In the light of the preceding discussion it is manifested that hub 5 will be moved back and forth in accordance with the action of the governor and the position of sleeve 17, in other words in response to variations in engine speed. The hub 5 follows sleeve 17 in both directions inwardly and outwardly dependent upon whether fluid under pressure is allowed to enter the chamber 5' or whether the fluid in the chamber is discharged through groove 20. When fluid under pressure is trapped in chamber 5' the hub 5 will be maintained in a predetermined position until the governor actuates the sleeve to permit the escape of the fluid from said chamber 5', whereupon the hub is moved rearwardly by its actuating spring until port 22 in the hub and port 24 are again brought into registration.

In conclusion it will be seen that the subject invention provides a simple mechanism for imparting forward and rearward movement to hub 5 and its gear 3 in order to advance or retard the timing action of the fuel injection pumps.

Having thus described our invention, what we claim as new and wish to secure by Letters Patent is:

1. A control mechanism comprising in combination, a cam shaft driving member, driven instrumentalities including a helical gear driven from the driving member, a chamber adapted to be placed in communication with a fluid under pressure, a hub slidably mounted on the cam shaft, the said hub including a collar and having a port therein, the hub and collar forming a portion of the chamber and adapted to be slidably actuated by the fluid under pressure in the chamber, a helical gear on the outer periphery of and at one end of the collar and meshing with the helical gear of the driven instrumentalities responsively to actuation of the hub, a slidably mounted sleeve including a port adapted to be actuated to align the port in the hub for admitting fluid under pressure into the chamber and to place the port in the sleeve out of alignment with the port in the hub, whereby the chamber is cut out of communication with the fluid under pressure, and a governor mounted to actuate the sleeve in accordance with variations in speed of the cam shaft.

2. A control mechanism comprising a cam shaft driving member having a hollow end position provided with an aperture, a gear rigidly connected to the cam shaft, a flanged bushing connected to the gear, driven instrumentalities including a helical gear driven from the driving member, a chamber adapted to contain fluid under pressure, and speed-responsive mechanism connecting the driving member and the driven instrumentalities including a bushing having a port therein fixedly mounted on the hollow end portion of the cam shaft with the aperture in the said hollow end portion of the shaft registering with the port in the bushing, a sleeve having a port therein slidably mounted on the bushing, a hub provided with a collar and slidably mounted on the said bushing and upon the sleeve, the hub having a port therein and being adapted to be actuated by the fluid under pressure in the chamber, a helical gear on the hub meshing with the helical gear on the driven instrumentalities and adapted to be actuated by the hub for selectively advancing and retarding actuation of the helical gear on the driven instrumentalities, and a governor mounted to actuate the sleeve automatically for aligning the port therein with the

port in the hub whereby fluid under pressure adapted to flow in the hollow end portion of the cam shaft may pass through the aperture therein, enter the port in the bushing, thence through the port in the sleeve and into the chamber through the port in the hub for actuating the hub, the governor also being adapted to actuate the sleeve for moving the port therein out of alignment with the port in the hub, whereby the chamber is cut out of communication with the fluid under pressure in accordance with variations in speed of the cam shaft.

JULIUS E. WITZKY.
WOLFGANG S. LANG.
RICHARD J. JAKOB.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,764,493	Ball	June 17, 1930
2,001,843	Kasley	May 21, 1935
2,107,070	Fleury	Feb. 1, 1938