June 6, 1944. A. G. F. WALLGREN ET AL 2,350,434

FUEL PUMP FOR INTERNAL COMBUSTION MOTORS

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Fig. 1.

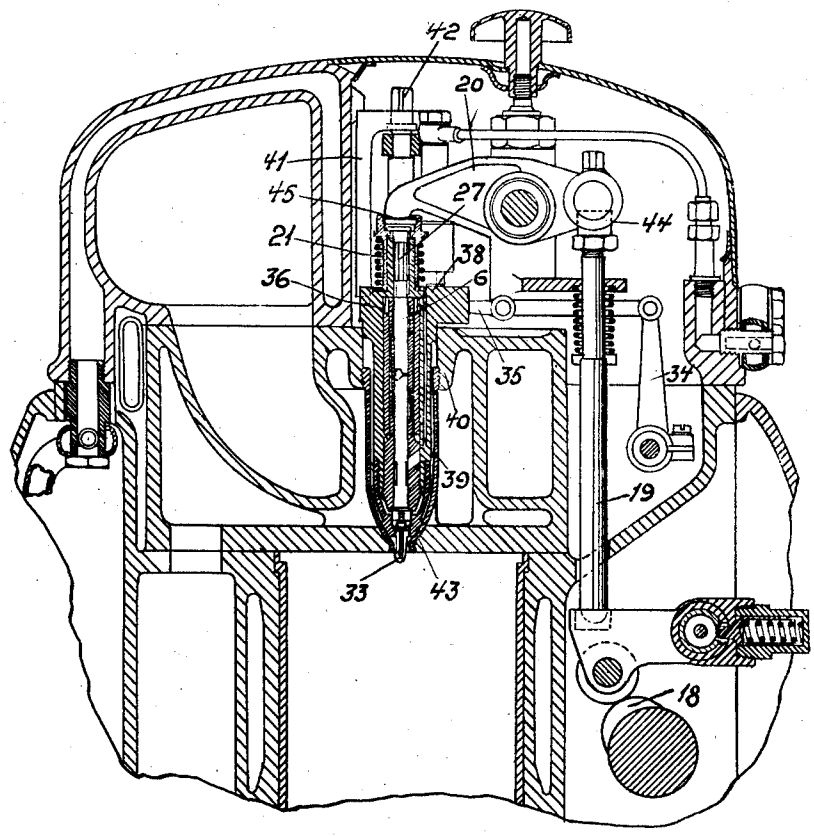
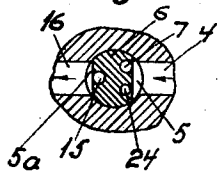


Fig. 3.



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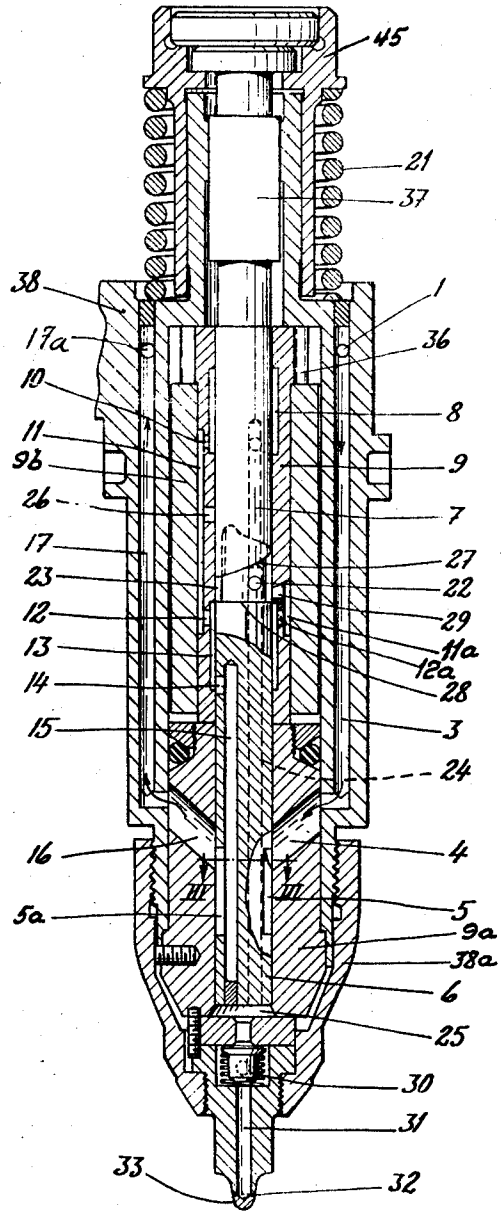
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FUEL PUMP FOR INTERNAL COMBUSTION MOTORS

