April 8, 1958 J. J. KUPKA 2,829,873

PRESSURE CARBURETOR

Filed Oct. 22, 1956

2 Sheets-Sheet 1

Fig. 1.

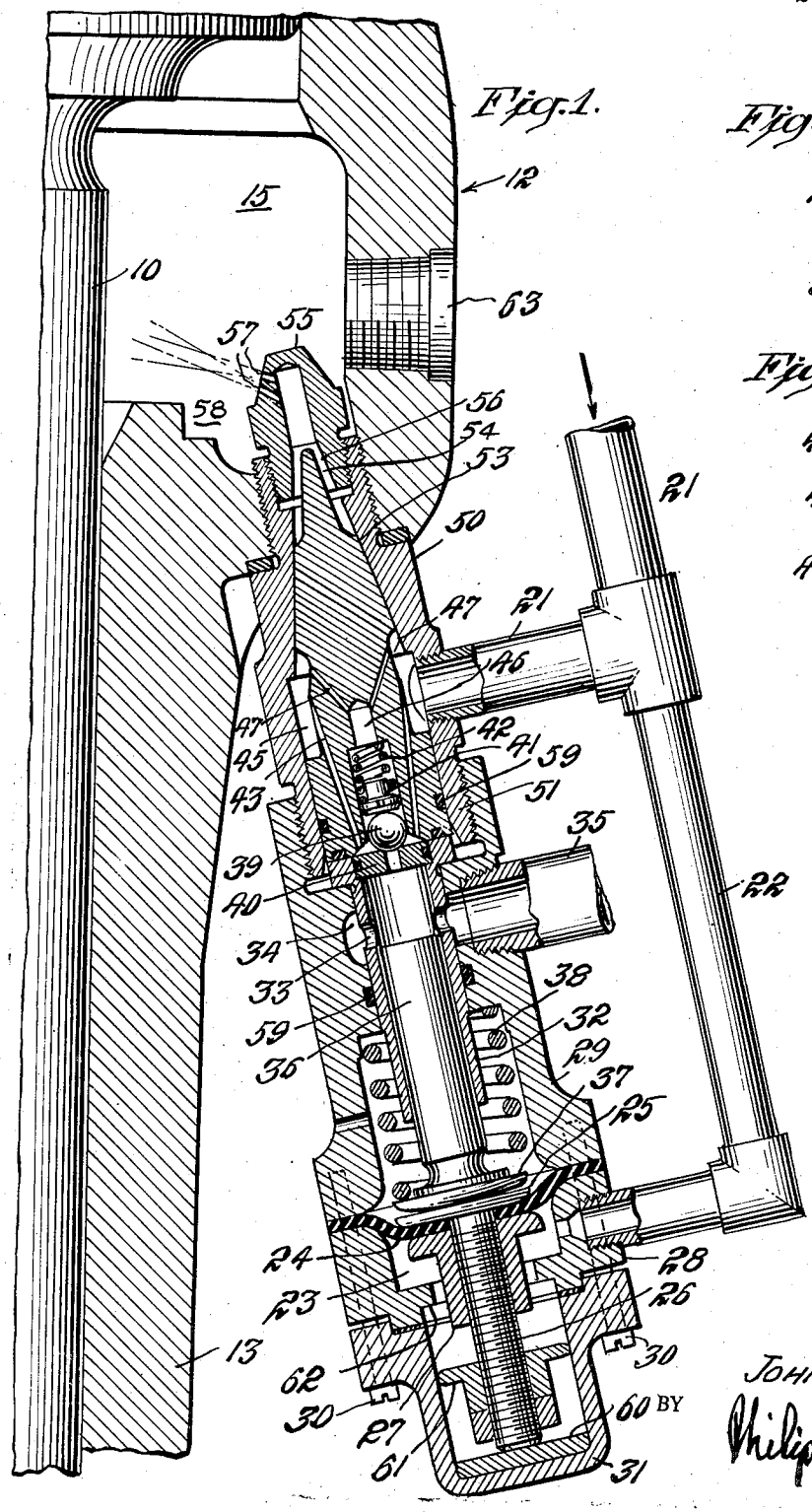


Fig. 3.

