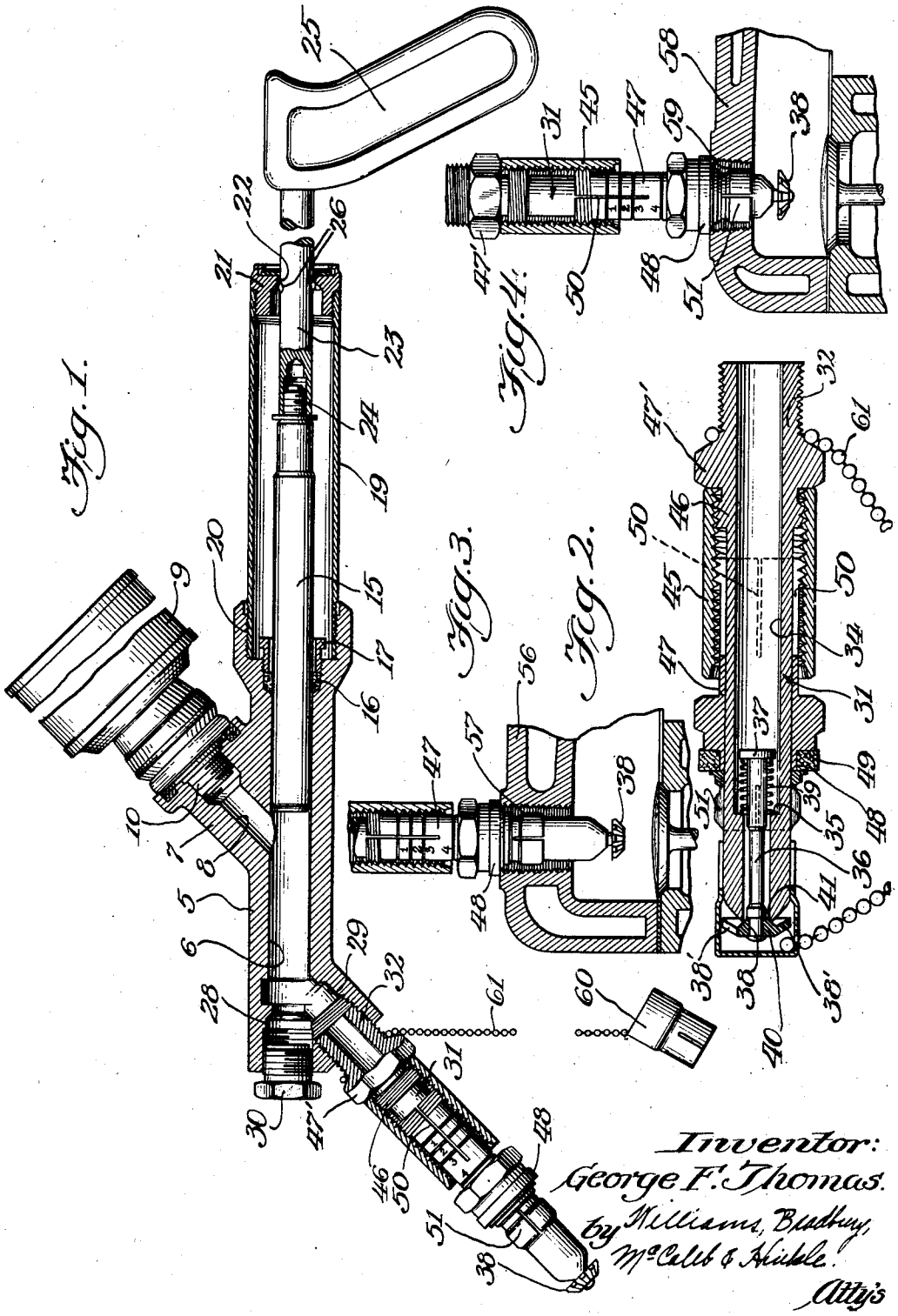
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DECARBONIZING APPARATUS

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# UNITED STATES PATENT OFFICE

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## DECARBONIZING APPARATUS

Application filed June 17, 1930. Serial No. 461,812.