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Fig. 2



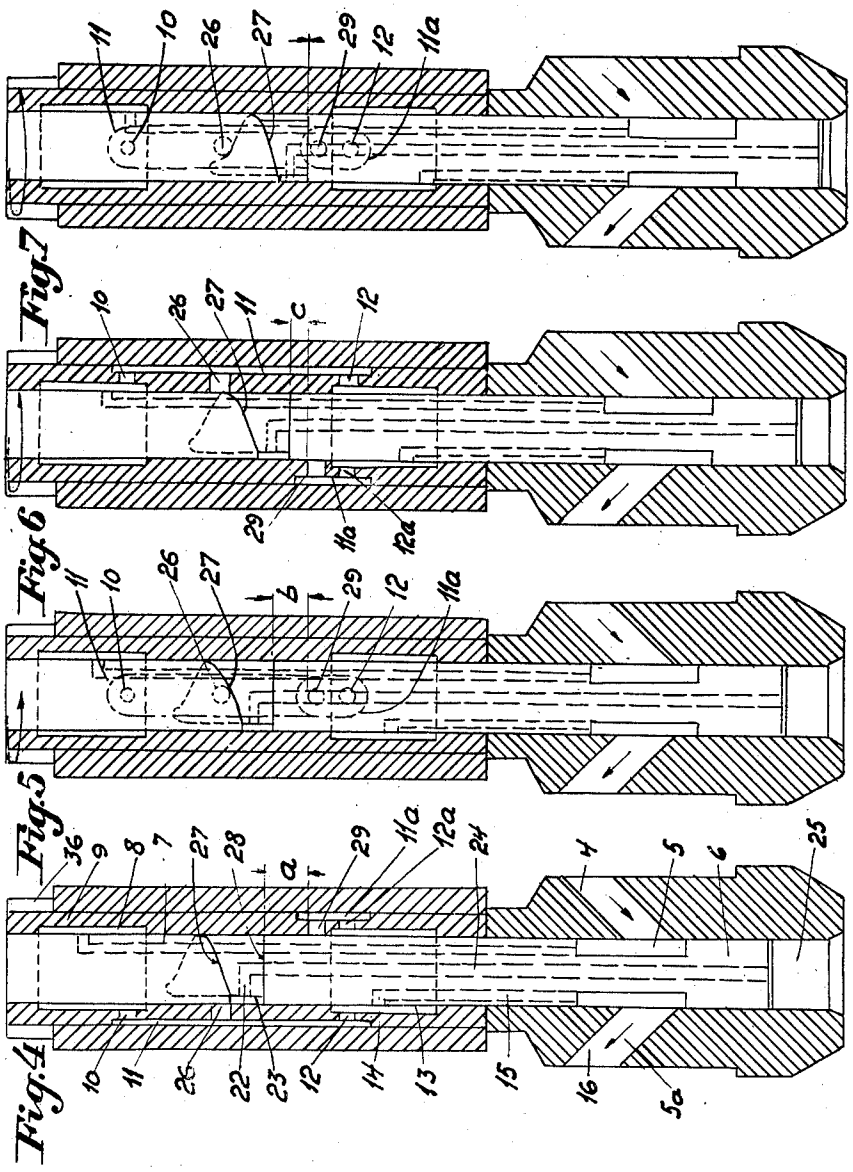
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FUEL PUMP FOR INTERNAL COMBUSTION MOTORS

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2,350,434

FUEL PUMP FOR INTERNAL-COMBUSTION MOTORS

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In Sweden December 21, 1939

7 Claims. (Cl. 103—41)

This invention relates to a fuel plunger pump for internal combustion motors with a variable effective pump stroke. More particularly the invention relates to a fuel plunger pump which is combined with an injection nozzle.