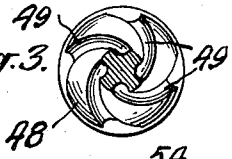
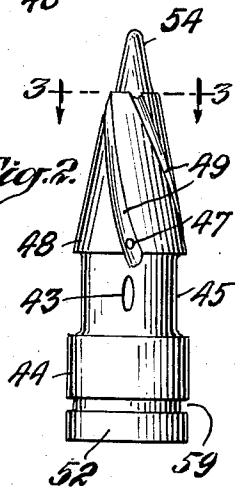


Fig. 2.



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2 Sheets-Sheet 2

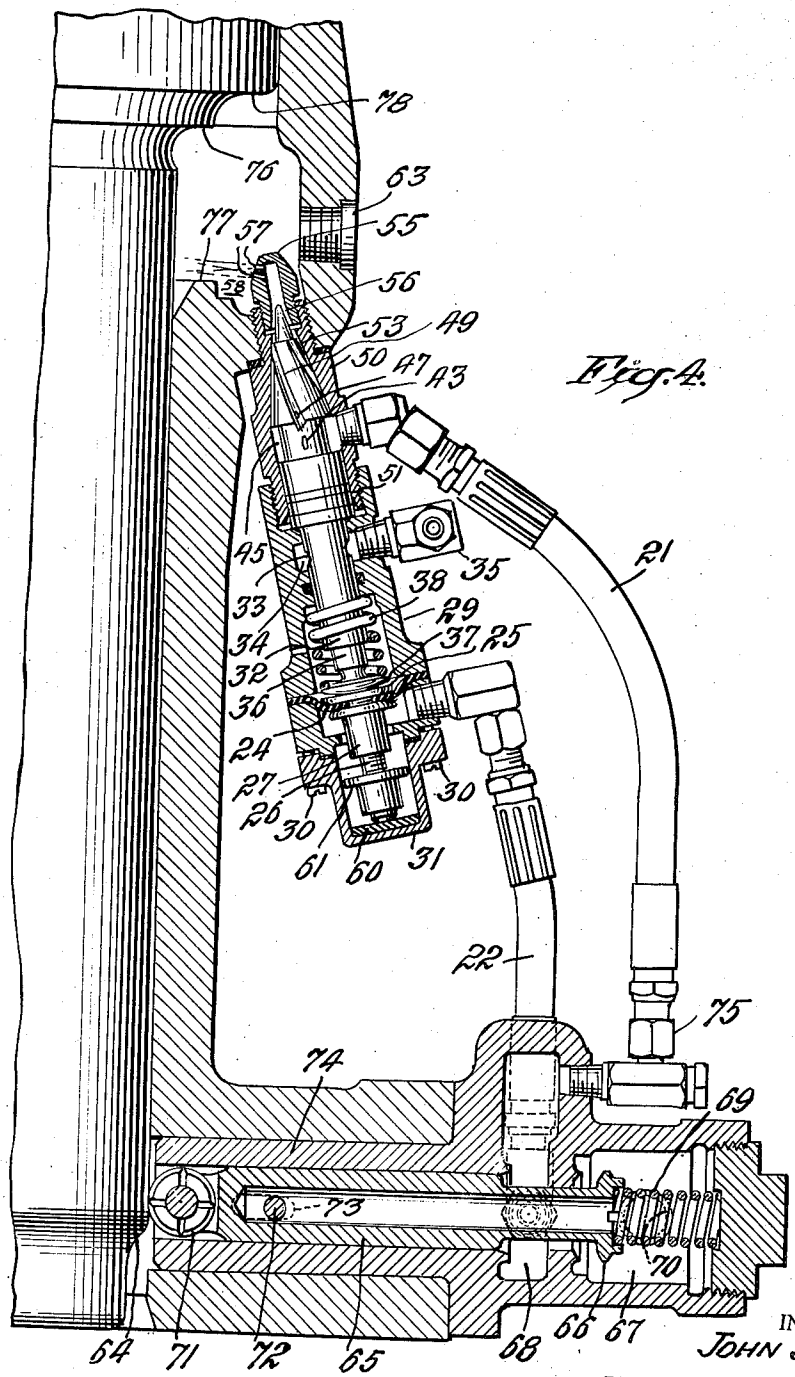


Fig. 4.

