March 27, 1945. H. C. EDWARDS 2,372,180

ANGULARLY ADJUSTABLE COUPLING

Filed June 12, 1941 2 Sheets-Sheet 1

Fig. 1.

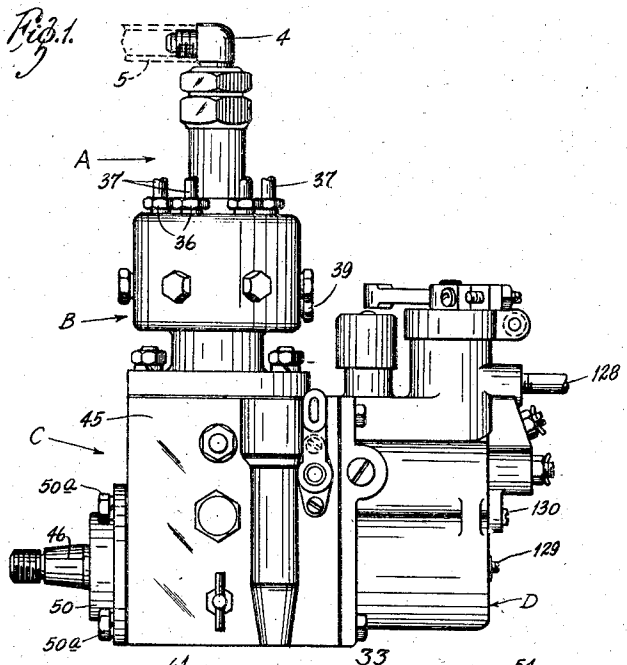


Fig. 2.

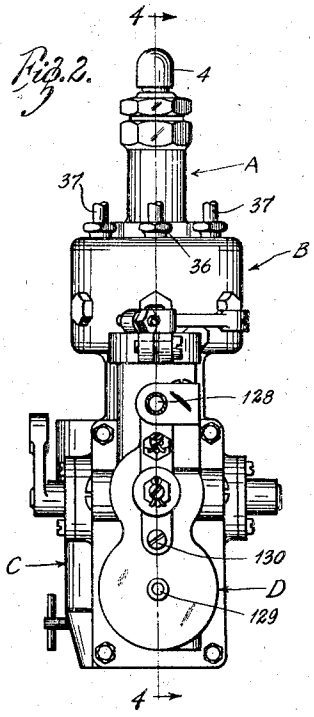


Fig. 4.

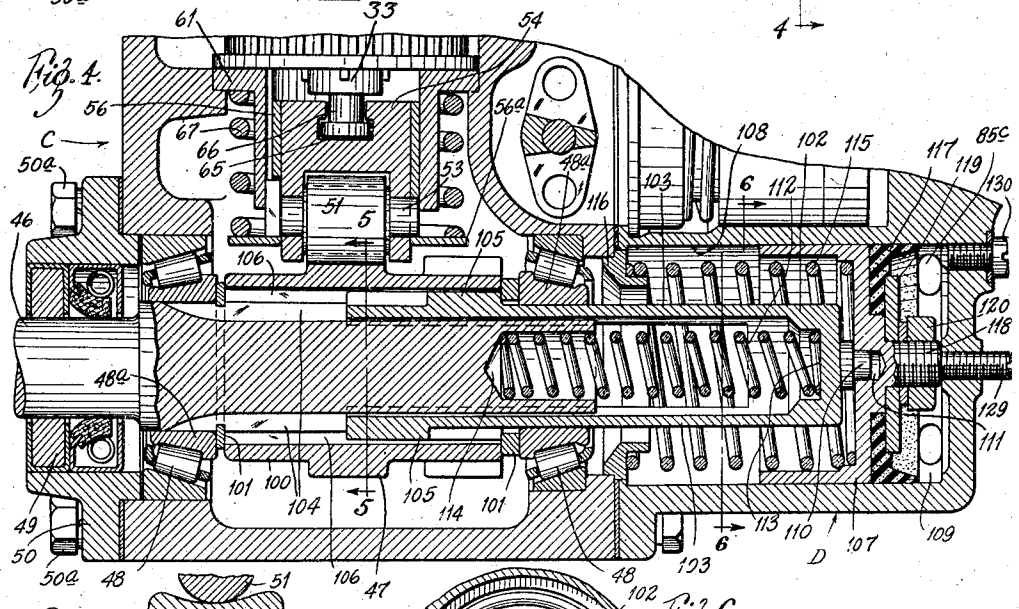


Fig. 5.

