Dec. 1, 1942. J. C. W. FRAZER ET AL 2,303,992

INJECTOR NOZZLE

Filed Oct. 9, 1940

Fig. 1.

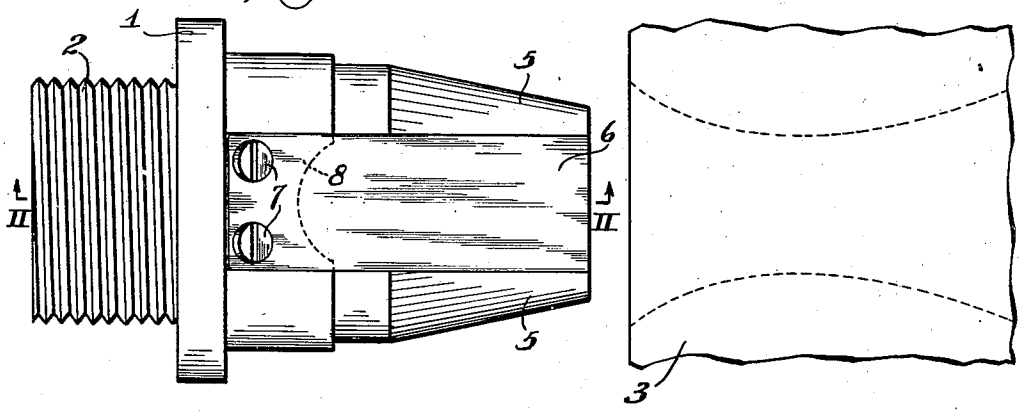


Fig. 2.

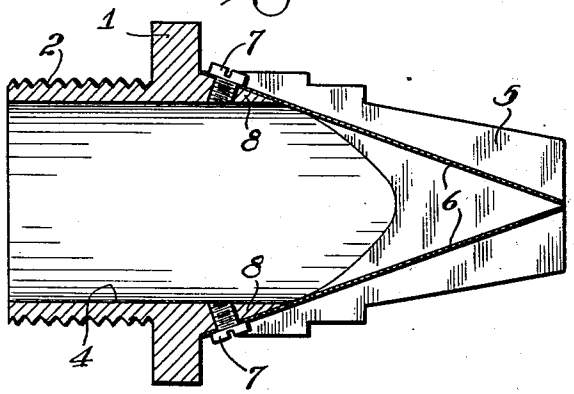


Fig. 3.

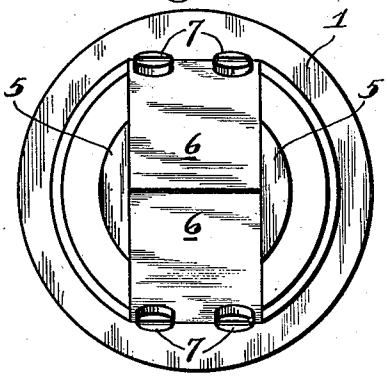
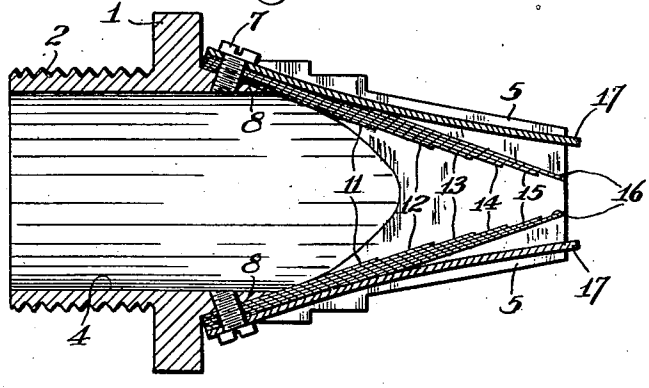


Fig. 4.



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INJECTOR NOZZLE

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3 Claims. (Cl. 299—133)

This invention relates to injectors for entraining a gas by a fluid flowing through the injector, and more particularly to injector nozzles for use with fluids of varying volume or pressure.

It is known that when a fluid issues at a certain velocity from an injector nozzle having a passage or orifice of fixed dimensions, the fluid entrains at a constant rate the gas surrounding the nozzle at the inlet of the injection throat or Venturi tube. It is also known that if the velocity of the fluid changes, due to change in volume or pressure, the rate of gas entrainment is varied thereby, but not in proportion to the volume of fluid flowing from the injector nozzle to the injection throat. Consequently, an injector that is designed to function satisfactorily with a fluid issuing from its nozzle at a certain velocity may operate unsatisfactorily in case the velocity of the fluid varies, as it may do in some instances, as in the case of internal combustion engines.

