

Dec. 26, 1939.

H. C. EDWARDS

2,185,144

FUEL INJECTION PUMP

Filed May 27, 1937

3 Sheets-Sheet 1

Fig. 1.

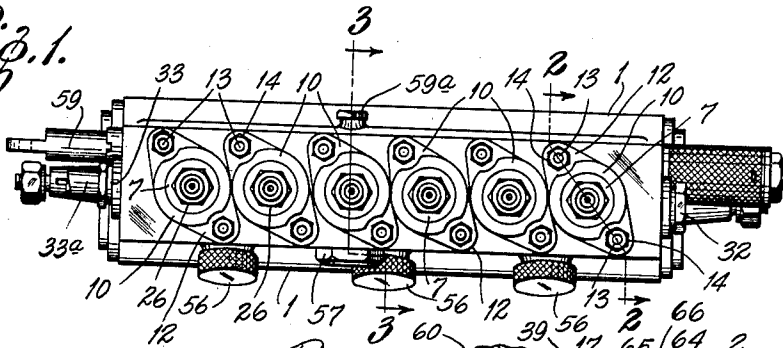


Fig. 2.

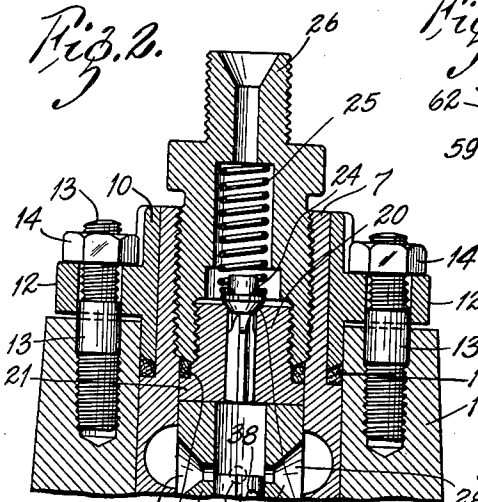


Fig. 3.

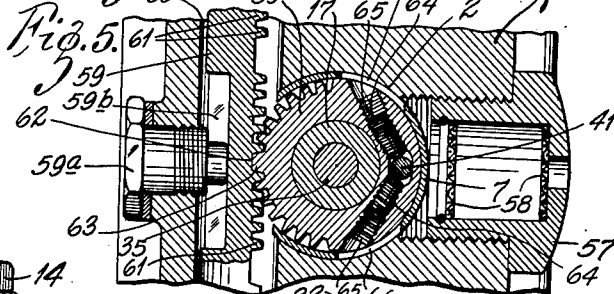


Fig. 4.

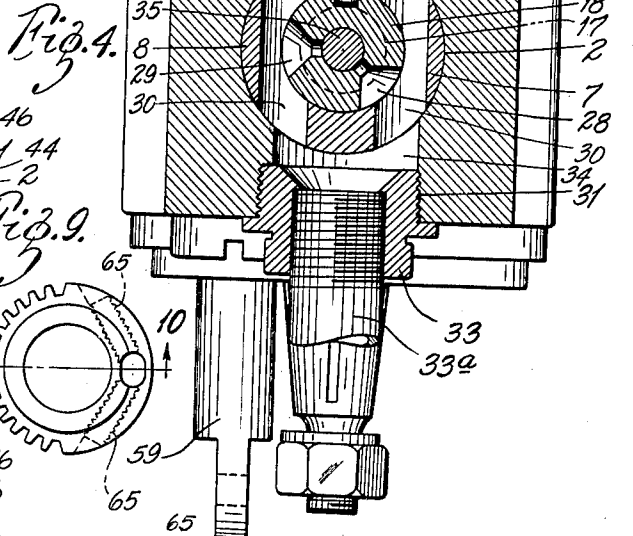


Fig. 5.

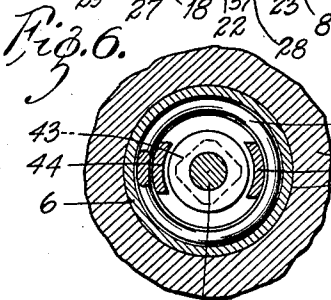


Fig. 6.

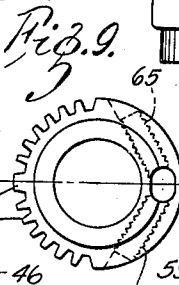


Fig. 7.

