March 29, 1927. 1,622,266

C. J. AKE

DEVICE FOR THE ATOMIZATION AND INJECTION OF LIQUIDS

Filed Aug. 12, 1925 2 Sheets-Sheet 1

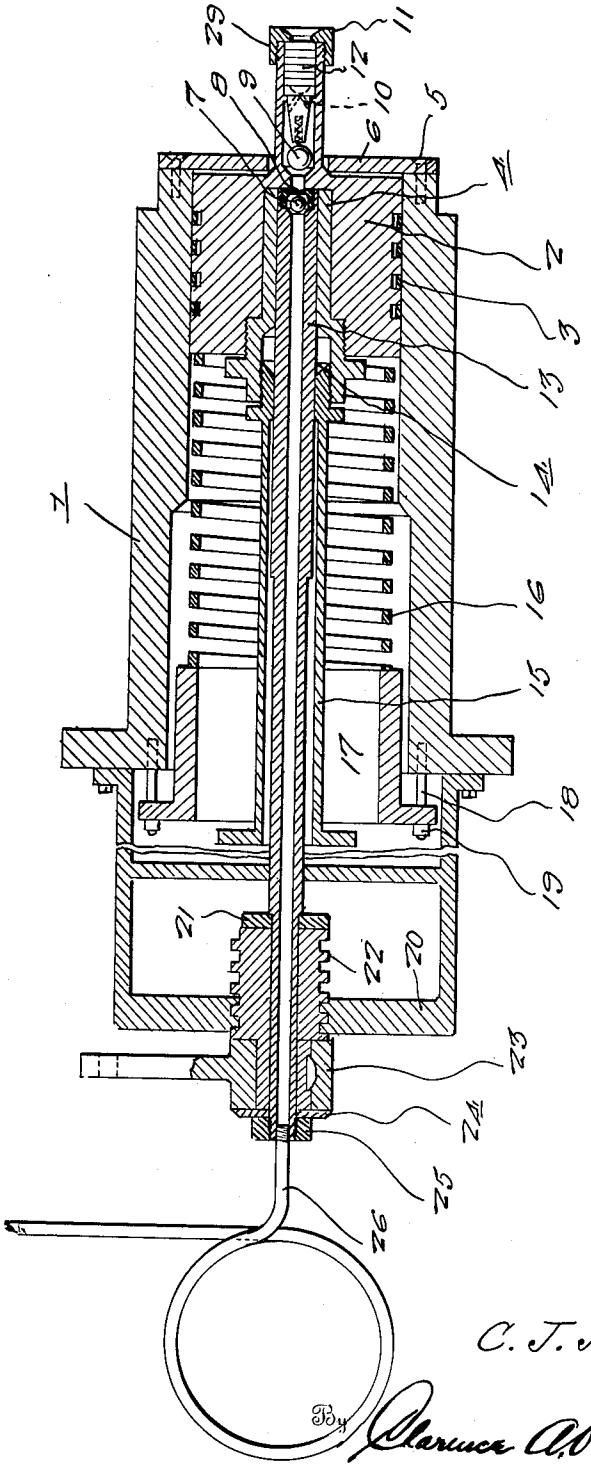


Fig. 1.

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Fig. 2.

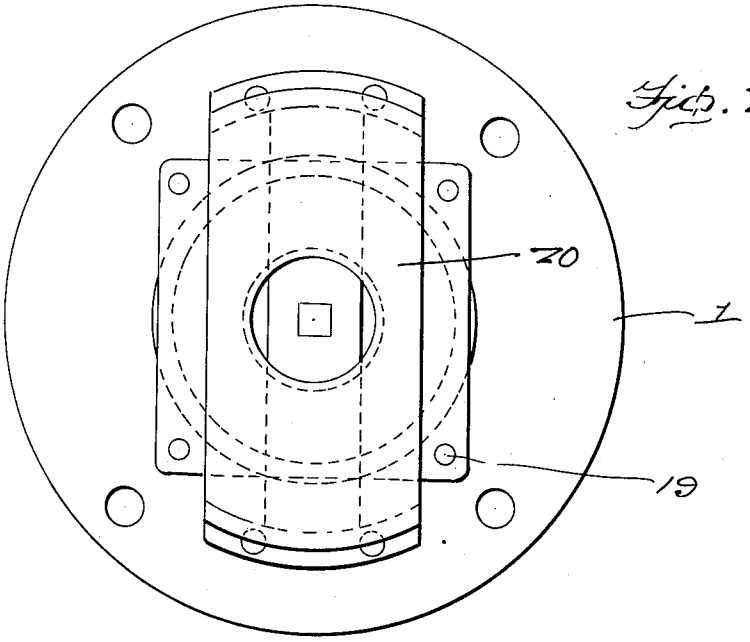


Fig. 3.

