INJECTOR FOR CARBON REMOVER FLUID

Filed March 5, 1954 2 Sheets-Sheet 1

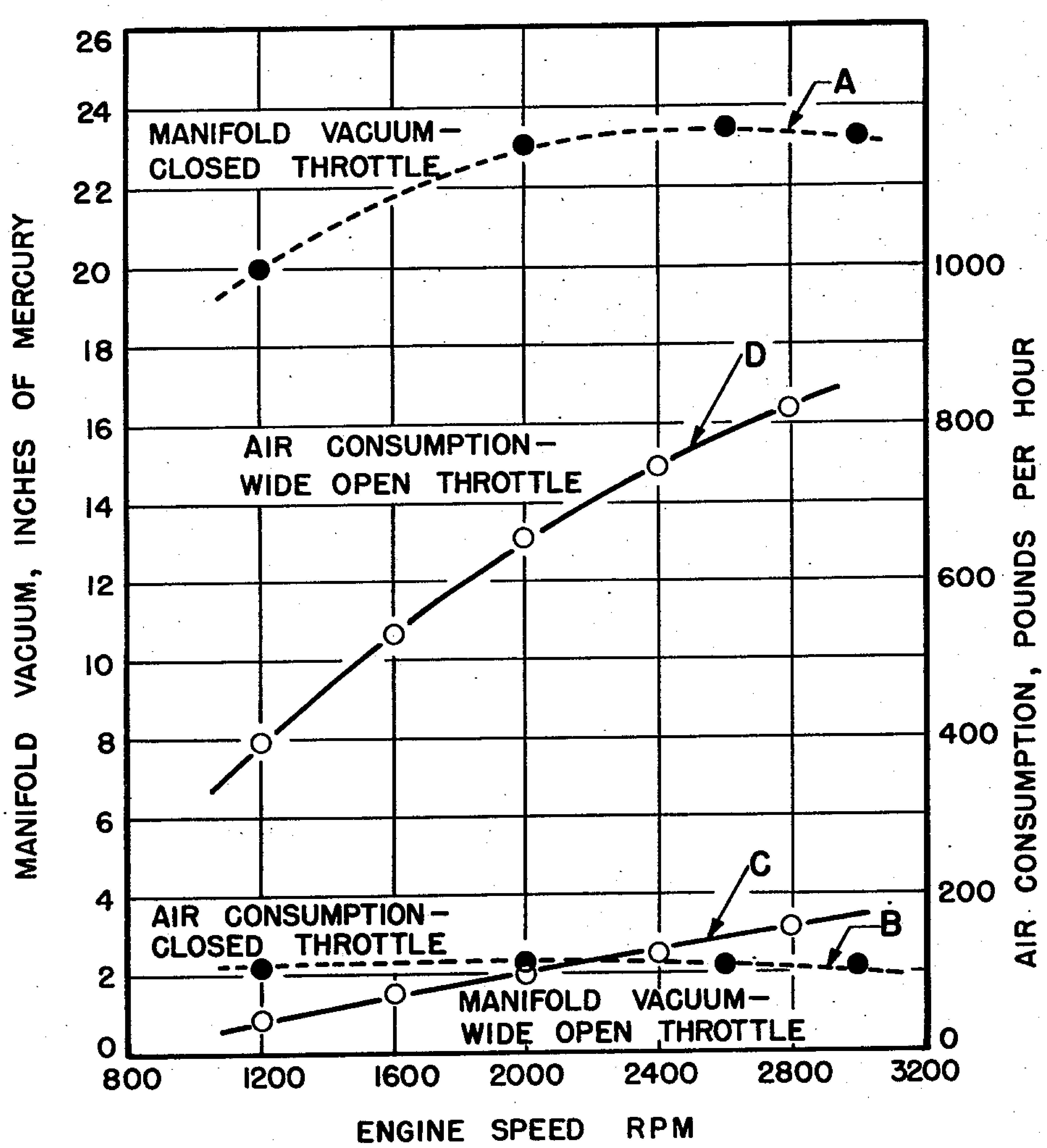

FIGURE I

EARL BARTHOLOMEW
INVENTOR.