Still more particularly the invention relates to fuel plunger pumps of the known type which are provided with an axially movable plunger and a rotatable sleeve surrounding the same, in which members channels and a recess are provided, said recess having a varying axial extension around the axis of the pump. The channels and the recess are adapted to determine the effective length of the pump stroke and provide a variation of this length by a rotation of the sleeve.

It is one of the objects of the invention to provide means for unloading the rotatable sleeve from all pressure from the fuel so that the latter can be supplied to the pump under a certain pressure above atmospheric. A further object of the invention is to provide means to continuously circulate fuel under a certain pressure above atmospheric through the pump.

Further objects and advantages of the invention will be apparent from the following description considered in connection with the accompanying drawings, which form a part of this specification, and of which:

Fig. 1 is a view partly in section of the upper part of a cylinder of an internal combustion motor with an injection apparatus according to the invention disposed in the cylinder cover of the motor;

Fig. 2 is a longitudinal section of the injection apparatus on an enlarged scale;

Fig. 3 is a section taken on the line III—III of Fig. 2;

Figs. 4, 5 and 6 and 7 are longitudinal sections of the plunger and of a sleeve surrounding the same in different positions of load.

In the drawings, 6 denotes a plunger which is reciprocatable in a lining within an external casing 38. Said lining comprises two members, one lower fixed member 9a which is screwed fast to a lower cap 38a pertaining to the casing 38, and an upper rotatable member 9, 9b. There is no axial force on the rotatable member 9, 9b originating from the plunger forces. The rotatable member is composed of an inner sleeve 9 and an outer sleeve 9b, which latter is shrunk onto the inner sleeve 9 so as to be rotatably movable together with the same. The plunger 6 is provided between its end portions with a recess forming a space 23 with the inner sleeve 9, said space being bounded at the top by a spirally extending controlling edge 27, and at the bottom by a controlling edge 28. Extending through the plunger 6 is a bore 7 communicating at the top with an annular recess 8 on the inside of the sleeve 9, and at the bottom with a recess 5 provided in the plunger, said recess communicating with a bore 4 in the fixed member 9a. The opening of the bore 7 is plugged against the space 25 underneath the plunger. The bore 4 communicates with an intake 1 for the combustible oil through a passage 3 provided in the casing 38. Extending through the plunger 6 is another bore 24 which opens at the bottom in the lower end surface of the plunger, and communicates at the top with the space 23 through an aperture 22. The plunger 6 has a third bore 15 communicating at the top through an aperture 14 with an annular recess 13 provided on the inside of the sleeve 9, said recess communicating through apertures 12 and 12a with axial grooves 11 and 11a, respectively, provided on the outside of the sleeve 9 and being radially outwardly closed by the sleeve 9b. The space 23 can be brought into communication with the grooves 11 and 11a through ports 26 and 29, respectively, in the sleeve 9. Diametrically opposite the recess 5, there is provided another recess 5a (see Fig. 3) in the plunger 6, which communicates with the bore 15 and, through a bore 16 provided in the fixed member 9a and a passage 17 in the casing 38, with an outlet for the combustible oil.

All by-passes in the sleeve are, as will be evident from the aforesaid, arranged either on the inside of the inner sleeve 9 or between the two sleeves 9, 9b, whereas the outer side of the external sleeve 9b is smooth. Between the outside of the sleeve 9b and the casing 38 there is a play large enough to prevent any contact.

The injection apparatus is mounted in the cylinder cover 40 in a jacket 39 which is well cooled by water, said jacket consisting preferably of copper or some other material of good heat-conductivity, the atomizer point 33 of the apparatus projecting somewhat into the combustion chamber. The casing 38 is pressed by means of a bracket 41 and a screw 42 against the conical seat 43 of the jacket 39 so as to provide a good tightening effect against the gas pressure prevailing within the combustion chamber.