My invention relates to apparatus for use in supplying decarbonizing solvents to the cylinders of an internal combustion engine. It has been found to be effective in removing carbon from the cylinders in internal combustion engines to inject a certain quantity of a suitable solvent into the cylinders. This solvent loosens the carbon deposits so that they may be discharged through the manifold upon operation of the engine.

In the copending joint application of myself, Olaf Ternstrom and Rawson Lile, Serial No. 399,433, filed October 14, 1929, is disclosed a pumping device for injecting carbon solvents into the cylinders of an engine to decarbonize or remove carbon deposits from the engine.

My present invention relates directly to the apparatus disclosed in the above-mentioned copending application and is an improvement thereon.

It has been found that the use of a decarbonizing injector of this type requires the injection of liquid into spark plug ports of engines of different makes and sizes, some having a shallow combustion chamber, some a deeper one, others a short spark plug port, and still others a relatively longer one, and therefore it is highly desirable to provide a means whereby one injector may be used universally to inject liquid into all of the various types and sizes and makes of combustion engines now in use. One of the main requirements is to locate the atomizing or spraying point of the nozzle directly in the center of the combustion chamber or as near thereto as possible in order to insure an even and equal distribution of the liquid throughout the combustion chamber. By providing a readily adjustable nozzle for use on such an apparatus, I overcome the necessity of having a special compressor for each of the different types of combustion chambers.

It is an object of my invention to provide an improved liquid injecting device or decarbonizing apparatus of the type described in the above-mentioned copending application.

Another object of my invention is to provide an adjustable nozzle for such an injector for supplying carbon solvent to various types of combustion chambers.

Another object of my invention is to provide an adjustable nozzle for supplying carbon solvent to the combustion chambers of engines having different sized cylinder heads and spark plug ports.

Another object of my invention is to provide improved means for quickly effecting such an adjustment of the nozzle so that the device may be readily applied to different sized cylinder heads.

And still another object of my invention is to provide improved means of maintaining the position of the nozzle when once adjusted and prevent accidental change of this adjustment during the operation of the injector.

Other objects and advantages of my invention will readily become apparent from the following detailed description and from the accompanying drawing, in which similar characters of reference indicate similar parts throughout the several views.

Fig. 1 is a sectional elevation of a liquid pumping device, including the improved form of nozzle of my invention;

Fig. 2 is an enlarged cross-sectional view of the nozzle portion of the pumping device shown in Fig. 1;

Fig. 3 is a fragmentary cross-sectional view of a combustion chamber illustrating the manner in which my device is applied, and

Fig. 4 is a fragmentary cross-sectional view of a different type of combustion chamber illustrating the manner in which my device is applied.

Referring now to the drawing, in Fig. 1 I have illustrated a pumping device such as is disclosed in the said joint copending application, Serial No. 399,433, which comprises a body member 5 having a cylinder 6 formed therein. A boss 7 is formed on the body 5 and contains a passageway 8 which communicates with the cylinder 6. A container 9 of the solvent to be used in removing carbon from the engine is mounted on the boss 7 by a quick detachable leak proof connecting means carried by an axially bored plug 10. This connection is shown in the copending

application of Ernest W. Davis, Serial No. 388,343, filed August 26, 1929.

A plunger 15 is reciprocably mounted in the cylinder 6 and extends through one end of the body 5. A packing 16 surrounds the plunger 15 and a packing nut 17 threaded in the end of the cylinder 6 holds the packing in place to prevent leakage while permitting reciprocation of the plunger 15.

A cylindrical shell 19 is mounted at one end of the body 5 by threads 20 and the other end is partially closed by a screw plug 21 having an aperture 22 therein. A plunger rod 23 is screw-threaded to the plunger 15 at 24 and passes through the aperture 22 in the plug 21. A suitable handle 25 is secured to the end of the plunger rod 23 for operating the plunger 15.