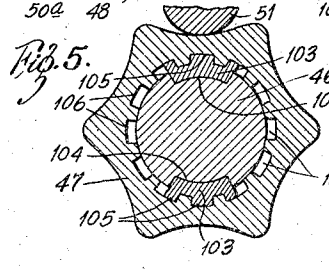
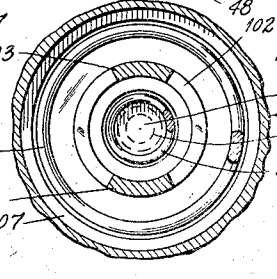


Fig. 6.



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Filed June 12, 1941 2 Sheets-Sheet 2

Fig. 3.

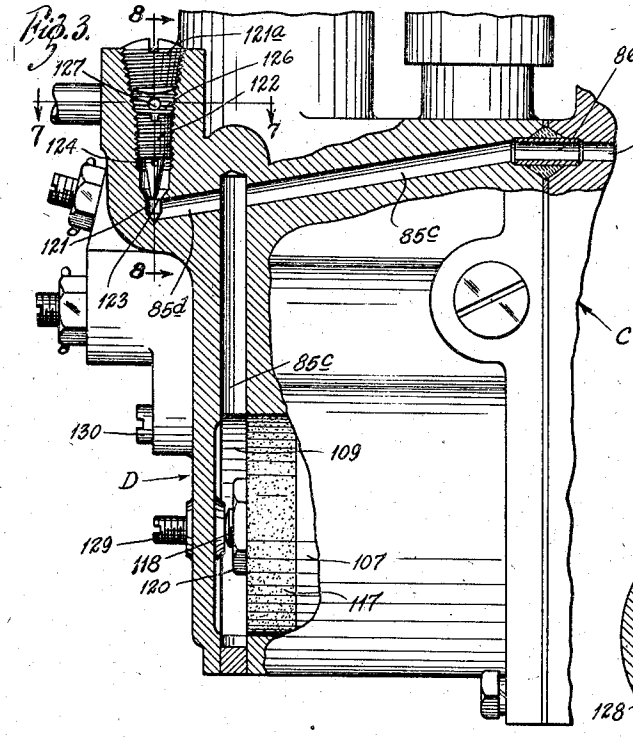


Fig. 7.

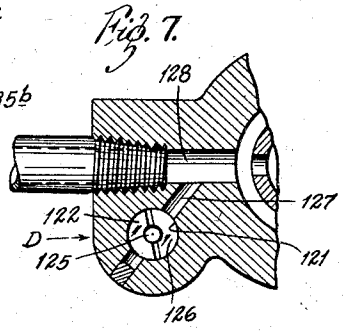
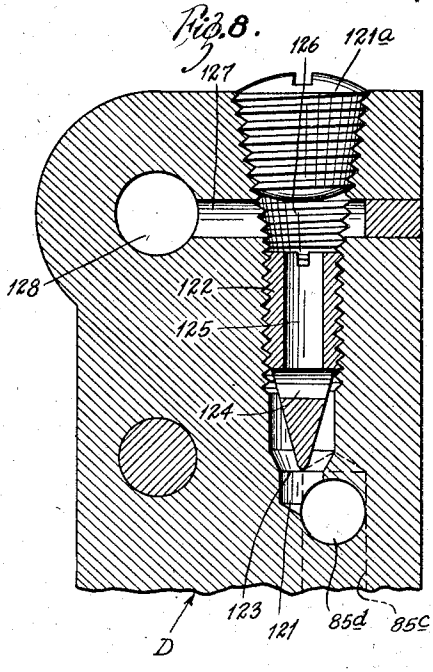


Fig. 8.



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2,372,180

UNITED STATES PATENT OFFICE

2,372,180

ANGULARLY ADJUSTABLE COUPLING

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Application June 12, 1941, Serial No. 397,715

5 Claims. (Cl. 64—24)

This invention relates to angularly adjustable couplings, particularly hydraulic timing couplings or governors for fuel pumps for compression ignition engines. The principal object of the present invention is to utilize the varying pressure developed by the fuel pump for automatically regulating the time of injection of the fuel in accordance with the speed of the engine. Other objects are simplicity and cheapness of construction and compactness of design. The invention consists in the hydraulic timing device and in the construction, combinations and arrangements of parts hereinafter described and claimed.

