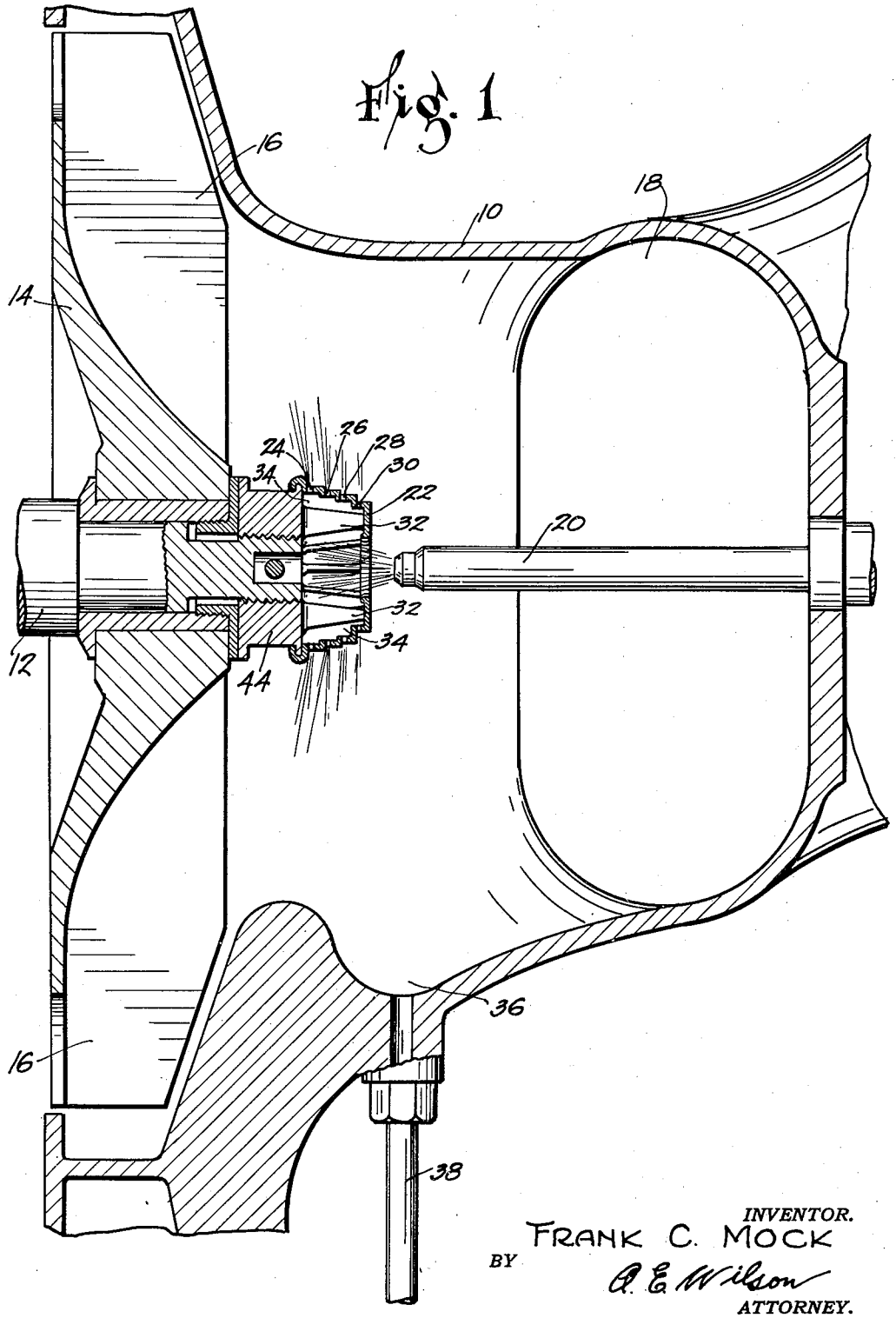
Aug. 25, 1942. F. C. MOCK 2,294,313

CHARGE FORMING DEVICE

Filed Nov. 21, 1938 3 Sheets-Sheet 1

Fig. 1



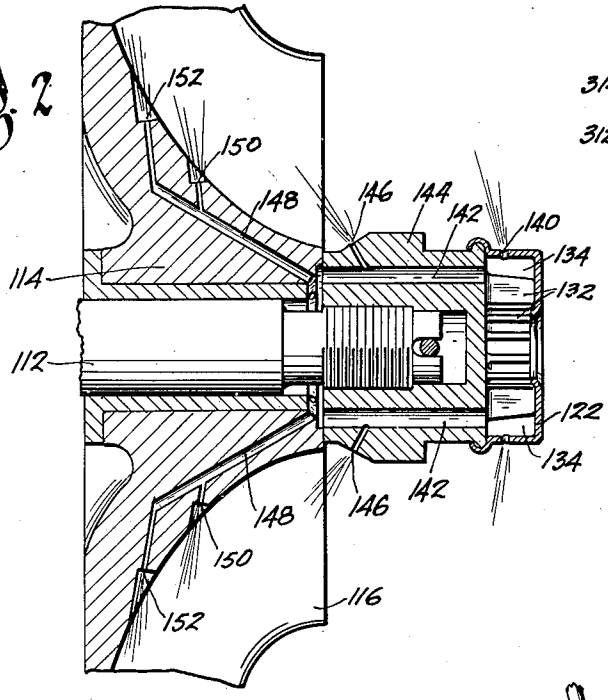
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CHARGE FORMING DEVICE