The plunger rod 23 is crimped at 26 to serve as a stop when engaging the edges of the aperture 22 in the plug 21, thereby limiting the outward movement of the plunger 15. The forward end of the cylinder 6 communicates with two branched outlets 28 and 29, respectively, each of which are screw-threaded to receive a plug 30, which is shown in Fig. 1 screwed into the outlet 28. A nozzle 31 is screw-threaded at one end 32 and adapted to fit in either the outlet 28 or outlet 29 and is shown in the drawing, Fig. 1, as threaded in the outlet 29.

The interior of the nozzle has a longitudinal bore 34 which extends throughout its length and is slightly reduced at its lower end to form a shoulder 35, as shown in Fig. 2. A valve stem 36 is reciprocably mounted within the longitudinal bore 34 and has a head 37 formed at its upper end and a toothed spraying disc 38 secured at its lower or outer end. A compression spring 39 surrounds the stem 36 and is seated at one end on the shoulder 35, while the other end engages the under sides of the head 37 of the stem 36.

The toothed spraying disc 38 is provided with teeth 38′. The inner conical surface of the center hub of the disc 38 forms a valve 40 which is adapted to seat on the end 41 of the nozzle 31, as illustrated in Fig. 2. It will be noted that the spring 39 normally raises the headed stem 36 and maintains the valve 40 against its seat 41, thereby closing the end of the passageway in the nozzle 31.

It will also be noted that pressure upon the head 37 of the stem 36 will compress the spring 39 and move the combined spraying disc 38 and valve closure 40 downwardly, as shown in Figs. 3 and 4, thereby opening the end of the passageway 34 to permit discharge of the solvent into the interior of the combustion chamber.

A metal cap or guard 60 is provided for protecting the spraying disc and nozzle when the injector is not in use and is shown attached to the injector in a suitable manner by a chain 61. The guard is adapted to be placed on the nozzle as shown in Fig. 2.

In the nozzle of my invention, as illustrated in Fig. 2, an internally screw-threaded sleeve 45 is mounted on a projecting screw-threaded rib 46 at the upper end of the nozzle 31 and surrounds the outer surface of the nozzle with considerable clearance throughout the major portion of its length. A second sleeve 47 surrounds the outer surface of the nozzle 31 and slides thereon and its upper end is provided with external screw threads for engaging the internal threads of the sleeve 45. It will thus be noted that the second sleeve 47 may be moved upwardly and downwardly upon the nozzle 31 by screw-threading the sleeve 47 into and out of the sleeve 45. This rotation of the sleeve 47 is accomplished by means of an adjusting nut 47′. A leak-proof gasket 48 is suitably mounted in a groove 49 at the lower end of the sleeve 47 to provide a projecting shoulder.

An adapter 51 fits over the lower end of the nozzle 31 and is split and sprung outwardly to frictionally engage the nozzle. This adapter is placed over the nozzle from the lower end and pressed upwardly against the gasket 48 aiding in maintaining the gasket on its seat. The adapter 51 is to be used on the nozzle for large spark plug ports to provide a firm seat. If the spark plug port is of small diameter the adapter 51 may be removed during the spraying operation.

It will be noted that the upper end of the sleeve 47 is split at 50, these upper end portions being sprung inwardly so that when screwed into the sleeve 45 they will press outwardly and thus cling more securely to the internal threads in the sleeve 45. The possibility of accidental rotation of the sleeve 47 is thus greatly reduced because of this frictional engagement and the sleeve will remain in the position in which it is set until readjusted.

Fig. 3 shows a fragmentary view of the head 56 of an internal combustion engine of a well-known type which has, among other things, a screw-threaded spark plug port 57, while Fig. 4 shows a fragmentary view of another head 58 of an internal combustion engine which is of a different size than the head 56 illustrated in Fig. 3 and has a screw-threaded spark plug port 59.