In the accompanying drawings, which form part of this specification and wherein like symbols refer to like parts wherever they occur,

Fig. 1 is a side elevational view of a Diesel engine fuel injection pump provided with a hydraulically actuated timing mechanism or governor embodying my invention,

Fig. 2 is an elevational view of the governor shown in Fig. 1,

Fig. 3 is a part side elevational and part vertical longitudinal sectional view of the governor housing and the adjacent portion of the injection housing, showing the passageway leading from the pump to the governor cylinder, and the valve for regulating the size of the outlet orifice of said passageway,

Fig. 4 is an enlarged section similar to Fig. 4 through the lower portions of the injection pump and governor housing,

Figs. 5 and 6 are vertical cross-sectional views on the lines 5—5 and 6—6, respectively, in Fig. 4,

Fig. 7 is a horizontal fragmentary section on the line 7—7 in Fig. 3; and

Fig. 8 is a vertical fragmentary section on the line 8—8 in Fig. 3.

In the accompanying drawings, my invention is illustrated in connection with a pump for the fuel injection system of a compression ignition engine. The pump apparatus illustrated in the accompanying drawings is of the type shown in my co-pending application, Serial No. 364,232, filed November 4, 1940, and comprises three superposed, rigidly connected sections, namely, an upper fuel supply pump section A that communicates through a fitting 4 and conduit 5 with a fuel supply tank (not shown), an intermediate fuel injection pump section B having a plurality of fuel discharge conduits 37, one for each engine cylinder, and a lower base section C containing the driving mechanism for the fuel injection pump.

The lower or fuel section C of the base pump comprises a housing 45, which contains the mechanism for continuously reciprocating and rotating, the pump plunger 33. This mechanism comprises a cam shaft 46 extending horizontally through the lower portion of the housing 45 below and at right angles to the pump plunger 33. The cam shaft 46 is driven by or in unison with the engine and is adapted to rotate a cam 47 having identical circumferentially spaced lobes corresponding in number to the number of discharge passageways 34 of the injection pump. The cam shaft is supported in suitable roller bearings 48 mounted in alined openings in opposite ends of the housing 45. Surrounding the cam shaft 46 adjacent to the driven end thereof is a suitable oil seal 49 that is supported in an opening provided therefor in a plate 50 that is removably secured to said housing 45 by cap screws 50a.

The lobes of the cam 47 are adapted to successively engage a tappet roller 51 that is journaled on a pin 53 carried by a cylindrical tappet block 54 having an outer shell 56 rigid therewith. This tappet block is reciprocable in an upright cylindrical guide sleeve 59 that is disposed in a vertical bore 60 that leads upwardly through the top of the housing 45 from the cam shaft receiving opening therein; and said tappet guide sleeve has an outstanding peripheral flange 61 at the top thereof that rests on an annular seat 62 provided therefor in said vertical bore. The tappet block 54 has a diametrical T-slot 65 in the top thereof adapted to receive a grooved lower end portion 66 of the pump plunger 33, whereby said tappet block and plunger are connected together for joint reciprocating movement but may be disconnected by relative movement crosswise of the plunger axis. The upward or pressure stroke is imparted to the pump plunger 33 by the engagement of the lobes of the cam 47 with the tappet roller 51 carried by the lower end of said plunger. The downward or suction stroke is imparted to the plunger 33 by a coil compression plunger retracting spring 67, which surrounds the tappet guide sleeve 59 with its lower end seated on an outstanding base flange 56a on the tappet shell 56 and with its under end bearing against the upper side of the outstanding base flange 61 of said tappet guide sleeve.

In accordance with the present invention, means are provided for circumferentially adjusting the pump operating cam 47 relative to the cam shaft 46 during rotation to advance or retard the time of the fuel injection; and this tim-

ing means is operatively connected to the supply pump for automatic operation by the pressure developed by the supply pump A. This timing device comprises a sleeve 100 having the cam 47 formed thereon or rigid therewith. This sleeve is mounted on the cam shaft between the two supporting bearings 48 therefor, thrust washers 101 being interposed between the ends of said sleeve and the inner raceway members 48a of the respective bearings to take up the end play and end thrust of said sleeve.

The driving connection between the cam shaft 46 and the cam sleeve 100 comprises a tubular coupling member 102 that is disposed in axial alinement with said cam shaft at the inner end thereof and has two diametrically opposed longitudinally disposed arms or branches 103 that extend between said cam shaft and sleeve mounted thereon. These splines or branches 103 of the coupling member 102 fit within and are slidable lengthwise of diametrically opposed longitudinal peripheral grooves 104 in the cam shaft 46, thereby providing an axial sliding driving connection between said cam shaft and said coupling member. The branches 103 of the coupling member 102 have series of external teeth or ribs 105 that are disposed at an oblique angle to the axis of said member and intermesh with a corresponding series of teeth or ribs 106 formed in the bore of the cam sleeve 100. By this arrangement, the rotary motion of the cam shaft 46 is transmitted to the cam sleeve 100 through the coupling member 102 in all positions of axial adjustment of the latter, while axial movement of said coupling causes relative rotary movement of said cam shaft and sleeve, thereby advancing or retarding the cam 46 with respect to the cam shaft, depending on the direction of axial sliding movement of said coupling, and thus changing the timing of the fuel injection of the pump B.