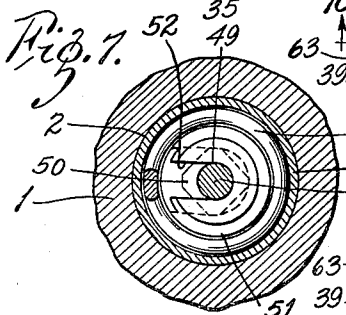


Fig. 8.

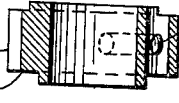


Fig. 9.

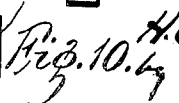
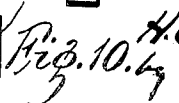


Fig. 10.



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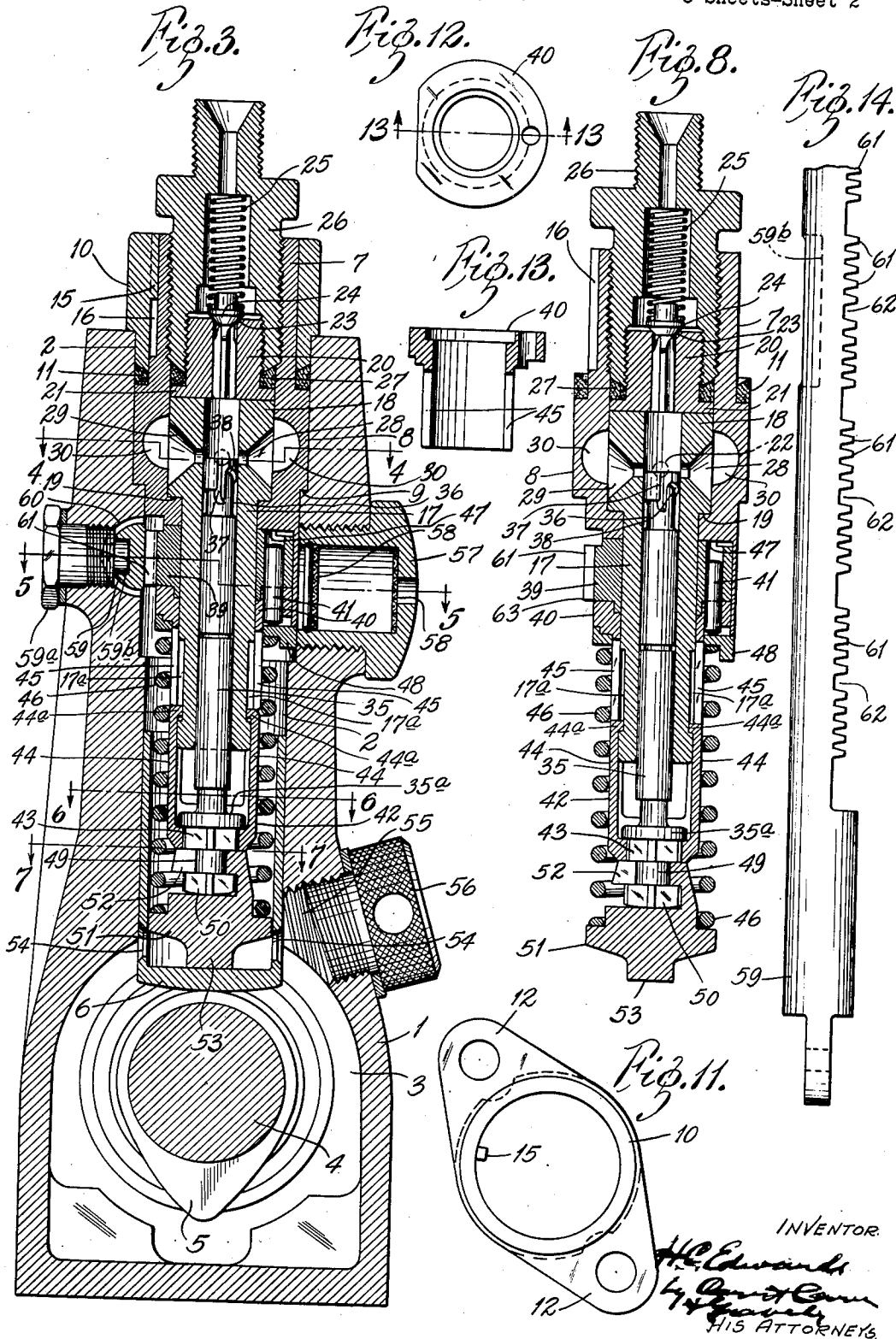
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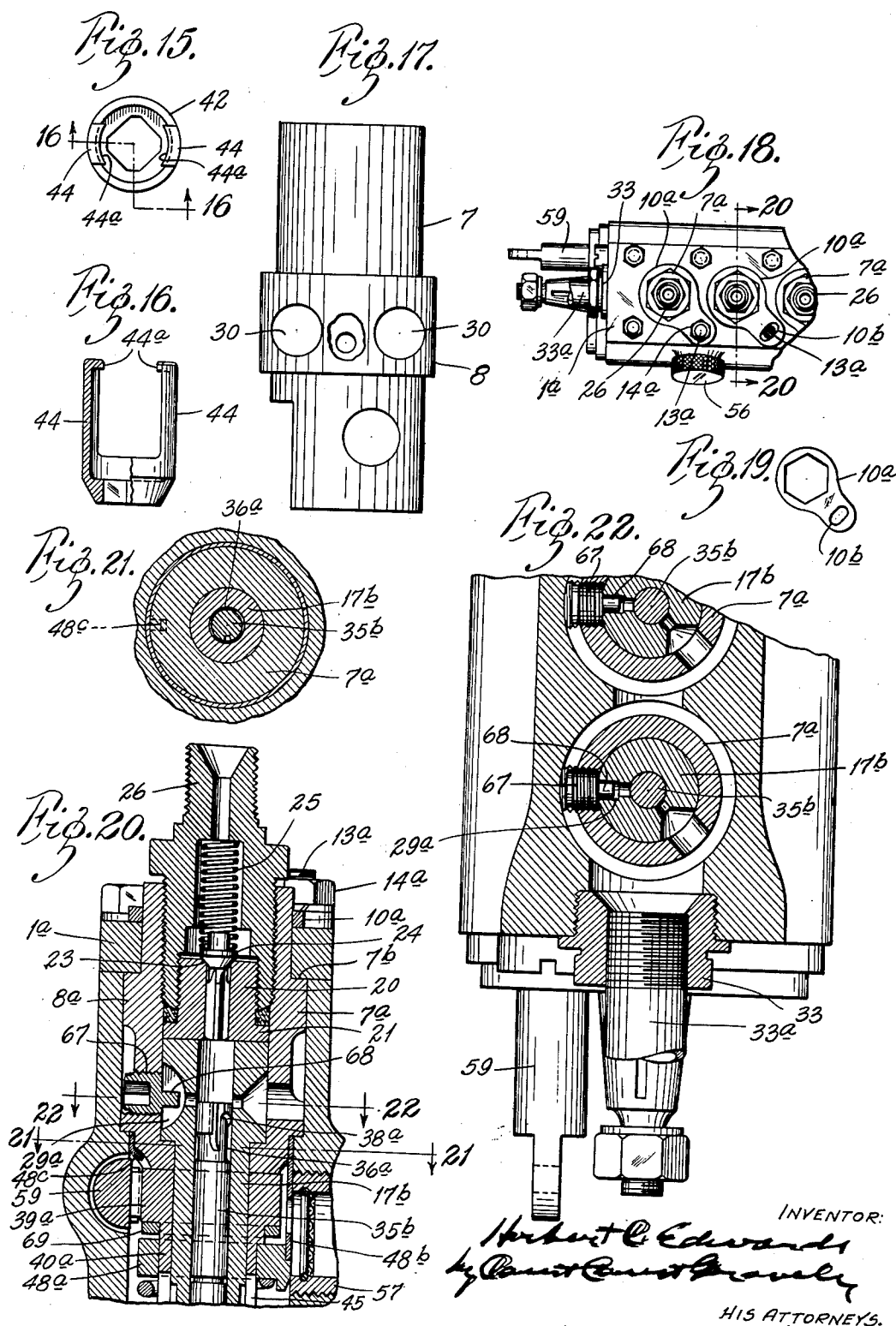
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UNITED STATES PATENT OFFICE

2,185,144

FUEL INJECTION PUMP

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Application May 27, 1937, Serial No. 145,001

6 Claims. (Cl. 103—41)

This invention relates to pumps, particularly fuel injection pumps of the kind having a plurality of reciprocating plungers that are rotated in their respective cylinders to regulate the quantity of fuel delivered. It has for its principal objects to provide for the quick and easy insertion and removal of the individual pump assemblies as complete preassembled units; to provide for properly positioning the pump units in the pump housing; to devise means for obtaining a proper angular setting of the piston in its cylinder; and to provide for simplicity of construction, reduced cost of manufacture, reduction in weight and compactness of design.