When the operator of the combustion engine wishes to use the device of my invention to inject decarbonizing solvent into the combustion chamber of the engine, he runs the engine until it is hot, removes a spark plug, and inserts the nozzle 31 of the injector into the spark plug openings 57 or 59, as shown in Figs. 3 and 4, with the gasket 48 abutting the top of the cylinder head. A container of decarbonizing solvent is mounted on my de-

vice as hereinbefore described and the plunger 15 is withdrawn to allow decarbonizing solvent to flow into the cylinder 6 and the nozzle 31. The plunger is then advanced, acting as a valve to close the passageway 8, and prevent return of the liquid to the container 9, and placing the solvent in the cylinder 6 and passageway 36 under pressure, whereupon the pressure of the solvent upon the head 37 will compress the spring 39 and move the stem 36 downwardly to move the combined spraying disc 38 and valve closure 40 away from the seat 41 and allow solvent to be sprayed by the spraying disc 38, and thus distribute it evenly to all parts of the combustion chamber, as is more completely described in my copending application.

When the plunger 15 reaches the limit of its discharge stroke, the pressure on the head 35 will be reduced and the valve 40 will be reseated at the ends of the nozzle 31 and prevent further discharge of liquid. The spark plug may then be replaced and a second spark plug removed from the next succeeding cylinder and the same operation performed until all of the cylinders have been charged with decarbonizing solvent. The reason for removing but one spark plug at a time is to prevent the cylinders from cooling off before the solvent is injected as each must be thoroughly warm for efficient results.

In the use of an injector having an adjustable nozzle of my invention, the operator first determines the exact distance between the spraying disc 38 and gasket 48 which will be necessary to locate the spraying disc in the center of the combustion chamber of the engine. This will be entirely dependent on the depth of the spark plug port and the size of the combustion chamber, the main object of course being to locate the spraying disc or atomizing point as nearly equi-distant from the top as from the bottom of the combustion chamber to insure a proportionate distribution of liquid. This adjustment may be accomplished by rotating the sleeve 47 about the discharge nozzle 31 by means of the adjusting nut 47' within the sleeve 45 until the correct adjustment is obtained.

Should the operator then desire to spray the interior of a combustion chamber of much narrower width and having a spark plug port relatively shallower than that shown in Fig. 3, the sleeve 47 may be unscrewed from the sleeve 45 the desired distance which will bring the spraying disc portion closer to the gasket shoulder portion 48, as shown in Fig. 4, and thus provide a proper adjustment for discharging liquid to a smaller or narrower combustion chamber. As illustrated in the drawing, the outer surface of the sleeve 47 may be calibrated to correspond with the proper adjustment which shall be necessary, for example, to spray liquid to the combustion chambers of various popular makes of automotive vehicles. The operator may then predetermine the proper adjustment necessary and set the nozzle by means of the calibrations to the required depth of the combustion chamber and proceed to inject the carbon dissolving liquid.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a device for supplying liquid to the combustion chamber of an internal combustion engine, a spray nozzle for insertion in the spark plug port of the combustion chamber, means for adjusting the amount of the spray nozzle which shall be extended into the spark plug port, said means comprising a sleeve rotatably surrounding said nozzle and screw-threaded thereto, and a shoulder for engaging the edges of the spark plug port formed on said sleeve whereby the amount of the spray nozzle which shall enter the spark plug port may be readily varied by rotation of the sleeve.

2. In a device for supplying liquid to the combustion chamber of an internal combustion engine, a high compression nozzle communicating with a compressor cylinder for receiving liquid therefrom for insertion in the spark plug port of the combustion chamber, a valve in said nozzle normally closing the outlet and adapted to be opened by an increase in pressure in the compression nozzle, a spraying tip formed on said valve to distribute liquid to the combustion chamber, and a sleeve surrounding the high compression nozzle and screw-threadedly secured thereto, having a shoulder formed at the lower end of said sleeve for engaging the edges of the spark plug port of the combustion chamber, whereby the distance between the spraying tip and said shoulder may readily be varied.

3. In a device for supplying a carbon removing liquid to the combustion chamber of an internal combustion engine, a high compression nozzle carried by a pump for supplying liquid thereto, the end of said nozzle being adapted to enter the spark plug port of a combustion engine, a spraying tip formed on the end of said nozzle, and a sleeve surrounding said nozzle and screw-threadedly secured thereto, having a shoulder at its lower end adapted to engage the outer edge of the spark plug port whereby, upon rotation of said sleeve, the distance between the spraying tip and said shoulder may readily be varied.