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2,829,873

PRESSURE CARBURETOR

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Application October 22, 1956, Serial No. 617,451

18 Claims. (Cl. 261—35)

The invention herein disclosed is a pressure carburetor, so named because of the fact that the mixture of fuel and air created by the device is injected into the combustion zone under pressure instead of being induced in the usual way by suction.

Objects of the invention have been to provide a carburetor which would accurately measure and thoroughly combine the fuel and air in a uniform combustible mixture and inject such mixture under effective pressure in properly timed relation.

Particularly it has been a purpose of the invention to provide a carburetor which would stand up under the severe operating conditions experienced with internal combustion power hammers of the type disclosed in the Kupka Patent No. 2,755,783 of July 24, 1956.

Accordingly the invention has been developed with a view to keeping the parts few in number and of simple sturdy construction and so arranged that the shock and stress of such operations would not affect the structure or operation of the carburetor.

It is a further purpose of the invention to provide a carburetor having characteristics such as mentioned which will be made up of relatively simple, easily assembled parts, which can be produced at reasonable cost and which will be fully automatic in its action and be free of servicing requirements.

The foregoing and other desirable objects are accomplished by the novel features of construction, combination and relation of parts as hereinafter described and claimed and illustrated in the accompanying drawings.

The drawings referred to show by way of example a present preferred embodiment of the invention but it will be apparent from the following that the structure may be modified and changed as regards the immediate illustration, all within the true intent and scope of the invention as herein defined and claimed.

Fig. 1 is a central longitudinal sectional view of one of the carburetors as mounted and in use on a pile hammer like that disclosed in the Kupka patent above-identified, portions of the hammer being shown broken away and in section and connections to the carburetor also broken and partly in section.

Fig. 2 is an elevation of the diffuser cone.

Fig. 3 is a sectional view of the latter as on line 3—3 of Fig. 2.

Fig. 4 is a view similar to Fig. 1 on a smaller scale, showing the carburetor connected up with the supply valve.

In Fig. 1 only enough of the power hammer is illustrated to show application of the carburetor thereto.

Thus in this view there is indicated the lower ram forming portion **10** and the enlarged upper piston forming portion **11** operating in a two diameter cylinder **12** having a lower guide section **13** for the ram and an upper larger diameter air compressor chamber forming section **14** for the piston.

This combination provides at the juncture of the larger and smaller cylinder sections, an annular combustion chamber **15** beneath the head of the piston, all as fully disclosed in the Kupka patent.

A further feature of the patent mentioned is a poppet valve actuated by a cam on the lower end of the ram for admitting air compressed by the piston into this annular combustion chamber for combination with fuel injected therein substantially at the bottom of the piston stroke.

In the present invention, the combustible mixture is made up outside and injected as a charge into the combustion chamber by a cam actuated poppet valve or the equivalent, which may be and is here shown as utilized for effecting injection of the complete mixture.

Piping for carrying the combustion air from this timing and supply valve to the carburetor is indicated in Fig. 1 at **21** and as a further special feature, an extension of this piping is indicated at **22** for furnishing pressure to actuate the fuel pumping element of the carburetor.

The latter power conducting, pressure carrying connection is shown as opening into a chamber **23** beneath a flexible diaphragm **24** clamped beneath the extended flat head **25** of screw **26** by screw sleeve **27**.

This diaphragm is clamped about its edges between the cap or bushing **28** and the end of the body or barrel member **29** and held in this relation by the screws **30** extending through the end or cover cap **31** and through the bushing **28** into the end of body member **29**.

Within the latter there is mounted a liner or sleeve, forming a pump cylinder **32**, ported at **33** to take gasoline or other fuel from a surrounding chamber **34** fed by fuel line **35**.

Operating in sleeve **32** is a plunger **36** to cover and uncover valve ports **33** and to expel a charge of fuel taken in through these ports.