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 plan view of a fuel injection pump embodying my invention,

Fig. 2 is a vertical cross-section through the upper portion of one of the pump cylinders on the line 2—2 in Fig. 1,

Fig. 3 is a vertical transverse section on the line 3—3 in Fig. 1,

Figs. 4, 5, 6 and 7 are fragmentary horizontal cross-sections on the lines 4—4, 5—5, 6—6, and 7—7, respectively, in Fig. 3.

Fig. 8 is a central vertical section through one of the removable pump units or assemblies,

Fig. 9 is a plan view of the plunger turning pinion of said pump,

Fig. 10 is a central longitudinal section through said pinion on the line 10—10 in Fig. 9,

Fig. 11 is a bottom plan view of the clamping sleeve of said unit,

Fig. 12 is a plan view of the driving sleeve of said unit,

Fig. 13 is a central longitudinal section through said sleeve on the line 13—13 in Fig. 12,

Fig. 14 is a plan view of a portion of the plunger turning rack rod,

Fig. 15 is a plan view of the driven sleeve of said unit,

Fig. 16 is a side view of said driven sleeve, partly in section, on the line 16—16 in Fig. 15,

Fig. 17 is a side elevation of the main supporting sleeve for said unit, the near side of said sleeve being broken away to disclose the pin receiving opening in the far side thereof,

Fig. 18 is a fragmentary plan view of a pump provided with a modified arrangement for angularly adjusting the pump units in the housing and for securing them thereto,

Fig. 19 is a plan view of one of the adjusting and securing plates,

Fig. 20 is a vertical cross-section through the upper portion of said pump, the section being taken through one of the cylinders on the line 20—20 in Fig. 18; and

Figs. 21 and 22 are horizontal cross-sections on the lines 21—21 and 22—22 in Fig. 20.

In the accompanying drawings, my invention is shown in connection with a fuel injection pump comprising a suitable housing 1 provided with a plurality of vertical bores 2 that are spaced apart lengthwise of said housing and lead downwardly from the upper end thereof to a longitudinal chamber 3 in the bottom thereof within which is located a cam shaft 4 provided with lobe-shaped cams or tappets 5 adapted to engage tappet cups 6 slidably mounted in the lower portions of the respective bores.

Located in each of the vertical bores 2 of the pump housing 1 is a pump assembly that is adapted and arranged for insertion in and removal from said bore as a complete preassembled and adjusted unit. Said pump unit or assembly comprises a cylindrical supporting sleeve holder 7 provided intermediate its ends with an enlarged collar portion 8 that fits within the upper portion of the vertical bore 2 of the pump housing 1 and is held down on an annular seat 9 in said bore by means of a clamping sleeve 10, which fits around the upper portion of said supporting sleeve. The lower end portion of this clamping sleeve fits within the housing bore 2 and bears against an annular gasket 11 that fits around the supporting sleeve and seats on the annular shoulder formed by the upper end of the collar portion 8 thereof. The clamping sleeve is provided above the pump housing with oppositely extending ears or lugs 12 that are perforated to receive the threaded upper ends of stud bolts 13 that are threaded into said housing and are provided at their upper ends with nuts 14 that bear against the upper surfaces of said ears and thus hold the collar portion 8 of the supporting sleeve 7 down on the annular seat 9 provided therefor in the bore of the pump housing. The clamping sleeve also compresses the gasket 11 and thus prevents leakage around the supporting sleeve. The supporting sleeve is prevented from rotating in the clamping sleeve preferably by means of a longitudinal rib or key 15 that is formed in the bore of said clamping sleeve and fits within a longitudinal peripheral groove or keyway 16 in said supporting sleeve.