4. In a device for supplying a carbon removing liquid to the combustion chamber of an internal combustion engine, a discharge nozzle adapted for mounting on a pump for supplying liquid thereto and shaped to enter the spark plug port of a combustion engine, a sleeve surrounding said nozzle and having a shoulder to abut against the cylinder head around said spark plug port, and a frictional

screw-threaded connection between said sleeve and said nozzle whereby the distance between said shoulder and the end of the discharge nozzle may be varied.

5. In a device for supplying a carbon removing liquid to the combustion chamber of an internal combustion engine, a discharge nozzle adapted for mounting on a pump for supplying liquid thereto, the end of said nozzle being shaped to enter the spark plug port of a combustion engine, an internally screw-threaded sleeve secured to the upper end of said nozzle, a second sleeve surrounding said nozzle and rotatable thereon having screw-threads at its upper end for engaging the internal threads of the first-mentioned sleeve, the upper portion of the second sleeve being split and sprung inwardly to frictionally engage the first-mentioned sleeve, a shoulder formed on the lower end of the second sleeve adapted to abut the outer edge of the spark plug port, a gasket surrounding said shoulder to provide a leak-proof connection when the nozzle is inserted within the spark plug port, and an adjustment nut formed on the second sleeve for rotating it about the nozzle to vary the distance between the shoulder on the second sleeve and the end of the discharge nozzle.

6. In a device for supplying a carbon removing liquid to the combustion chamber of an internal combustion engine, a discharge nozzle adapted to enter the spark plug port of a combustion engine, a source of liquid under pressure for supplying liquid to said nozzle, and an adjustable shoulder for cooperating with the edge of the spark plug port for limiting the extent to which the nozzle will be lowered into the combustion chamber.

7. In a device for supplying a carbon removing liquid to the combustion chamber of an internal combustion engine, a discharge nozzle adapted to enter the spark plug port of a combustion engine, means for supplying liquid to said nozzle, and an adjustable sleeve frictionally engaging said nozzle and having a shoulder for limiting the depth at which such nozzle shall be lowered into the combustion chamber.

8. In a device for supplying a carbon removing liquid to the combustion chamber of an internal combustion engine, a discharge nozzle adapted to enter the spark plug port of a combustion engine, an internally screw-threaded sleeve secured to the upper part of said nozzle, and an externally screw-threaded sleeve surrounding said nozzle and frictionally engaging said first-mentioned sleeve and having a shoulder for engaging the edge of the spark plug port to limit the amount of the nozzle which shall enter the combustion chamber.

9. In a device for injecting liquid into the combustion chamber of an internal combustion engine, the combination of a nozzle tube, having a spraying tip, and adapted for insertion into the combustion chamber through a port thereof with a sleeve slidably positioned on said nozzle tube and having an external shoulder near one end thereof providing a seat for engaging the periphery of the port through which the nozzle tube is inserted, and manipulative means carried by said nozzle tube for cooperating with said sleeve for adjusting the position of said shoulder with respect to the spraying tip.

10. In a device for spraying fluid onto the walls of combustion chambers of internal combustion engines, the combination of a spray nozzle adapted for insertion into the combustion chamber through a port thereof with a sleeve frictionally secured on said nozzle tube and having an annular shoulder providing a seat for engaging the edges of said port for determining the depth to which the spray nozzle shall be lowered into the combustion chamber, and manipulative means cooperating with said sleeve for adjusting the position of said shoulder on said spray nozzle.

11. In a device for spraying fluids onto the walls of combustion chambers of internal combustion engines, the combination of a high compression nozzle in communication with a source of fluid under pressure and adapted for insertion into the combustion chamber through a port thereof with a shoulder for limiting the length to which said nozzle shall be extended into the combustion chamber, a sleeve for adjusting the position of said shoulder relative to the discharge end of the nozzle and calibrated indicia carried by said nozzle for indicating the length to which the nozzle extends into the combustion chamber.

In witness whereof, I hereunto subscribe my name this 9 day of June, 1930.

GEORGE F. THOMAS.