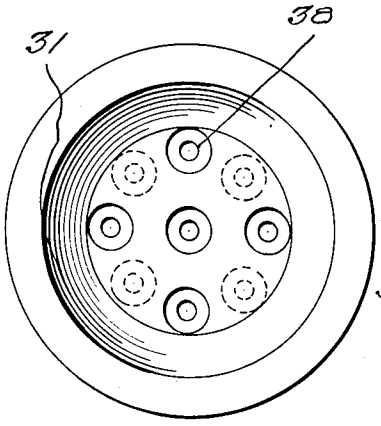
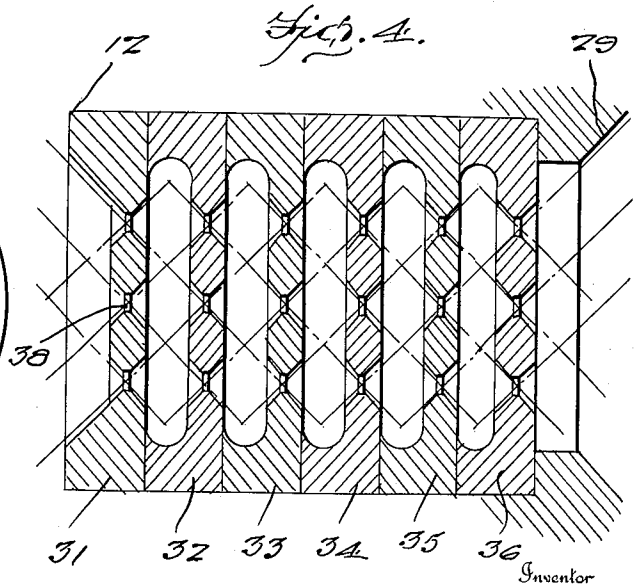


Fig. 4.



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UNITED STATES PATENT OFFICE.

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DEVICE FOR THE ATOMIZATION AND INJECTION OF LIQUIDS.

Application filed August 12, 1925. Serial No. 49,863.

The present invention relates to a device of an automatic nature for atomizing and injecting liquids into a chamber, the pressure in which is greater than atmospheric pressure.

An important object of the invention is to provide a device of this nature which is capable of automatically atomizing and injecting liquids under pressure greater than the chamber into which they are forced, at certain given periods, containing within itself the means of timing, atomizing, and injection; receiving no energy mechanically; the liquids flowing into it by gravity; actuating itself automatically at proper regulated periods.

The principle on which this device operates is that of a compound piston, the diameter of one being greater than the other, and the fact that the cross-sectional area of a piston twice as large as another will be four times as great, and if two pistons of different diameters be connected and a pressure applied on the larger one, the resulting pressure on the smaller one, will be multiplied by the difference of the cross-sectional areas provided the smaller piston be exposed to a pressure not greater than that acting on the larger piston.

Another important object of the invention is to provide a device of this nature which is simple in its construction, inexpensive to manufacture, strong, durable, efficient and reliable in operation, not likely to easily become out of order, and otherwise well adapted to the purpose for which it is designed.

With the above and numerous other objects in view as will appear as the description proceeds, the invention resides in certain novel features of construction, and in the combination and arrangement of parts as will be hereinafter more fully described and claimed.

In the drawings:

Figure 1 is a longitudinal sectional view through the device embodying the features of my invention;

Figure 2 is a top plan or end elevation of the device with the throttle and secondary piston removed;

Figure 3 is an end elevation of the atomizer unit; and

Figure 4 is a sectional view through the atomizer unit taken longitudinally.

Referring to the drawing in detail, it will be seen that the primary cylinder 1 contains a number of the working parts of the device. This primary cylinder should preferably be constructed of cast iron and the inner working surface is ground and lapped to a good smooth finish. The height of this surface in the cylinder, need not be greater than the greatest travel of the primary piston 2, and one and one-half times the length of the primary piston. The remainder of the upper part of the cylinder is counter-bored to allow free running of a spring 16 and the spring bearing 17. The lower end of the outside of the cylinder is under-cut allowing for a gasket, where it comes into contact with the face of the chamber into which the device is to be fitted. The lower end of the cylinder 1 is closed, with the exception of a port, in the center, which has a bevel of approximately 45°. The bottom of the cylinder 1 is preferably made removable as is shown in the accompanying drawings. The removable plate 6 is held on a ground joint or a gasket as may be necessary to the cylinder 1 by means of screws 5 or like fastening elements, the number and size of which will be governed by the circumstances under which the device must function. The object of this removable bottom plate to cylinder 1 is to allow more easy access to the interior thereof for the assembling of the device and also for the grinding of the ground seat where the primary piston 2 comes in contact with the same. The primary piston 2 should be made of a good composition of cast steel, if circumstances will permit. The object of this being to strengthen, if possible, that part of the piston which contains the atomizing unit indicated at 12. This piston contains four working rings 3 preferably eccentric and with step joints compressed and ground to size. The piston 2 also contains a removable liner 4 which is, in reality, the secondary cylinder. Where the primary piston 2 projects through the bottom of the cylin-