The coupling member is slid in one direction of its axial sliding movement by means of a piston 107 that is reciprocable in a horizontal bore 108 provided therefor in the lower portion of a housing D that is secured flatwise to the adjacent end face of the injection pump housing C. The horizontal piston supporting bore 108 is disposed in axial alinement with the horizontal cam shaft receiving bore of the injection pump housing C and the piston 107 cooperates with the closed inner end of the bore 108 to form a pressure space or chamber 109 inwardly of said piston. The piston 107 is an outwardly opening cup-shaped piston that is adapted to receive the closed end of the coupling member 102; and said end of said coupling member abuts flatwise against the end face of a hardened stud or button 110 that is press fitted in an axial recess 111 provided therefor in the end wall of said piston. The closed end of the coupling member 102 is held against the button 110 provided therefor in the piston 107 by means of a coil compression spring 112 having one end seated within an axial recess 113 provided therefor in said end of said coupling member and the other end seated in an axial seat 114 provided therefor in the adjacent end of the cam shaft 46.

The piston 107 is shifted inwardly in the bore 108 by means of a coil compression spring 115 that surrounds the coupling member 102 and has one end seated in the cup portion of said piston and the other end supported in an annular spring seat member 116 that fits within the adjacent end of the horizontal cam shaft receiving bore in the injection pump housing C. The piston 107 has a rubber packing ring 117 fixed to the inner end thereof that snugly fits the cylindrical wall of the pressure space or chamber 109 and is tightly clamped to the end wall of said piston round an axial stud 118 thereon by means of a clamping washer 119 and a nut 120 threaded on said stud.

The piston 107 is slid endwise against the pressure of the springs 112 and 115 by means of fluid pressure developed by the supply pump A for the fuel injection pump B. The connection between the supply pump A and the pressure space or chamber 109 of the fuel injection timing device comprises a passageway 85b which opens through the side wall of the housing 45 and is connected by a ferrule 86a to a passageway 85c in the housing D. This passageway 85c opens at its inner end into the pressure space or chamber 109 between the inner end of the bore 108 in said housing and the piston 107 working in said bore. The passageway 85c is provided with an extension or branch 85d that opens into the lower end of a bore 121 that leads downwardly through the top of the housing D.

The lower end portion of the bore 121 is threaded to receive a needle valve 122 for controlling the size of the orifice 123 between the branch passageway 85d and said bore. The needle valve 122 has a diametrical bore 124 therein below the threaded portion thereof and an axial passageway or bore 125 leading upwardly from said diametrical bore and opening through the top of said valve, thereby permitting passage of the fluid pressure through said valve when the latter is open. The upper end of the bore 121 for the valve 122 is closed by a screw plug 121a, which is spaced above the upper end of said valve to provide a chamber 126 therebetween; and this chamber communicates through a horizontal passageway 127 with a conduit or passageway 128 that leads from the housing D to the fuel supply tank for the fuel supply pump.

By the arrangement described, the pressure developed by the supply pump A is utilized for automatically adjusting the timing coupling 102 to thereby advance or retard the cam sleeve 100 with respect to the cam shaft 46 while the latter is rotating and thus change the timing of the fuel injection. The supply pump A, delivers a fixed quantity of fuel per stroke, and the pressure necessary to deliver this fuel to the injection pump will vary according to the square of the speed of rotation of the cam shaft 46. Thus, this supply pump pressure will increase as the speed of the engine increases and thus cause the operating piston 107 of the timing device to move against the pressure of the springs 112 and 115 and force the timing coupling 102 axially of the cam shaft 46 and the cam sleeve 100 driven thereby. During this movement of the coupling member 102, the helical or oblique rib-and-groove connection 105, 106 between said member and the cam sleeve 100 will produce a phase change between the cam shaft 46 and said cam sleeve, and thus bring about a change in the timing of the fuel injection. The timing may be adjusted to suit different engine characteristics by providing springs 112 and 115 of different strength of deflection. The timing device may be manually adjusted by means of a screw 129 that is threaded through the housing D in abutting relation to the axial stud 118 on the timing control piston 107. The housing D may be provided with an opening leading from the pressure space or chamber 109 and normally closed by a screw plug 130 so as to allow the escape of air from said space

in order to obtain a more positive hydraulic action. If necessary, the timing device pressure may be vented back to the main supply tank through the orifice 123 controlled by the needled valve 122. This valve may be adjusted to provide a proper vent or discharge orifice 123 for different installations. In some installations, however, proper operation of the timing device may be obtained with the needle valve completely closed.