BY Kenneth Swartwood

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Filed March 5, 1954 2 Sheets-Sheet 2

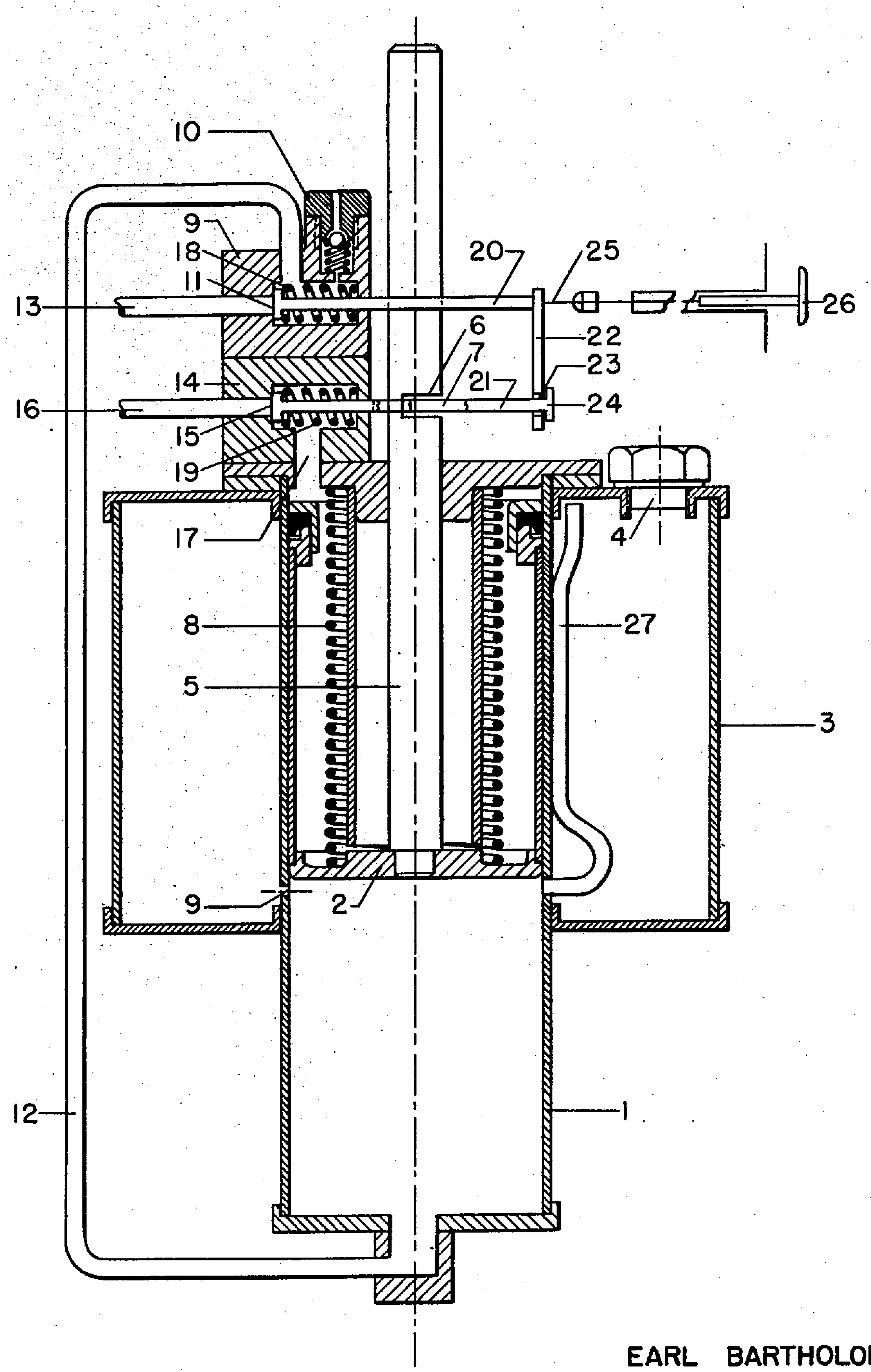

FIGURE 2

EARL BARTHOLOMEW
INVENTOR.