The lower end of this piston plunger is shown as having an extended rounded head **37** bearing on the head **25** of the plunger forming diaphragm screw and engaged by coiled spring **38** tending to hold the plunger retracted and the diaphragm depressed as shown in Fig. 1.

The upper end of the pump sleeve **32** is shown as closed by an upwardly opening check valve made up of companion ball **39** and valve seat **40**.

A loosely guided stud **41** bearing on the ball and engaged by spring **42** holds the check valve normally closed.

Fuel forced by the pump past the check valve passes through outwardly divergent passages **43** in the base of diffuser cone **44** into an annular space at **45** where it joins with air supplied through the connection **21**.

Other fuel is forced from the central bore **46** ahead of the check valve through the more sharply divergent passages **47** into the same surrounding annular air receiving chamber **45**.

The head of the diffuser is conical as shown at **48** and this conical portion is rifled as shown at **49** in spiral grooves which are deepest at the larger end of the cone and are shallower or tapered down toward the smaller end of the cone.

The diffuser fits closely within a barrel or housing **50** having a cylindrical base end **51** which screws into the end of the body member **29** and contains the cylindrical outer end portion **52** of the diffuser.

The upper or inner end portion of the casing is conically tapered at **53** to closely fit the taper of the diffuser and to wall in the spiral diffuser grooves **49**.

The inner end of the cone is continued as a reduced conical extension **54** for leading the mixture in annular form into the base of the nozzle **55**.

This nozzle is shown as screwed in to the end of the diffuser housing and as having a conically tapered central opening **56** to freely receive the conical tip or point of the diffuser cone.

Convergent outlet passages **57** in the side of the nozzle discharge the mixture in crossing and intermingling streams into the base of the annular combustion chamber **15**.

The combustion chamber forming part of the hammer may be inset or pocketed as indicated at **58** so that the carburetor unit may be screwed up through the bottom of the annular portion of the combustion chamber, thus to locate the carburetor in a slightly inclined position, as nearly as possible parallel with the axis of the hammer.

By thus locating the carburetor with its longitudinal extent as nearly parallel with the axis of the hammer, the shock and strain on the parts is less and action on the pump is along the axis of the pump rather than at an angle thereto.

The annular air admission chamber may be formed by grooving the cylindrical base portion of the diffuser cone as shown in Fig. 2 so as to provide necessary chamber space when the cone is seated in the housing **50**.

Fig. 2 shows how the fuel passages **43** and **47** may open into the grooved air chamber forming portion **45** and into the initial ends of the spiral grooves **49** in the diffuser cone to assure co-mingling, atomization and complete mixture of the fuel with admitted air which has been heated by compression.

The seat member **40** of the check valve may be a Teflon washer and this element, like the diffuser, pump sleeve and possibly other parts, may be suitably packed as by O-ring elements at **59**.

The end cap **31** is shown as containing a resilient disc **60** cushioning the out-stroke of the diaphragm plunger.

The inward movement and hence the feed stroke of the pump piston is shown as fixed by a stop flange **61** adjustably screwed on the stem of the diaphragm plunger and engageable with a stationary flange **62** on the member **28** which with the body member **29** and end cap **31** forms the body or housing of the device. By adjusting this stop flange the forward stroke and hence the amount of fuel injected may be varied according to requirements. Once set the fuel injection may be constant, except possibly as fuel supply may be varied by external control, shut-off or the like.

A particular advantage of the invention is that the carburetor as a whole is in the nature of a small diameter short plug which can be quickly screwed into position or be removed and is made up of screw connected sleeve elements, which can be quickly and easily assembled or disassembled.

The operation is simple, positive and direct. Air compressed for combustion purposes and supplied in properly timed relation by cam operated poppet valve or other mechanism through connection **22** lifts the diaphragm **24** to actuate plunger **36** to force the charge of fuel taken in through ports **33** in pump cylinder **32**, out through check valve **39**, **40** through fine passages **43** and **47** into surrounding chamber **45** which at the time is being loaded with combustion air from the main source of supply through connection **21**. This air and fuel is swirled and further compressed and accelerated through the contracting rifling grooves in the diffuser cone, finally issuing through the crossed jet openings in the nozzle as a complete, thoroughly atomized, dry combustible mixture in the base of the annular combustion chamber **15**.