der 1, an angular seat is made which is ground to the seat or the bottom of the primary cylinder 6. The piston 2 must be constructed so that when it is at the bottom of the primary cylinder 1 and against its seat on plate 6, there will be very little or no volume left between its face and the face of the bottom plate of the cylinder 6. Should there be a very great volume remaining between the piston and the bottom plate of the cylinder it would result in the imprisoning of a pressure after the piston has seated, as will be seen later, which would seriously interfere with the proper functioning of the timing ability of the device. The removable liner is mounted in the primary piston 2 as before mentioned and constitutes the secondary cylinder. This secondary cylinder should be made of bronze or some similar soft metal, the surface of its cylinder walls being lapped to size. The upper part of the bore of the secondary cylinder is counter-bored and threaded, constituting a packing gland. This secondary cylinder is screwed in place into the primary piston and a soft copper gasket may be inserted between the shoulder where it comes in contact with the primary piston. A collar is made on the end of the secondary cylinder which projects out of the primary cylinder thus forming a shoulder in the shape of a hexagon to facilitate the tightening of the secondary cylinder into the primary piston against the gasket. The packing nut for said gland has a peculiar construction, as will be seen in the drawings, being elongated so that the packing may be taken up on while the device is completely assembled and in motion. Little need be said of the ball spring retainer 10 except that it is held securely in place against its shoulder by the plates of the atomizer unit to be described later and has passages drilled into it as at 10 to allow the oil to flow through the atomizer unit. The nut 11 screws on primary piston 2 overlapping the last plate in the atomizer unit 12 holding the complete unit securely in place. The secondary piston 13, as shown in the drawing, is hollow and contains at its lower extremity a ball check 7 held in place by a fitting containing cross wires or the like across its aperture 8. These cross wires should be in such a position as to allow ball check 7 to drop back far enough so as not to impede the flow of the oil through the center of the piston 13. However, if too much distance is allowed, too great an amount of oil will flow back through the secondary piston 13 before the ball check 7 is seated, as this ball check does not carry a spring. However, should it be found necessary a very light conical spring may be used, being very careful that the spring is not so strong that the vacuum created in the secondary cylinder 4 by the removal of the secondary piston 3, as will be set forth later, will not be able to readily overcome the spring, as this would tend to make the device function sluggishly or improperly.

The secondary piston 13 is ground and fitted to the secondary cylinder 4 for approximately half its length. From there to the point where the collar 21 is fitted to the piston 13, the said piston is square so that it will run through the square guide hole in the cross beam of the housing 20. The object of this is to eliminate the turning of the secondary piston 13 when the throttle is moved as, of course, its motion is circular. From the point where the collar 21 is fitted to the secondary piston 13 for the remaining distance to the upper end of the secondary piston 13, said piston is round and threaded on the end of the nut 25 which when matured moves up against a small shoulder to eliminate the members 24, 23, 22 and 21 from binding on the secondary piston 13.

The hole in the secondary piston 13 is threaded for the feed pipe 26. This feed pipe has one or more loops between the device and its first bracket (not shown) to allow for the motion when the device is throttled.

The housing 20 is cast in one piece being fixed to the cylinder 1 by four bolts. The top of the housing 20 is threaded to fit the throttle 22. The cross-bar of this housing 20 has a square hole formed in it, in which slides the square portion of the secondary piston 13. The object of this has been previously brought out.

The complete throttling unit which simply raises or lowers the secondary piston 13 and maintains the piston's position of any given point and consists of four parts, the lower thrust washer 21, the threaded barrel 22, the handle 23, and the upper thrust washer 24. The handle 23 is keyed to the barrel 22 in any suitable manner.

It is apparent that a turn of the handle 23 throttles the device because a turn of this handle turns the barrel which is threaded into the housing 20 thereby raising or lowering the secondary piston 13 which is disposed between the upper and lower thrust collars 21 and 24. Priming may be accomplished by the simple expedient of opening and closing the throttle one or more times rapidly. This action draws oil into the secondary cylinder and forces the air out of the device past the ball check 9 and through the atomizing unit 12.