Mounted in the supporting sleeve 7 of the pump unit is a cylinder or barrel 17 having an enlarged head or upper end portion 18 that is held down

on an annular seat 19 provided therefor in the lower portion of said sleeve by means of a tubular member 20 having a base flange 21 that rests upon the upper end of said cylinder. The cylinder 17 is prevented from rotating in the supporting sleeve 7 by means of a pin 22 that is mounted in a radial hole in the wall of said supporting sleeve with its inner end seated in a recess provided therefor in the exterior surface of the head 18 of said cylinder. The bore of this tubular member terminates at its upper end in a conical seat 23 for a suitable valve 24 that is held down on said seat by means of a coil compression spring 25. This valve seat member 20 is threaded into the lower end of the axial bore of a tubular shell or fitting 26; and the valve spring 25 is held under compression in said axial bore or passageway between a shoulder in said bore and a seat on the valve 24. A suitable washer or gasket 27 is interposed between the lower end of said fitting and the base flange 21 of said valve seat member for preventing leakage therebetween. This tubular shell or fitting is threaded into the bore of the supporting sleeve 7 and has its upper end threaded for connection with a fuel line (not shown) that leads to a fuel injector (not shown). This spring holder or fitting serves to hold the valve seat member 23 down on the head 18 of the cylinder 17 and said head down on the annular seat 19 provided therefor in the bore of the main supporting sleeve 7.

The head 18 of the pump cylinder 17 is provided on one side of its axis with a radial inlet port 28 and on the opposite side with a radial overflow or by-pass port 29; and cylinder supporting sleeve 7 is provided at about the level of said ports with a pair of spaced parallel passageways 30 that pass through said sleeve transversely thereof on opposite sides of its axis and open into the bore thereof and communicate with the respective ports. The pump housing 1 is provided in its opposite ends at about the level of the passageways 30 in the cylinder supporting sleeve 7 with circular recesses 31, one of which is closed by a screw plug 32 and the other of which has a sleeve 33 threaded therein that is adapted to receive and support the threaded end of a fuel inlet pipe 33a. The pump housing also has a pair of spaced parallel bores 34 therein that extend longitudinally of said housing from the plug receiving recess at one end thereof to the sleeve receiving recess at the opposite end thereof. The bores 34 are disposed on opposite sides of the axis of the bores 2 of the pump housing, open into said bores and register with the bores in the supporting sleeve 7 to form a passageway on one side of the cylinders that communicates with the inlet ports 28 thereof and a passageway on the other side of said cylinders that communicates with the overflow or by-pass ports 29 thereof.

Mounted for rotary and axial sliding movement in the bore of the cylinder or barrel 17 of each pump unit is a plunger or piston 35 of the general type having an annular groove 36 therein that communicates through a longitudinal peripheral groove 37 with the pressure space above the plunger and has an inclined or helical upper edge 38, whereby said plunger may be turned in its cylinder to vary the point in its delivery stroke in which the overflow port 29 is placed in communication with said pressure space through the grooves 36 and 37. By this arrangement, delivery of the fuel begins as soon as the plunger on its way up covers the ports 28

and 29 and ends as soon as the helical upper edge 38 of the annular groove 36 in the plunger opens the overflow or by-pass port 29 and relieves the pressure in the space above said plunger.

The mechanism for turning the plunger 35 of each pump unit to vary the amount of fuel delivered thereby comprises a pinion 39 located in the lower end of the bore of the supporting sleeve 7 and rotatably mounted on the cylinder 17 supported therein, a driving sleeve 40 rotatably mounted on said cylinder below said pinion and secured to the latter for rotation therewith by means of a pin 41, and a driven sleeve 42 having a nonrotatable connection with the plunger below the cylinder, comprising a flatsided portion 43 on the piston that fits a similarly shaped opening in the lower end of said driven sleeve. The driving connection between the driving sleeve 40 and the driven sleeve 42 comprises upwardly extending diametrically opposed tongues 44 on the driven sleeve that fit within downwardly opening diametrically opposed notches 45 in the driving sleeve, thereby permitting relative axial movement of the two sleeves, but preventing relative rotary movement thereof.