Ignition may be effected by a spark plug or other igniting device, mounted in a seat adjacent or over the carburetor nozzle as indicated at **63**.

While of particular importance for pile hammers and other reciprocating forms of tools where vibration and shock are serious factors, it will be appreciated that the invention is well adapted for other very different forms of engines and combustion devices.

The construction is such that the carburetor may be operated in any position rendering it adaptable for use in special locations or for special operations.

In all positions the action is positive and accurate.

While particularly suited to constant load operation, the fuel supply may be varied by adjusting the stroke of the pump.

By using pressure of the combustion air to operate the pump, automatic timing is accomplished without resorting to mechanically driven mechanism such as gears and cams. There is thus accomplished a saving in parts with attendant advantages.

The check valve at the entrance to the diffuser cone avoids the possibility of back fire.

The discharge nozzle assists or completes atomization of the air-fuel mixture and while that shown is particularly effective, it will be realized that nozzles of different form or with different kinds of discharge orifices may be substituted and that other changes may be made, all within the true intent and scope of the invention as claimed.

Fig. 4 shows how the carburetor may be connected up with a supply valve operated in properly timed relation by a cam or the like on the hammer or other power machine with which the invention is used.

This view shows the ram as having a cam **64** at the lower end for operating a plunger **65** carrying a poppet valve **66** controlling passage of compressed air from inlet chamber **67** to the supply chamber **68** and the air connections **21** and **22** leading to the diffuser and the diaphragm of the carburetor.

The inlet chamber **67** is connected with air storage tank or other supply by connection **69**. The valve is forced to closed position by spring **70** and the plunger valve stem **65** is shown as carrying a roll **71** at the inner end for engagement with the actuating cam of the ram. The valve stem is held against turning so as to keep the roll in proper riding engagement with the ram by cross-pin **72** operating in slots **73** in the surrounding guide **74**.

The air line **21** to the mixing chamber is longer and of greater frictional resistance than the air line **22** to the diaphragm, giving time for the pump to operate to furnish fuel to the air reaching the mixing chamber.

The air supply line **21** may be equipped with a non-return check valve, indicated at **75**, to avoid any tendency to backfire.

To prevent any possible injury to the carburetor in event of the pile dropping away from the hammer and the ram falling to the bottom of its movement, the ram is shown provided with an annular shoulder **76** and the cylinder with stop shoulder **77** engageable thereby and the underside of the piston is shown as recessed or pocketed at **78** to provide clearance for the innermost portion of the carburetor if the ram should engage shoulder **77**.

What is claimed is:

1. Pressure carburetor comprising the combination of discharge nozzle, diffuser having convergent contracting spiral passages leading to said nozzle, an annular air supply and mixing chamber about and in communication with the larger end of said spiral passages, divergent fuel passages leading to said air supply chamber, a check valve at the entrance to said fuel passages, a fuel pump in back of and in communication with said check valve, fluid pressure operable means for actuating said pump disposed in back of and in line with said pump, a common housing containing and supporting said elements in unitary relation, air supply connections extending to the portions of said housing containing said air supply chamber and said fluid pressure operable means and a fuel supply connection extending to that portion of the housing containing said fuel pump.

2. Pressure carburetor comprising the combination of discharge nozzle, diffuser having convergent contracting spiral passages leading to said nozzle, an annular air supply chamber about the larger end of said spiral passages, divergent fuel passages leading to said air supply chamber, a check valve at the entrance to said fuel passages, a fuel pump in back of said check valve, fluid pressure operable means for actuating said pump and air

supply connections extending to said air supply chamber and to said fluid pressure operable means, said nozzle, diffuser and pump operating means being disposed longitudinally in concentric relation within a tubular housing providing a longitudinally extended plug construction, and said air supply connections being entered in the side of said housing near the inner and outer ends of the same and a fuel connection with the intermediate portion of the housing in line with the pump therein.