The details of the device have been sufficiently described to understand the operation. The device functions as follows:—

The throttle 23 is turned, thereby drawing the secondary piston 13 upwardly where it remains stationary unless the throttle be moved again. This operation results in a

space being left clear in the secondary cylinder due to the fact that the ball check 9 is held closed by its spring. A vacuum is thus created so that oil will be drawn through the center of the secondary piston 13 until the space created by the removal of the secondary piston is filled. The distance that the secondary piston is withdrawn from the secondary cylinder regulates the amount of oil drawn into the secondary cylinder constituting the throttling of the device. It will be supposed that the piston of the working cylinder of the main engine is going downwardly on its intake stroke. The main piston 2 of the device is at the bottom of the primary cylinder and is seated against the plate or seat 6 being held there by the spring 16. The valve is now ready to function. The piston of the working cylinder of the engine now advances on its compression stroke. At a certain point on this stroke which we will take to be 20° from top center, a pressure of approximately 250 pounds per square inch is attained. At this point the spring 16 which holds the primary piston 2 against its seat 6 is overcome by the pressure acting on the area of the primary piston 2 that is exposed through the ground joint in seat 6. This causes the primary piston to become unseated from the seat 6 and the pressure of the working cylinder is exerted upon the full area of the primary piston 2 which forces the primary piston 2 upwardly or away from the seat 6. The pressure in the working cylinder of the engine, of course, increases to about 460 pounds per square inch by the time it reaches top center. As soon as the primary piston 2 is unseated it decreases the volume in the secondary cylinder, causing the pressure to rise therein. A slight back rush of oil through the secondary piston 13 seats the ball check 7. The advance of the primary piston 2 is rapid, causing an enormous pressure to prevail in the secondary cylinder. This lifts the ball check 9 and the oil flows past it through conduits 10 and into the atomizer unit through which it is sprayed into the cylinder.

The working of the atomizer will now be described in detail: Atomization is, of course, a prime factor in the construction and operation of a device for atomizing and injecting solid liquids into the combustion chamber of an internal combustion engine. This atomizer is made up principally of a series of plates held together in a container with holes drilled in various specified places and countersunk to such angles and depths as to bring about atomization through the law that oil, when forced through a cone, flows along the sides. The relative position and angles of the various holes are so arranged that oil flowing from the sides of one cone will intersect that of the other cones at an equal distance between the plates. It will be readily seen that due to the great pressure under which this occurs and the number of times the various films of oil come in contact with one another that the absolute and complete atomization can be the only result. Referring to the atomizer unit 12 in detail, it will be seen that the tip 29 holds the plates 31 to 36, inclusive, in place. It will be seen that this tip is shaped like a cone for the purpose of spreading the atomized oil. The space between the plates, while varying under different circumstances, should always be kept as narrow as possible to eliminate the retention of oil after the device has functioned. In some cases it is necessary to stagger the holes in the various plates or to introduce a greater or smaller number of holes or a different number of plates to obtain the proper results. This all depends upon the volume, the pressure, the viscosity, and the number of times per minute the device must function. The oil continues to flow through the atomizer until the primary piston 2 advances so far that the secondary piston 13 completely fills the secondary cylinder and all the oil has been forced into the atomizer. The piston of the working cylinder is now going down on its working stroke. As soon as the pressure drops in the working cylinder in the main engine to a point where the spring 16 is able to force the primary piston 2 downwardly, it does so, and the primary piston 2 seats itself in the bottom of the primary cylinder 1 against the seat or plate 6. The pressure in the secondary cylinder has long since dropped below that of the pressure in the atomizer as will be apparent and the ball check 9 has seated. Since the secondary piston 13 does not move and the primary piston containing the secondary cylinder has returned to its lower position, a vacuum is again created in the secondary cylinder causing the ball check 7 to again unseat itself and drop back against its cross wires allowing another charge of oil to enter the secondary cylinder. The device has completed its function and awaits the rise in the pressure which will actuate it on the next cycle. Therefore, it will be seen that the spring 16 is what actually controls the timing of the device. This spring should be of sufficient capacity to allow the valve to function properly under normal conditions. Should an adjustment of the timing of the device be deemed necessary while it is in operation, or the means not at hand for renewing the spring 16, a minor adjustment can be made by use of the spring bearer 17 as in the case where it is desired to change the firing time from, say, 60° before top center of the working piston of the main engine to, say, 15° before top center, as is often the case where the normal running speed is changed and it be-

comes necessary to change the timing in order to maintain the highest efficiency. The spring bearer 17 as will be seen in the drawing is held to the primary cylinder 1 by four studs 18 allowing for an adjustment through the nuts 19.