The hereinbefore described arrangement admits of considerable modification without departing from the invention. Therefore, I do not wish to be limited to the type of supply pump and injection pump shown and described.

What I claim is:

1. An angularly adjustable coupling comprising a shaft, a cam sleeved on said shaft for rotary but non-axial sliding movement relative thereto and a coupling member interposed between said shaft and said cam and having an axially slidable but non-rotary driving connection with said shaft and having a driving connection with said cam adapted to cause relative rotation of said shaft and cam when said coupling member is moved axially thereof, a cylinder disposed in axial alinement with said axially slidable coupling member, a piston mounted in said cylinder in endwise abutting relation to said coupling member, a fluid pressure supply conduit opening into said cylinder, whereby said piston and coupling member are operable in one direction by the pressure transmitted to said cylinder by said conduit, a spring operatively engaging said piston for operating the same in the opposite direction, and a spring interposed between said shaft and said coupling member for pressing the latter axially into engagement with said piston.

2. An angularly adjustable coupling comprising a shaft, a cam mounted on said shaft, and a coupling member between said shaft and said cam and having an axially slidable but non-rotary connection with said shaft and having a connection with said cam adapted to cause relative rotation of said shaft and cam when said coupling member is moved axially of said shaft, a cylinder disposed in axial alinement with said axially slidable coupling member, a piston reciprocable in said cylinder and cooperating with said coupling member to shift the latter axially in one direction, a fluid pressure supply conduit opening into said cylinder, whereby said piston is operable in such direction by the pressure transmitted to said cylinder by said conduit, a spring operatively engaging said piston for operating the same in the opposite direction, a hardened stud press-fitted in an axial recess provided therefor in said piston, and a spring interposed between said shaft and said coupling member for pressing the latter axially into engagement with said stud.

3. An angularly adjustable coupling comprising a shaft, a sleeve on said shaft, a driving connection between said shaft and sleeve comprising a tubular coupling member disposed in axial alinement with said shaft at one end thereof and extending between said shaft and said sleeve and having an axially slidable but non-rotary connection with said shaft and a series of oblique ribs cooperating with a similar series of ribs on said sleeve, and pressure responsive means for sliding said coupling member axially of said shaft and sleeve, said means comprising a cylinder disposed in axial alinement with said coupling member, a piston reciprocable in said cylinder, a spring interposed between said shaft and coupling member for holding the latter in endwise abutting relation to said piston, a second spring bearing against said piston and exerting an endwise pressure thereon in the same direction as said first mentioned spring, a conduit leading to said cylinder for supplying fluid pressure thereto to shift said piston and said coupling member axially against the force of said springs, said conduit having an outlet orifice, and means for varying the size of said orifice.

4. An angularly adjustable coupling comprising a shaft, a separate cam mounted on said shaft for rotary but non-axial sliding movement relative thereto, a driving connection between said shaft and said cam adjustable to advance or retard said cam with respect to said shaft, and fluid pressure responsive means cooperating with said driving connection for adjusting the latter, said driving connection comprising a coupling member extending between said shaft and said cam and having an axially slidable but non-rotary connection with said shaft and an obliquely slidable but non-rotary connection with said cam, and said fluid pressure responsive means comprising a cylinder disposed in axial alinement with said shaft, a piston reciprocable in said cylinder, a spring interposed between said shaft and said coupling member for holding the latter in endwise abutting relation to said piston, a second spring bearing against said piston and exerting an endwise pressure thereon in the same direction as said first mentioned spring, and a conduit for supplying fluid pressure to said cylinder to shift said piston and coupling member axially against the force of said springs.

5. An angularly adjustable coupling comprising a shaft adapted to be driven from one end thereof, axially spaced bearings for the other end of said shaft, a sleeve mounted on said shaft between said bearings, a driving connection between said shaft and said sleeve comprising a tubular coupling member located at said other end of said shaft in axial alinement therewith and extending through the endmost bearing at said other end of said shaft and between said shaft and said sleeve and having an axially slidable but non-rotary connection with said shaft and a series of external oblique ribs cooperating with a similar series of ribs in said sleeve, a spring cooperating with said coupling member for urging the same in one direction of its axial sliding movement, and fluid pressure actuated means cooperating with the outer end of said coupling member for moving the same in the other direction of its axial sliding movement against the pressure of said spring.

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