The pressure chamber 25 of the pump communicates with the combustion chamber by means of a valve 30, a passage 31, and a plurality of minute apertures 32 arranged in the atomizer point 33. The valve 30 prevents leakage both of combustible oil into the combustion chamber

and of gas from the latter into the fuel system. The apertures 32 in the atomizer point are dimensioned so that the resistance of the same bring about a pressure as required for sufficient atomization of the fuel.

The sleeve 9 is provided at the top with a pinion 36 engaged by a toothed rack 35 (see Fig. 1), which is connected to a lever 34, the position of which is controlled by a governor (not shown).

To prevent the plunger 6 from being carried along in the rotary movements of the sleeve 9, 9b, the plunger is formed at the top with a part 37 of angular section which is guided in the casing 38.

The downward movement of the plunger (the pressure stroke) is effected positively by means of a cam disk 18 through the agency of a rod 19 and a lever 20 bearing on the upper end of the plunger. The upward return movement of the plunger is effected by means of a spring 21, which with its one end bears against the casing 38 and with its other end against a sleeve 45 slidably mounted on the casing.

Fuel oil is supplied by a circulation pump under pressure of a few atmospheres, and enters, on having preferably passed through a filter, into the injection apparatus through the intake 1. Thence the fuel passes through channel 3, bore 4, recess 5, bore 7, annular space 8 and aperture 10 to the groove 11. From the groove 11 the fuel passes through aperture 12, space 13, aperture 14, bore 15, recess 5a, bore 16, and passage 17 to the opening 17a. The intake 1 and the opening 17a communicate with one another in all positions of the plunger and form a constantly open passage for recirculation of the fuel. By the fact that cold fuel always circulates in this manner through the apparatus, a uniform temperature will be obtained in all parts of the apparatus, besides which all traces of air will be effectively removed from the system.

During the last portion of the return stroke of the plunger, the groove 11 communicates with the chamber 25 through the port 26, the space 23, the aperture 22, and the bore 24, the pressure chamber 25 and the appertaining passages being thus filled with fuel.

When during the pressure stroke the plunger moves downwardly under the influence of the linkage 19, 20, the oil in the chamber 25 will first be displaced through bore 24, aperture 22, space 23, and port 26 back to the space 11 and to the constantly open passage of flow for the oil. When the upper spiral-shaped edge 27 of the space 23 covers the port 26, the communication with this open passage of flow being consequently interrupted, the effective pressure stroke of the plunger commences, during which the predetermined quantity of fuel from the pressure chamber 25 is forced into the combustion chamber through valve 30, passage 31, and apertures 32. The pump stroke continues until the lower edge 28 of the space 23 uncovers the port 29, whereupon at the continued downward movement of the plunger the oil is pressed out without resistance through said port, groove 11a, aperture 12a, annular recess 13, and further, through the open passage of flow. When during the upward return movement of the plunger as caused by the spring 21 the upper edge 27 of the spiral-shaped space 23 uncovers the port 26, the pressure chamber 25 again fills with fuel in the manner above described.

The effective pressure stroke consequently lasts from the moment at which the spiral-shaped controlling edge 27 of the space 23 covers the port 26, to the moment at which the straight edge 28 of the space 23 uncovers the port 29. Fig. 4 shows the apparatus as adjusted for full load, the length of the effective pressure stroke being then the greatest and equal to the distance *a*, inasmuch as the port 26 is then covered already by the lowest part of the spiral-shaped controlling edge 27. By rotating the sleeve 9 in a counter-clockwise direction, viewed from above in Fig. 2 and Figs. 4–7, under the influence of an impulse from the governor, the position of the port 26 will be altered relatively to the controlling edge 27 in a manner such that the port 26 is covered later and later. Fig. 5 shows the apparatus as adjusted for half-load operation. The sleeve 9 has been turned by 90° from the position shown in Fig. 4, and the effective pump stroke has been reduced so as to correspond to the distance *b*. In Fig. 6, the apparatus is adjusted for idle operations. The sleeve has been turned by 180°, and the effective length of stroke has been reduced so as to correspond to the distance *c*. In Fig. 7, the sleeve has been turned by 270°, and the effective length of stroke is naught.