Surrounding the driving sleeve 40 and the driven sleeve 42 of each pump unit is a helical compression spring 46 that serves to retract the plunger 35 and force the driving sleeve upwardly against the pinion 39 and the latter against an annular shoulder 47 provided therefor in the upper end of the pinion receiving portion of the bore of the supporting sleeve 7. The tappet cup 6 surrounds the driven sleeve 42, but is spaced therefrom far enough to accommodate the plunger retracting spring. An annular plate or washer 48 surrounds the notched portion of the driving sleeve 40, seats against an annular shoulder provided therefor near the upper end of said sleeve and forms a seat for the upper end of the plunger retracting spring 46. The plunger is provided below the lower end of the driven sleeve with an annular groove 49 and terminates below said groove in a flatsided head portion 50. The lower end of the plunger retracting spring is supported on an annular seat provided therefor on a member 51 having a lateral notch 52 therein having a narrow upper portion that snugly receives the grooved portion 49 of the plunger and a wide lower portion that receives the head 50 at the lower end thereof. Thus the spring seat member 51 is held against axial movement relative to the plunger but may be rotated relative thereto and removed sidewise therefrom. The bottom wall of the driven sleeve 42 fits between the upper end of the spring seat member 51 thereon and a collar 35a formed integral with the piston, thereby preventing relative axial movement of said sleeve and said piston.

The spring seat 51 has a lower portion 53 of reduced diameter that bears against the bottom of the tappet cup 6, whose side walls are provided opposite said reduced portion with one or more openings 54 through which access may be had to said spring seat for tappet inspection and for reciprocating the plunger by hand. Access to the openings in the tappet cup may be had through an opening 55 which is located in one side of the pump housing adjacent to the lower end of said cup and is closed by means of a screw plug 56. The pump housing is also provided with a hollow breather plug 57 having suitable filtering screens 58.

The upper end portions of the fingers 44 of

the driven sleeve 42 overlap the lower end portion of the cylinder 17 in all positions of the axial sliding movement of said sleeve; and the upper ends of said fingers are provided with inwardly extending hooks or lugs 44a that fit within an annular groove 17a provided therefor in the peripheral surface of said cylinder. The driven sleeve is forced endwise over the lower end of the cylinder, the fingers of said sleeve being spread apart over said end of said cylinder and being resilient to cause the projections 44a in said fingers to snap into the groove 17a in said cylinder. As shown in Fig. 3, the hooks 44a are clear of the lower edge of the groove 17a in the lowest position of the plunger; and, as shown in Fig. 8, said lugs bear against said edge of said groove when the pump unit is removed, thus retaining the plunger retracting spring 46 under tension and preventing separation of the parts under the pressure of said spring when the unit is detached from the pump.

As shown in the drawings, the pump is provided with a control rod 59 for simultaneously rotating the pinions 39 of all of the pump units. This rod is mounted for axial sliding movement in a longitudinal bore 60 provided therefor in the pump housing and has one end extended beyond said housing for connection with a suitable mechanism (not shown) for reciprocating said rod, no fuel being delivered by the pump when said rod is at one end of its reciprocating movement and a maximum quantity of fuel being delivered when said rod is at the other end of said movement. The axial sliding movement of said rod is limited by a stop screw 59a that is threaded through the side of the pump housing and extends into longitudinal groove 59b in said rod. The rod is provided opposite each pinion 39 with a series of rack teeth 61 that intermesh with the teeth of said pinion. As shown in Figs. 5, 9 and 14, the rack rod has one wide tooth space 62 and the pinion has one wide tooth 63 which fits said wide tooth space and thus insures proper engagement of the rack teeth and the teeth of the pinion.

A proper initial adjustment between the helical edge 38 of the groove 36 in the plunger and the overflow ports 29 in the cylinder 17 is accomplished by angularly adjusting the pinion 39 on said cylinder before the pump unit is applied to the pump housing. As shown in Fig. 5, this adjustment comprises screws 64 that are mounted in threaded bores 65 provided therefor in the pinion 39 in position to bear against opposite sides of the pin 41 that secures the driving sleeve 40 to said pinion. This pin has a snug fit in the opening provided therefor in the driving sleeve 40 and a loose fit in the opening provided therefor in the pinion 39, whereby manipulation of the adjusting screws 64 causes relative rotary movement of said sleeve and said pinion. Access is had to said adjusting screws through openings 66 provided therefor in the pinion receiving end of the bore of the cylinder supporting sleeve 7. This portion of the cylinder supporting sleeve, together with the upper spring seat 48 and the enlarged upper portion of the driven sleeve 42 are flattened on their rack rod opposing sides so as to permit these elements to clear said rack when the unit is inserted and removed from the pump housing. These flattened faces also insure positioning of the pump unit in one position only in the bore provided therefor in the pump housing.