Various processes have been proposed for eliminating carbon monoxide and other combustible constituents of internal combustion engine exhaust gases which involve mixing the gases with air to supply oxygen for the combustion of such constituents. For various reasons the amount of air mixed with the gases should not greatly exceed that needed to supply sufficient oxygen for the combustion, but difficulties have been encountered in applying injectors for that purpose. Thus, the volume of exhaust gases varies as the engine idles, labors and changes speed, and the content of combustible matter likewise is varied through the same and other factors. Hence the amounts of air needed vary widely, and experience has shown that injectors of ordinary constructions are incapable of properly supplying air to the exhaust gases over the entire range of operating conditions. For example, injector nozzles designed to supply air properly under certain conditions of operation fail to supply sufficient air if the volume of exhaust gases, or their pressure, decreases, while their increase may, and commonly does, cause the injector to choke. Also, devices of modified construction, such as those embodying a plurality of nozzles, have been found to be unsatisfactory, either practically or economically. For this and other purposes it would be desirable to have an injector capable of supplying definite amounts of gas under widely varying operating conditions.

It is among the objects of this invention to provide an injector which functions satisfactorily over widely varying volumes and pressures of fluid flowing therethrough, which includes an injector nozzle from which fluid issues at a constant velocity regardless of changes in its volume and pressure, and which is dependable in operation, simple in construction, and relatively inexpensive.

In accordance with this invention there is provided an injector nozzle having a fluid passage a portion of the wall of which is normally inclined toward the opposite portion of the passage wall to close or nearly close the passage when fluid flows through it. This converging portion of the wall is adapted to be moved outwardly by the pressure of fluid flowing through the nozzle whereby the area of the outlet is controlled by the pressure of fluid flowing through the nozzle so that the velocity of the fluid issuing from the outlet remains substantially constant at all times. More specifically, the wall of the nozzle passage has at least one portion the inner end of which is mounted in fixed position and the outer end of which is movable toward and away from the opposite portion of the passage wall to vary the area of the outlet of the passage. This movable portion of the wall is biased inwardly in any suitable manner, but is adapted to be moved outwardly by the pressure of the fluid in the passage.

The invention is illustrated in the accompanying drawing in which Fig. 1 is a side view of the injector nozzle showing it disposed at the inlet end of an injection throat; Fig. 2 is a longitudinal section through the nozzle, taken on the line II—II of Fig. 1; Fig. 3 is an end view of the nozzle; and Fig. 4 is a view, similar to Fig. 2, of a modified embodiment.

Referring to Figs. 1, 2 and 3 of the drawing, an annular base memer 1 has a threaded nipple 2 at one end adapted to be connected by any suitable conduit to the supply of fluid that is to flow through the nozzle and into a Venturi tube 3 forming the injection throat. The base member is provided with a central opening 4 and with a pair of opposed, fixed wall members 5 projecting from the base member axially of the opening from diametrically opposite sides thereof. Disposed between the fixed wall members is a second pair of wall members 6 forming therewith a conduit or passage through the nozzle for fluid flowing through base member opening 4. The inner faces of wall members 5 are parallel, and wall members 6 are formed of a pair of thin metal strips disposed between walls 5 at right angles thereto with their opposite edges in sliding contact with the parallel surfaces. The inner ends of these strips are secured to the base member on diametrically opposite sides of the opening therethrough. This is preferably accomplished by connecting the inner ends of the strips by screws 7 to the outer surfaces of short wall portions 8 of base member 1 between fixed members 5.

It is a feature of this invention that the size of the outlet from the passage through the nozzle is controlled by the fluid flowing therethrough so that the velocity of the fluid issuing from the

nozzle will remain substantially constant regardless of variations in volume and pressure of the fluid flowing through the opening in base 1. Accordingly, the metal strips are resilient and are so mounted between fixed members 5 that their outer edges approach each other and are preferably in contact when the injector is not in use. This is preferably brought about by beveling the outer faces of short wall portions 8 so that strips 6 attached thereto converge toward the outer end of the nozzle. The flow of fluid through the nozzle flexes the resilient strips and spreads their outer ends apart so that there is provided a variably apertured outlet whose area is controlled by the pressure of fluid flowing through the nozzle. If the pressure of the fluid increases, the strips are separated still further. On the other hand, when the pressure decreases, the resiliency of the strips brings their free ends back toward each other and diminishes the size of the passage outlet accordingly.