The position of the plunger 6 in the plunger lining may be adjusted by means of an adjusting nut 44 on the upper end of the rod 19, the distance between the upper plane of the spring abutment 45 and the upper plane of the apparatus casing 38 being then adjusted to a predetermined value for each type of apparatus.

While we have described several more or less specific embodiments of our invention, it is to be understood that this has been done for purposes of illustration only and that our invention is not to be limited thereto, but its scope is to be determined by the appended claims viewed in the light of the prior art.

What we claim is:

1. A fuel pump for internal combustion engines comprising a rotatable sleeve member, and an axially movable plunger member in said sleeve member, means around one end of said plunger forming a pump chamber, said means being formed with a discharge injection outlet from said chamber, a fuel supply conduit comprising channels formed in the interior portions of said members to prevent communication between the exterior of said sleeve member and said conduit, a recess in one of said members having varying axial extent around the pump axis and a port in the other of said members in communication with said fuel conduit, and a passage formed in one of said members connecting said recess with said pump chamber, said port and said recess being located to be in communication in certain stroke positions of the plunger and to be out of communication with each other in other stroke positions of the plunger, whereby to determine the effective stroke of the pump plunger and providing a variation in the length of the effective stroke upon turning of said sleeve due to the varying axial extent of said recess.

2. A fuel pump for internal combustion engines comprising a rotatable sleeve member, and an axially movable plunger member in said sleeve member, means around one end of said plunger forming a pump chamber, said means being formed with a discharge injection outlet from said chamber, a fuel supply conduit comprising channels formed in the interior portions of said members to prevent communication between the exterior of said sleeve member and said conduit,

a recess in one of said members having varying axial extent around the pump axis and a port in the other of said members in communication with said fuel conduit, and a passage formed in one of said members connecting said recess with said pump chamber, said port and said recess being located to be in communication in certain stroke positions of the plunger and to be out of communication with each other in other stroke positions of the plunger, whereby to determine the effective stroke of the pump plunger and providing a variation in the length of the effective stroke upon turning of said sleeve due to the varying axial extent of said recess and cooperating openings in said members having sufficient axial extent so as to be in registry in all stroke positions of said plunger, and an outlet conduit for excess fuel, one of said cooperative openings being in communication with said supply conduit and the other cooperative opening being in communication with said outlet conduit.

3. A fuel pump for internal combustion engines comprising a rotatable sleeve member, and an axially movable plunger member in said sleeve member, means around one end of said plunger forming a pump chamber, said means being formed with a discharge injection outlet from said chamber, a fuel supply conduit comprising channels formed in the interior portions of said members to prevent communication between the exterior of said sleeve member and said conduit, a recess in one of said members having varying axial extent around the pump axis and a port in the other of said members in communication with said fuel conduit, and a passage formed in one of said members connecting said recess with said pump chamber, said port and said recess being located to be in communication in certain stroke positions of the plunger and to be out of communication with each other in other stroke positions of the plunger, whereby to determine the effective stroke of the pump plunger and providing a variation in the length of the effective stroke upon turning of said sleeve due to the varying axial extent of said recess, said sleeve member comprising two concentric parts rigidly secured together, the channels in the sleeve member being formed in the inner part and between said parts and the outer surface of said outer part being smooth.

4. A fuel pump for internal combustion engines comprising a casing, a sleeve member rotatable within said casing, a plunger member reciprocable within said sleeve, said casing forming a pump chamber at one end of said plunger, a discharge injection outlet from said chamber formed in said casing, a fuel supply conduit comprising channels formed in said housing and in the interior portions of said members to prevent communication between the exterior of said sleeve member and said conduit, a recess in one of said members having varying axial extent around the pump axis and a port in the other of said members in communication with said fuel conduit, and a passage formed in one of said members connecting said recess with said pump chamber, said port and said recess being located to be in communication in certain stroke positions of the plunger and to be out of communication with each other in other stroke positions of the plunger, whereby to determine the effective stroke of the plunger and providing a variation of the effective stroke upon turning of said sleeve due to the varying axial extent of said recess, there being clearance between said rotatable sleeve and said housing.