In the modified construction shown in Figs.

18 to 22, inclusive, the pump cylinder 17b is angularly adjusted in the supporting sleeve 7a by means of a screw plug 67 that is mounted in a threaded radial bore in said sleeve and has an eccentric pin 68 that extends into the overflow port 29a of said cylinder. Rotation of this plug causes the eccentric pin to turn about the axis thereof and force the cylinder to rotate in its supporting sleeve and thus vary the position of the helical edge 38a of the annular groove 36a of the plunger 35b relative to the overflow port. In this construction, the entire pump assembly is angularly adjusted in the bore of the pump housing by means of a plate 10a that has a flatsided opening therein adapted to receive a similarly shaped flatsided portion on the upper end of the cylinder supporting sleeve 7a. This plate is secured flatwise to the removable top cover portion 1a of the pump housing by means of a nut 14a that is threaded on a stud bolt 13a, which is fixed to said housing and extends upwardly through said cover and through an arcuate slot 10b provided therefor in said plate. By this arrangement, the pump unit may be turned in the bore in the pump housing and then locked in the desired position of adjustment by tightening the nut 14a. This nut bears against the upper surface of the plate 10a. The cover plate 1a bears against an annular shoulder 7b provided therefor on the cylinder supporting sleeve and thus serves to hold the pump assembly in the housing.

In the modified construction, the supporting sleeve 7a is shortened below its collar portion 8a, thereby eliminating the thin walled pinion receiving portion of said sleeve, and the pinion 39a is formed integral with the upper end of the driving sleeve 40a and abuts against the lower end of said supporting sleeve. A washer 69 is pressed on the driving sleeve in abutting relation to the annular shoulder formed by the pinion thereon, and an annular spring seat 48a is sleeved on said driving sleeve below said washer. The spring seat 48a has an upward cylindrical sleeve extension 48b formed rigid therewith that surrounds the pinion 39a and has its upper end supported on the supporting sleeve 7a below the collar 8a thereof. The upper end of the sleeve extension of the upper spring seat abuts against the underside of the collar of the supporting sleeve and serves to space said seat below the washer 67 that is pressed on the driving sleeve 40a. Said sleeve extension is provided near its upper end with an inwardly extending tab or tongue 48c that fits into a notch provided therefor in the lower end of the supporting sleeve 7a and thus prevents rotation of the spring seat when the driving sleeve is rotated. The washer 69 and the spring seat 48a and its cylindrical extension 48b are flattened on their rack rod opposing sides so as to permit these elements to clear said rack when the unit is inserted in and removed from the pump housing. These flattened faces insure proper meshing of the pinion teeth with the teeth of the rack rod when the unit is inserted in the bore in the pump housing.

The hereinbefore described fuel injection pump has numerous advantages. It permits the entire pump assembly, including the delivery valve assembly, to be inserted in and withdrawn from the bore of the pump housing as a complete pre-assembled and accurately adjusted unit. The clamping sleeve serves to rigidly hold the unit in the bore of the pump housing; and it also prevents rotation of said unit in said bore. The plunger may be easily and accurately angularly

adjusted in its cylinder to obtain a proper initial adjustment of the helical edge of the groove in the piston relative to the overflow port in said cylinder. The flatsided portions of the driving sleeve and spring seat make it impossible to insert the unit in the pump housing bore in any position except the correct position. The wide tooth of the pinion sleeve and the wide tooth space on the rack rod insure proper inmeshment of the pinion and rack teeth. When it is desired to remove the unit for inspection or repair, all that is necessary is to remove the nuts that secured the clamping sleeve to the pump housing. The entire pump unit assembly may then be withdrawn leaving the tappet cup only which can be withdrawn from the bore of the pump housing by removing the rack rod stop screw and withdrawing the rack rod.

Reference is hereby made to my copending application Serial No. 167,972, filed October 8, 1937, for subject matter shown but not claimed herein.