BY Kenneth Swartwood

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INJECTOR FOR CARBON REMOVER FLUID

Earl Bartholomew, Birmingham, Mich., assignor to Ethyl Corporation, New York, N. Y., a corporation of Delaware

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2 Claims. (Cl. 123—198)

This invention relates to a method of injecting carbon remover fluid into an internal combustion engine and the apparatus to accomplish this result for the purpose of removing objectionable deposits in the combustion chamber.

In an earlier period it was common practice to employ the vacuum in the intake manifold of an internal combustion engine to transfer carbon remover fluids from the reservoir of an injector to the intake manifold. Subsequent development of automotive engines for improved performance at high speed has included large increases in the cross-sectional area of the fuel induction system. As a consequence, the pressure differential between that in the intake manifold and atmospheric pressure, commonly termed manifold vacuum, is quite low at full throttle, even at high engine speed. Thus, there is insufficient difference in pressure to aspirate such liquids into the manifold at full throttle. However, full throttle operation is desirable during injection to provide the velocity and control required for good distribution of the carbon removing liquid to the various cylinders via the intake manifold.

It is therefore an object of the present invention to provide a process of injecting a pre-determined amount of a carbon removing fluid into an internal combustion engine under full throttle operating conditions. It is likewise an object of this invention to provide apparatus for accomplishing this process. A particular object of the present invention is to provide a process and apparatus for injecting a predetermined amount of a carbon removing fluid into an internal combustion engine involving concurrent fluid actuation and positive control of fluid expulsion. Other important objects of this invention will become apparent from the discussion hereinafter.

The above and other objects are accomplished by practicing my invention which resides in features of construction within the spirit and scope of my apparatus and in providing for the cooperation of such features in accordance with my processes of operation.

My invention can be best understood by referring to the drawings in which:

Figure 1 is a plot of manifold vacuum in inches of mercury pressure and air consumption in pounds per hour in relation to extreme throttle settings (throughout a range of engine speeds) frequently encountered in passenger car service. The data for the plot, obtained with modern high compression ratio automobiles, are typical of the conditions existing in the fuel induction systems at both closed and wide open throttle conditions with vehicle speeds of approximately 30.6 to 81.6 miles per hour.

Figure 2 is a schematic drawing partially in cross-section, illustrating a device for injection of carbon remover fluid into an operating engine.

Referring now to Figure 1, it is apparent that the greatest pressure differential (i. e. manifold vacuum) obtainable in modern automotive engines occurs with closed throttle, represented by curve A. However, under these conditions the rate of air consumption is low as

shown by curve B. At full throttle the converse is true, curves C and D indicating respectively that the manifold vacuum is low and the rate of air consumption is relatively high. To effectively inject a carbon removing fluid into such engines it is highly desirable to utilize the relatively high rate of air consumption existing when the throttle is open so that the fluid attains sufficient velocity to be uniformly distributed in the cylinders and on the associated engine parts. To do this, however, it is necessary to impose a supplemental force upon the fluid since the manifold vacuum alone is insufficient at open throttle to result in engine induction solely by aspiration.

A device capable of injecting a pre-determined amount of carbon removing fluid under full throttle conditions is represented in Figure 2. Referring to this figure, fluid container 1, equipped with a piston 2, is surrounded on the upper part of its length by concentric cylinder 3 which is a reservoir for carbon remover fluid. The reservoir is provided with a filler plug 4. The lower portion of container 1 has a volume equal to that of the fluid required for one injection, whereas cylinder 3 has a volume equal to that of the fluid for several injections. The volumes of the container 1 and cylinder 3 are connected by orifice 9. Although not shown, it is to be understood that the reservoir for the fluid can be separated from the fluid container 1 if desired. In such a case the volumes of the separated containers can be connected by means of any suitable type of conduit leading from the reservoir to the orifice 9.

Piston rod 5 is rigidly attached to piston 2 and is normally retained in the position shown by means of a disengageable retention means which comprises a latch member 7 and latch receiving means 6. In this position the piston actuating means 8 is ineffectual.

The valve head assembly on the upper surface of the injector consists of two discreet portions comprising suction valve and dispensing valve assemblies. As shown, the dispensing valve assembly is positioned on top of the suction valve assembly. It is to be noted, however, that these assemblies can be laterally placed on the upper surface of the injector.