5. A fuel pump for internal combustion engines comprising a rotatable sleeve member, and an axially movable plunger member in said sleeve member, means around one end of said plunger forming a pump chamber, said means being formed with a discharge injection outlet from said chamber, a fuel supply conduit comprising channels formed in the interior portions of said members to prevent communication between the exterior of said sleeve member and said conduit, a recess in one of said members having varying axial extent around the pump axis and a port in the other of said members in communication with said fuel conduit, and a passage formed in one of said members connecting said recess with said pump chamber, said port and said recess being located to be in communication in certain stroke positions of the plunger and to be out of communication with each other in other stroke positions of the plunger, whereby to determine the effective stroke of the pump plunger and providing a variation in the length of the effective stroke upon turning of said sleeve due to the varying axial extent of said recess, said port being formed in the inner part of said sleeve member and communicating with a channel between said parts, and an outlet conduit for excess fuel, said channel between the parts being permanently in communication with said fuel supply conduit and with said outlet conduit.

6. A fuel pump for internal combustion engines comprising a rotatable sleeve member, and an axially movable plunger member in said sleeve member, means around one end of said plunger forming a pump chamber, said means being formed with a discharge injection outlet from said chamber, a fuel supply conduit comprising channels formed in the interior portions of said members to prevent communication between the exterior of said sleeve member and said conduit, a recess in one of said members having varying axial extent around the pump axis and a port in the other of said members in communication with said fuel conduit, and a passage formed in one of said members connecting said recess with said pump chamber, said port and said recess being located to be in communication in certain stroke positions of the plunger and to be out of communication with each other in other stroke positions of the plunger, whereby to determine the effective stroke of the pump plunger and providing a variation in the length of the effective stroke upon turning of said sleeve due to the varying axial extent of said recess, said sleeve member comprising two concentric parts rigidly secured together, the channels in the sleeve member being formed in the inner part and between said parts and the outer surface of said outer part being smooth, said port being formed in the inner part of said sleeve member and communicating with a first channel between said parts, an outlet conduit for excess fuel, said first channel between the parts being permanently in communication with said fuel supply conduit and with said outlet conduit, and a second port in the inner part of said sleeve communicating with a second channel between said parts, said second port being located so as to communicate with said recess at the end of the pressure stroke, said second channel being permanently in communication with said outlet conduit.

7. In a fuel pump for internal combustion en-

gines, a pump casing, means at one end of said casing providing a bore and a compression chamber, said means being formed with a discharge injection outlet from said chamber, a plunger reciprocably mounted in said bore, a sleeve rotatably mounted around said plunger within said casing in axial alignment with said means, a first port in said means communicating with an inlet passage in said housing, a second port in said plunger, the location and axial extents of said ports being such that they communicate with each other in all positions of said plunger, a channel in said plunger communicating with said second port and with a third port in said plunger, said sleeve being formed with a first annular recess so located and dimensioned as to communicate with said third port in all positions of said plunger and said sleeve, said sleeve having an axially extending passage communicating with said first recess and with a second annular recess in said sleeve, a fourth port in said plunger, said second recess and said fourth port being so located and dimensioned as to be in communication in all positions of said plunger and said sleeve, an axial passage in said plunger connecting said fourth port with a fifth port in said plunger, a sixth port in said means communicating with an overflow passage in said casing, said fifth and sixth ports being so located and dimensioned as to be in communication in all positions of said plunger, a recess in said plunger having varying axial extent around the pump axis, a seventh port in said sleeve communicating with the axial passage therethrough and being so located with respect to said recess in the plunger as to be in communication therewith in only certain stroke positions, whereby to determine the effective stroke of the plunger and providing a variation of the effective stroke upon turning of said sleeve due to the varying axial extent of the recess in the plunger, a passage in said plunger connecting the last-mentioned recess with said compression chamber, an eighth port in said sleeve so located and dimensioned as to communicate with the recess in the plunger at the end of the effective stroke, and a passage in said sleeve connecting said eighth port with said second annular recess in the sleeve, the space between said sleeve and said casing being out of communication with all of said passages, recesses and ports whereby fuel is prevented from entering said space.

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