What I claim is:

1. A detachable fuel injection pump unit comprising a cylinder, a plunger reciprocable in said cylinder and projecting from one end thereof, a pinion rotatably mounted on but otherwise unsecured to said end of said cylinder, a sleeve rotatable with said pinion, and a second sleeve fixed to the projecting end of said plunger and having a connection with said first mentioned sleeve permitting relative axial movement but preventing relative rotary movement of said sleeves, a spring for retracting said plunger, means for preventing endwise separation of said first mentioned sleeve and said cylinder under the action of said spring, said second sleeve having a portion overlapping said end of said cylinder and said cylinder having a shoulder adapted to be engaged by said overlapping portion of said second sleeve for preventing endwise separation of said second sleeve and said cylinder under the action of said spring.

2. A fuel injection pump comprising a cylinder having an annular groove in the outer periphery thereof, a plunger reciprocable in said cylinder and projecting from one end thereof, a pinion rotatably mounted on but otherwise unsecured to said end of said cylinder, a sleeve rotatable with said pinion, a second sleeve fixed to the projecting end of said plunger and having a connection with said first mentioned sleeve permitting relative axial movement but preventing relative rotary movement of said sleeves, said connection including a pair of diametrically opposed fingers on said second sleeve overlapping said end of said cylinder and having projections extending into the annular groove in said cylinder for preventing endwise separation of said second sleeve and said cylinder, said fingers being adapted to be spread apart over said end of said cylinder and being resilient to cause said projections to snap into said annular groove, a spring seat on the projecting end of said plunger, and a plunger retracting spring surrounding said sleeves and held under compression between said spring seat and said pinion, and means for preventing said first mentioned sleeve from being forced off the other end of said cylinder under urging of said spring.

3. A fuel injection pump comprising a cylinder, a plunger reciprocable in said cylinder and projecting from one end thereof, a pinion journaled on said cylinder, a sleeve journaled on said cylinder and having a connection with the project-

ing end of said plunger permitting relative axial sliding movement of said plunger and said sleeve but preventing relative rotary movement thereof, and a connection between said pinion and said sleeve permitting relative rotary adjustment thereof, said connection comprising a pin having a snug fit in an opening provided therefor in said sleeve and a loose fit in an opening provided therefor in said pinion, and adjusting screws threaded through said pinion and bearing against opposite sides of said pin.

4. A fuel injection pump comprising a housing having a bore therein, a supporting sleeve fitting in said bore and having an axial bore and a pair of transverse passageways spaced apart on opposite sides of the axis of said sleeve and opening into the bore thereof midway of the ends of said passageways, a pump cylinder mounted in said supporting sleeve and having ports therein in communication with the respective sleeve passageways intermediate the ends thereof, said housing having passageways therein communicating with the ends of the sleeve passageways and forming therewith separate fuel passageways on opposite sides of said cylinders, a plunger in said cylinder, a tubular fitting threaded into said sleeve above the cylinder therein, a valve seat member fitting into said tubular fitting, a valve cooperating with said valve seat member, and a spring mounted in said tubular fitting for holding said valve to its seat.

5. A pump assembly adapted for attachment to and detachment from a pump housing as a complete preassembled unit, said assembly comprising a cylinder, a plunger reciprocable in said cylinder and extending below the lower end thereof, a driving sleeve rotatably mounted on said cylinder, a driven sleeve fixed to the lower end of said plunger and having a connection with said driving sleeve permitting relative axial movement but preventing relative rotary movement of said sleeves, a spring for retracting said plunger, means for preventing endwise separation of said driving sleeve and said cylinder under urging of said spring, said connection comprising a pair of diametrically opposed upstanding fingers on said driven sleeve that overlap the lower end portion of said cylinder, said portion of said cylinder having a peripheral groove therein and said fingers having projections extending into said groove for preventing endwise separation of said driven sleeve and said cylinder, said fingers being adapted to be spread apart over the lower end portion of said cylinder and being resilient to cause said projections to snap into said groove, the opposing ends of said projections being beveled to facilitate spreading of said fingers.

6. A fuel injection pump comprising a housing having a bore therein, a supporting sleeve fitting in said bore and having an axial bore and a pair of transverse passageways spaced apart on opposite sides of the axis of said sleeve and opening into the bore thereof midway of the ends of said passageways, and a pump cylinder mounted in said supporting sleeve and having ports therein in communication with the respective sleeve passageways intermediate the ends thereof, said housing having passageways therein communicating with the ends of the sleeve passageways and forming therewith separate fuel passageways on opposite sides of said cylinders.

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