The embodiment of the invention shown in section in Fig. 4 is fundamentally the same in construction and operation as the one just described. However, instead of being provided with only two resilient strips, it has a plurality of overlapping resilient strips 11, 12, 13, 14, 15 and 16 at each of two sides of the passage through the nozzle, and each set of these strips is covered and protected by a rigid plate 17. The inner end of each plate and the inner ends of the underlying resilient strips are all secured to a wall portion 8 of the base member 1 by screws 7. The rigid plates are bent outwardly permanently so that they will not interfere with the movements of the resilient strips. The innermost strip of each set is relatively short, and each succeeding adjoining strip is longer than the preceding one. Due to this arrangement of the resilient strips vibration of the long outer strips is dampened and the noise resulting therefrom thereby eliminated. Nevertheless, no restraint is placed on the movements of the strips for changing the size of the nozzle passage in accordance with the pressure of the fluid flowing through the nozzle.

Although the injectors disclosed herein are intended for use wherever the volume and pressure of fluid flowing through the nozzle fluctuates materially, they are especially suitable for use in the treatment of exhaust gases from internal combustion engines to eliminate poisonous and noxious gases and vapors, and combustible constituents in general, from the exhaust gases. The gases are first mixed with sufficient oxygen to oxidize their combustible constituents and the mixture is then subjected to a catalyst capable of effecting such oxidation. The oxygen is added to the combustible constituents by mixing air with them, generally by means of an injector. However, the volume of exhaust gases from an automobile engine fluctuates widely, due to engine speed, carburetor setting and other conditions, and heretofore it has been found to be virtually impossible to properly treat those gases under all conditions encountered.

This important problem is solved in a dependable, inexpensive and automatic manner by the invention disclosed herein. When the volume of exhaust gases is quite small, the nozzle orifice is likewise small so that the velocity of the gases issuing therefrom is sufficient to entrain enough air to oxidize their combustible constituents. If the volume of gases increases, the nozzle orifice is opened wider, whereby the velocity of the gases does not increase to an extent where the amount of air entrained bears an improper relation to the increased volume of gases. Consequently, the exhaust gases are properly treated regardless of fluctuations in their volume.

With some fluids, such, for example, as exhaust gases, the nozzle must be able to withstand high temperatures in order to be dependable in operation at all times. The only part of the nozzle that presents any problem in this connection is the metal strips. Although they may be made in different thicknesses and of different composition, it has been found that satisfactory and efficient operation is had with strips 0.008 inch thick made of tungsten high speed steel, such as the well-known 18–4–1 tungsten-chromium-molybdenum steel.

According to the provisions of the patent statutes, we have explained the principle and construction of our invention, and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. An injector nozzle comprising a base member provided with an opening therethrough, a pair of opposed fixed wall members associated with said base member at opposite sides of said opening, and a pair of flexible wall members disposed between said fixed members with their inner ends connected to said base and converging toward each other outwardly from said base, said flexible walls forming with said fixed walls a conduit for fluid flowing through said opening, said flexible walls being responsive to the pressure of said fluid to vary the area of the outlet of said conduit, and each of said flexible walls including a plurality of resilient strip members the inner one of which is shorter than the outer one.

2. An injector nozzle comprising a base member provided with an opening therethrough, a pair of opposed fixed wall members associated with said base member at opposite sides of said opening, a pair of flexible wall members disposed between said fixed members with their inner ends connected to said base and converging toward each other outwardly from said base, said flexible walls forming with said fixed walls a conduit for fluid flowing through said opening, said flexible walls being responsive to the pressure of said fluid to vary the area of the outlet of said conduit, and a substantially rigid plate overlying each of said flexible walls with its major portion spaced therefrom, and each of said flexible walls including a plurality of resilient strip members the inner one of which is shorter than the outer one.

3. An injector nozzle provided with a passage for fluid conducted thereto, said passage having a wall at least a portion of which is flexible and normally inclined toward the opposite portion of the passage wall, and said flexible portion of the wall including a plurality of resilient strip members superimposed for a portion of their length with the inner one shorter than the outer one, and said strip members being adapted to be moved outwardly by the pressure of fluid flowing through said passage whereby the size of the passage outlet is controlled and thereby the outlet velocity of the fluid is maintained substantially constant.

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