The dispensing valve assembly, which includes a housing 9, a check valve 10, and a disc type valve 11, is connected to container 1 by means of conduit 12 and to the intake manifold (not shown) by conduit 13. The suction valve assembly comprising a housing 14 and a disc type valve 15 is connected to the intake manifold by conduit 16 and to the upper volume of cylinder 1 above piston 2 by means of orifice 17. The disc type valves 11 and 15 are normally held in the closed position as shown by springs 18 and 19 respectively.

Disc type valves 11 and 15 are rigidly attached to arms 20 and 21 respectively, which in turn are operatively connected by means of slide member 22. The slide member 22, which is pivotally connected to arm 20, engages arm 21 by means of an opening 23 in the member and a stop 24 on the end of arm 21.

The manual actuation system as shown consists of a pull wire 25 attached to one end to slide member 22 and the other end to a button 26 placed on the instrument panel (not shown) of the vehicle.

The operation of the device is as follows. A pull on button 26 causes valves 11 and 15 to open and concurrently disengages latch member 7 from latch receiving means 6, allowing the piston actuating means 8 to force piston 2 downwardly. The force imposed upon the liquid in container 1 causes the liquid to flow sequentially through conduit 12, into housing 9, past open valve 11 and through conduit 13 to the intake manifold. When button 26 is released valve 11 is closed by spring 18 but valve 15 remains open because latch member 7 is in contact with the cylindrical surface of piston rod 5. The pressure differential between the manifold vacuum communicated to the upper side of piston **2** through conduit **16** and orifice **17**, and atmospheric pressure imposed upon the lower surface of piston **2** through open check valve **10**, housing **9** and conduit **12** causes piston **2** to move upwardly. When piston rod **5** reaches the top of the stroke, latch member **7** engages latch receiving means **6** permitting valve **15** to close. During and subsequent to the repositioning of piston **2**, another charge of liquid flows from cylinder **3** to container **1**.

When making an injection of carbon removing fluid it is preferable to (1) allow the engine to warm up, (2) place the throttle in wide open position, (3) cut off the ignition and currently manually actuate the injector, (4) allow the engine to stand for at least 15 minutes, and (5) start the engine again. In this manner the pre-determined charge of the fluid is evenly and positively forced and carried through the intake manifold whence it impinges uniformly upon the hot engine deposits.

When the procedure of injection as described above is used, the cycle of operation of the device is interrupted with piston **2** at the bottom of its stroke. This interruption in the cycle provides a period of time during which the fluid acts upon the deposits resulting in a more efficient treatment. After the engine is started again and the manifold vacuum pressure exceeds the force asserted upon piston **2** by actuating means **8**, the piston is automatically repositioned and the lower portion of fluid container **1** is charged with carbon remover fluid.

I have found that the efficiency of operation of the apparatus of this invention is enhanced by using as actuating means **8** a spring having a low spring rate, that is, a spring in which the ratio of units of force per unit of deflection is low. By so doing, the force imposed upon the liquid as it is injected is substantially constant and uniformly applied throughout the entire injection stroke of the piston.

Although not shown in Figure 2, it is preferable to equip piston **2** with a lip-type seal so that by-pass of liquid between the piston and the cylinder wall is obviated. Such a seal should possess a low coefficient of friction with the inner surface of the cylinder and a high resistance to deterioration in the presence of organic solvents of the type used in carbon remover fluids. I have found that lip-type seals made from polychlorotrifluoroethylene of polytetrafluoroethylene are eminently suited for this purpose.

As shown in Figure 2, it has also been found efficacious to provide breather tube **27** positioned oppositely to orifice **9**. By extending this tube to a locus just below filler plug **4**, the tendency for the formation of vapor lock resulting from the vapor pressure of carbon removing liquids at underhood temperatures is avoided.

The use of means substantially independent of intake manifold pressure to expel carbon remover fluid into the engine at wide-open throttle results in the liquid being swept into the cylinders by an air stream of high velocity. This is in contrast to previous injection devices which relied on manifold vacuum for aspiration of the fluid into the engine at closed throttle, under which condition an insignificantly small amount of air flows through the manifold to the cylinders.