It is thought that the construction, operation, utility and advantages of this invention will now be clearly understood without a more detailed description thereof. The present embodiment of the device has been disclosed merely by way of example since in actual practice it attains the features of advantage enumerated as desirable in the statement of the invention and the above description. It will be apparent that numerous changes in the details of construction, in the materials, in the sizes, and in the combination and arrangement of parts, may be resorted to without departing from the spirit or scope of the invention as hereinafter claimed or sacrificing any of its advantages.

Having thus described my invention what I claim as new is:—

1. A device of the class described including a primary cylinder, a plate closing one end thereof and provided with a restricted opening, a primary piston slidable in the cylinder and having a reduced projection piercing the restricted opening, the diameter of the projection being smaller than the diameter of the opening, a frustoconical portion at the juncture of the primary piston with its projection for seating in the opening, an atomizer unit in the projection, a secondary cylinder in the primary piston, a secondary piston slidable in the secondary cylinder, said secondary piston being of hollow construction, a pair of check valves, one in the projection of the primary piston, and the other in the secondary piston adjacent the projection, and a spring associated with the primary piston normally holding its frustoconical portion closed against the restricted opening.

2. A device of the class described including a primary cylinder, a plate closing one end thereof and provided with a restricted opening, a primary piston slidable in the cylinder and having a reduced projection piercing the restricted opening, the diameter of the projection being smaller than the diameter of the opening, a frustoconical portion at the juncture of the primary piston with its projection for seating in the opening, an atomizer unit in the projection, a secondary cylinder in the primary piston, a secondary piston slidable in the secondary cylinder, said secondary piston being of hollow construction, a pair of check valves, one in the projection of the primary piston, and the other in the secondary piston adjacent the projection, and a spring associated with the primary piston normally holding its frustoconical portion closed against the restricted opening, means for adjusting the tension of said spring.

3. A device of the class described including a primary cylinder, a plate closing one end thereof and provided with a restricted opening, a primary piston slidable in the cylinder and having a reduced projection piercing the restricted opening, the diameter of the projection being smaller than the diameter of the opening, a frustoconical portion at the juncture of the primary piston with its projection for seating in the opening, an atomizer unit in the projection, a secondary cylinder in the primary piston, a secondary piston slidable in the secondary cylinder, said secondary piston being of hollow construction, a pair of check valves, on in the projection of the primary piston and the other in the secondary piston adjacent the projection, a spring associated with the primary piston normally holding its frustoconical portion closed against the restricted opening, means for adjusting the tension of said spring, manually controlled means for moving the secondary piston in the secondary cylinder.

4. A device of the class described including a primary cylinder, a plate closing one end thereof and provided with a restricted opening, a primary piston slidable in the cylinder and having a reduced projection piercing the restricted opening, the diameter of the projection being smaller than the diameter of the opening, a frustoconical portion at the juncture of the primary piston with its projection for seating in the opening, an atomizer unit in the projection, a secondary cylinder in the primary piston, a secondary piston slidable in the secondary cylinder, said secondary piston being of hollow construction, a pair of check valves, one in the projection of the primary piston and the other in the secondary piston adjacent the projection, a spring associated with the primary piston normally holding its frustoconical portion closed against the restricted opening, means for adjusting the tension of said spring, manually controlled means for moving the secondary piston in the secondary cylinder, means for preventing the rotation of said secondary piston.

5. A device of the class described including a primary cylinder, a plate closing one end thereof and provided with a restricted opening, a primary piston slidable in the cylinder and having a reduced projection piercing the restricted opening, the diameter of the projection being smaller than the diameter of the opening, a frustoconical portion at the juncture of the primary piston with its projection for seating in the opening, an atomizer unit in the projection, a secondary cylinder in the primary piston, a secondary piston slidable in the secondary cylinder, said secondary piston being of hol-

low construction, a pair of check valves, one in the projection of the primary piston and the other in the secondary piston adjacent the projection, a spring associated with the primary piston normally holding its frusto-conical portion closed against the restricted opening, a member mounted on the primary cylinder and having a threaded opening, a cylindrical member threaded in the threaded opening, said secondary piston having a portion extended through said threaded member, means for preventing longitudinal movement of the secondary piston through said threaded member, and means for turning said threaded member for moving said secondary piston in said secondary cylinder.

In testimony whereof I affix my signature.

CLARENCE JAMES AKE.