3. Pressure carburetor comprising the combination of discharge nozzle, diffuser having convergent contracting spiral passages leading to said nozzle, an annular air supply chamber about the larger end of said spiral passages, divergent fuel passages leading to said air supply chamber, a check valve at the entrance to said fuel passages, a fuel pump in back of said check valve, fluid pressure operable means for actuating said pump and air supply connections extending to said air supply chamber and to said fluid pressure operable means, said nozzle, diffuser, and pump operating means being disposed longitudinally in concentric relation within a tubular housing providing a longitudinally extended plug construction and said housing including screw thread connected tubular members enclosing the diffuser pump and pump operating means whereby said several parts are accessible by disconnecting said sections of the housing.

4. Pressure carburetor comprising the combination of discharge nozzle, diffuser having convergent contracting spiral passages leading to said nozzle, an annular air supply chamber about the larger end of said spiral passages, divergent fuel passages leading to said air supply chamber, a check valve at the entrance to said fuel passages, a fuel pump in back of said check valve, fluid pressure operable means for actuating said pump and air supply connections extending to said air supply chamber and to said fluid pressure operable means, said pump including a pump cylinder in abutting engagement with said diffuser, said check valve being interposed between said pump cylinder and diffuser and said housing comprising removably connected sections holding said pump cylinder, diffuser and check valve in assembled relation and separable substantially in line with said elements for enabling individual inspection and removal of the same.

5. Pressure carburetor comprising the combination of discharge nozzle, diffuser having convergent contracting spiral passages leading to said nozzle, an annual air supply chamber about the larger end of said spiral passages, divergent fuel passages leading to said air supply chamber, a check valve at the entrance to said fuel passages, a fuel pump in back of said check valve, fluid pressure operable means for actuating said pump and air supply connections extending to said air supply chamber and to said fluid pressure operable means, said diffuser including a diffuser cone having said spiral passages in the conical portion of the same and said cone having an annular grooved portion to provide annular space for the air supply chamber and said cone further having said fuel passages formed therein.

6. Pressure carburetor comprising the combination of discharge nozzle, diffuser having convergent contracting spiral passages leading to said nozzle, an annular air supply chamber about the larger end of said spiral passages, divergent fuel passages leading to said air supply chamber, a check valve at the entrance to said fuel passages, a fuel pump in back of said check valve, fluid pressure operable means for actuating said pump and air supply connections extending to said air supply chamber and to said fluid pressure operable means, said housing carrying the nozzle and having a conically tapered socket in back of said nozzle and said diffuser including a diffuser cone fitting said socket.

7. Pressure carburetor comprising a tubular casing in longitudinally extended separable sections including a diffuser section and a pump section, a diffuser cone fitted in the diffuser section and held between the adjoining

diffuser and pump sections of the casing, a pump cylinder fitted in the pump section and held between said adjoining diffuser and pump sections, a pump plunger operating in said cylinder, a flexible diaphragm in operative engagement with said pump plunger and an air chamber removably engaged over the end of said pump section and securing and enclosing said diaphragm and provided with means for supplying operating air under pressure thereto.

8. Pressure carburetor comprising a tubular casing in longitudinally extended separable sections including a diffuser section and a pump section, a diffuser cone fitted in the diffuser section and held between the adjoining diffuser and pump sections of the casing, a pump cylinder fitted in the pump section and held between said adjoining diffuser and pump sections, a pump plunger operating in said cylinder, a flexible diaphragm in operative engagement with said pump plunger and an air chamber enclosing said diaphragm and provided with means for supplying operating air under pressure thereto and a check valve held between the adjoining ends of said diffuser cone and pump cylinder.

9. Pressure carburetor comprising four longitudinally extended separably connected casing sections, a diffuser cone in the first, inner section, said first section having an air supply chamber about said diffuser cone; a pump cylinder within the second section and in abutting engagement with the diffuser cone and whereby said parts are held by the connection of said two sections, a plunger operating in said pump cylinder, a flexible diaphragm for operating said plunger and clamped between the second and third sections of the casing, the fourth section of the casing being a cap enclosing the outer face of said diaphragm and forming an air chamber over said diaphragm and air supply connections to said first and third sections of the tubular casing for furnishing air to said air supply chamber and to said diaphragm.