The high velocity of the air and liquid in the manifold which is associated with this invention has at least three advantages. First, there is a more nearly equal distribution of the liquid to the cylinders. Second, a smaller quantity of liquid is required for an injection since no cylinder tends to receive less than its proportionate amount of the charge. Third, the high velocity of the liquid entering the cylinders causes the liquid to be splashed onto all surfaces of the combustion chamber. Thus, unlike previous injection devices which relied upon manifold vacuum for aspiration of the fluid into the engine, devices adapting the principles of operation of this invention assure efficient contact between carbon remover and deposits accumulated on engine ports, valves, piston crown surfaces, cylinder walls, piston rings, and the like. Consequently, the efficiency of deposit removal resulting from this invention is dependent almost entirely upon the effectiveness of the carbon remover fluid employed.

Another advantage of this invention is simplicity of operation. Actually the operator is required only to place the throttle in wide open position and actuate the injector, although it is preferable to concurrently cut off the ignition. However, if the ignition is left on inadvertently, the sudden influx into the cylinders of typical carbon remover liquid in the form of a dispersion or spray "kills" the engine, that is, temporarily prevents its continued operation. This in turn prevents the fluid from being expelled from the engine through the exhaust system without an opportunity to cleanse the engine.

In the use of previous injection devices, a multiplicity of carefully coordinated operations was necessary which experience proved was beyond the ability of the average motorist. It was necessary to open the throttle and allow the engine to attain high speed in order to create a high vacuum in the manifold when the foot was lifted from the throttle and to provide sufficient momentum of the engine for aspiration of the liquid. No means existed for indication of the proper engine speed. Simultaneously with the lifting of the foot from the throttle it was necessary to operate the valve of the injector and to turn off the ignition switch. If the ignition was left on it was probably that engine operation would continue, particularly in view of the high degree of engine momentum necessarily required for injection using manifold vacuum. The result was that the fluid injected primarily as a stream of liquid not only had virtually no residence period in the engine to exert its intended action, but was burned to a greater or lesser degree with the formation of large amounts of offensive vapors and smoke.

Other modifications of my invention are possible within the spirit and scope of the following claims.

I claim:

1. An apparatus for introducing a pre-determined amount of fluid into an internal combustion engine comprising in combination a container adapted to receive a pre-determined amount of fluid, a discharge outlet positioned on said container and adapted to be placed in communication with an intake manifold of an internal combustion engine, a fluid driving member positioned within said container and adapted for movement therein, delivery means independent of the intake manifold pressure for driving said member so as to expel fluid from said container through said outlet, through a dispensing valve assembly and into said engine, repositioning means dependent upon the intake manifold pressure for repositioning said member, said repositioning means containing a suction valve assembly, and means for simultaneously opening but sequentially closing said dispensing valve assembly and said suction valve assembly in the order named.

2. An apparatus for introducing a pre-determined amount of fluid into an internal combustion engine comprising in combination a fluid container adapted to receive a pre-determined amount of fluid; a reservoir having a greater volume than said container, said reservoir and said container being connected by fluid transferring means; a piston positioned within said container; a spring mounted on said piston; a piston rod attached to said piston, said rod containing a latch receiving means; a fluid discharge outlet positioned on said container; a dispensing valve assembly connected by a fluid conduit to said discharge outlet, said dispensing valve assembly comprising a housing, a check valve and a fluid dispensing valve; a fluid conduit leading from said fluid discharge valve to the intake manifold of said engine; a suction valve assembly comprising a housing and a suction valve; a manual actuation means adapted to simultaneously open said dispensing valve and said suction valve and to cause

said piston to drive fluid from said container through said discharge outlet, said fluid conduits and said dispensing valve assembly to the intake valve of said engine, said actuation means adapted to thereafter sequentially close said dispensing valve and said suction valve in the order named; said actuation means containing a latch adapted to engage said latch receiving means when said piston is in retracted position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,051,207	Fitzgerald	Jan. 21, 1913
1,282,015	Le Maire et al.	Oct. 15, 1918
1,498,918	Jensen	June 24, 1924
1,722,791	Gillen	July 30, 1929
1,749,312	Blair	Mar. 4, 1930
2,277,749	Eckel et al.	Mar. 31, 1942