10. Pressure carburetor comprising four longitudinally extended separably connected casing sections, a diffuser cone in the first, inner section, said first section having an air supply chamber about said diffuser cone; a pump cylinder within the second section and in abutting engagement with the diffuser cone and whereby said parts are held by the connection of said two sections, a plunger operating in said pump cylinder, a flexible diaphragm for operating said plunger and clamped between the second and third sections of the casing, the fourth section of the casing being a cap enclosing the outer face of said diaphragm and forming an air chamber over said diaphragm and air supply connections to said first and third sections of the tubular casing for furnishing air to said supply chamber and to said diaphragm and means for limiting the movement of said diaphragm and hence the stroke of the pump plunger actuated thereby and said stroke limiting means being accessible upon removal of said fourth cap forming section of the casing.

11. Pressure carburetor comprising the combination of diffuser having passages for combining fuel and air and for discharging the same under pressure as a combustible mixture, passages for delivering fuel to said fuel and air passages and an air supply and mixing chamber in communication with said fuel and air passages, a pump for delivering fuel to said fuel passages, pressure operable means for actuating said pump and means for delivering air under pressure from a common source separately to said air supply chamber and to said pressure operable means to thereby furnish fuel and the air for combustion in properly timed relation for combination in said fuel and air combining passages of the diffuser, said air delivering means including a connection to said pressure operable means and a separate connection of greater frictional resistance to said air supply chamber for effecting delivery of fuel to said air supply and mixing chamber substantially simultaneously with the delivery of air to said chamber.

12. Pressure carburetor comprising the combination of diffuser having passages for combining fuel and air and for discharging the same under pressure as a combustible mixture, passages for delivering fuel to said fuel and air passages and an air supply and mixing chamber in communication with said fuel and air passages, a pump for delivering fuel to said fuel passages, pressure operable means for actuating said pump and means for delivering air under pressure from a common source separately to said air supply chamber and to said pressure operable means to thereby furnish fuel and the air for combustion in properly timed relation for combination in said fuel and air combining passages of the diffuser, said air delivering means including a connection to said chamber having a non-return check valve therein.

13. Pressure carburetor comprising the combination of diffuser having passages for combining fuel and air and for discharging the same under pressure as a combustible mixture, passages for delivering fuel to said fuel and air passages and an air supply and mixing chamber in communication with said fuel and air passages, a pump for delivering fuel to said fuel passages, pressure operable means for actuating said pump and means for delivering air under pressure from a common source separately to said air supply chamber and to said pressure operable means to thereby furnish fuel and the air for combustion in propertly timed relation for combination in said fuel and air combining passages of the diffuser, said air delivering means including an intermittently operated supply valve and said separate connections from said supply valve to said chamber and pressure operable means, the connection to the pressure operable means being of less frictional resistance than the connection to said chamber whereby to effect substantially simultaneous delivery of fuel and combustion air to said chamber.

14. Pressure carburetor comprising the combination of a tubular shell having a discharge nozzle at one end and having a conical seat in said end convergent toward said discharge nozzle, a diffuser cone having a conical surface conforming to and closely fitting said conical seat, said cone having spiral grooves sunk in the conical surface of the same, sealed at the outside by the conical wall of said conical seat, said spiral grooves being open to the discharge nozzle at the smaller end of the cone, an air supply and mixing chamber within the tubular shell about the larger end of the cone and in communication with the ends of said spiral grooves, said diffuser cone having fuel passages extending from the base end portion of the cone into communication with said spiral grooves, means for supplying fuel to said fuel passages and means for supplying air to said mixing chamber.

15. The invention according to claim 14, in which said spiral grooves are of progressively diminishing dimensions toward the discharge nozzle end of the cone.

16. The invention according to claim 14, in which said tubular shell is in sections adjustably connected together and in which the base end of the diffuser cone is subjected to pressure of said connected sections and whereby it is forced firmly into solid engagement in said conical seat.

17. The invention according to claim 14, in which a check valve is provided at the base end of the diffuser cone in position controlling admission of said fuel passages.

18. The invention according to claim 14, in which said diffuser cone has an annular groove in the periphery of the same and in which said fuel passages open into said annular groove portion of the cone.

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