Filed Nov. 21, 1938 3 Sheets-Sheet 2

Fig. 2



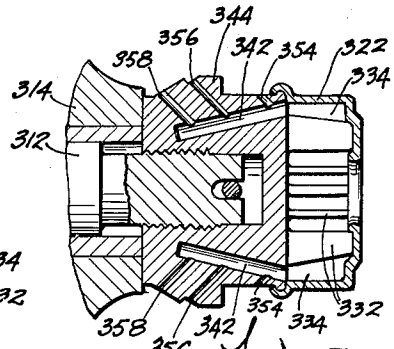


Fig. 5

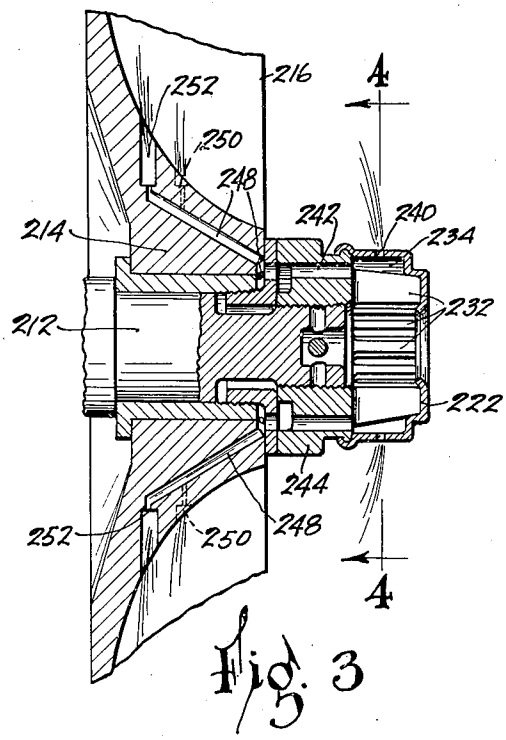


Fig. 3

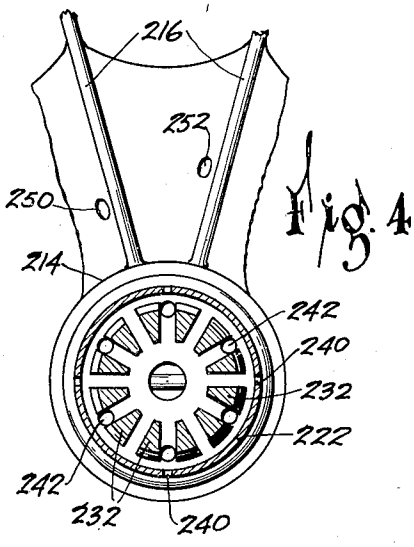


Fig. 4

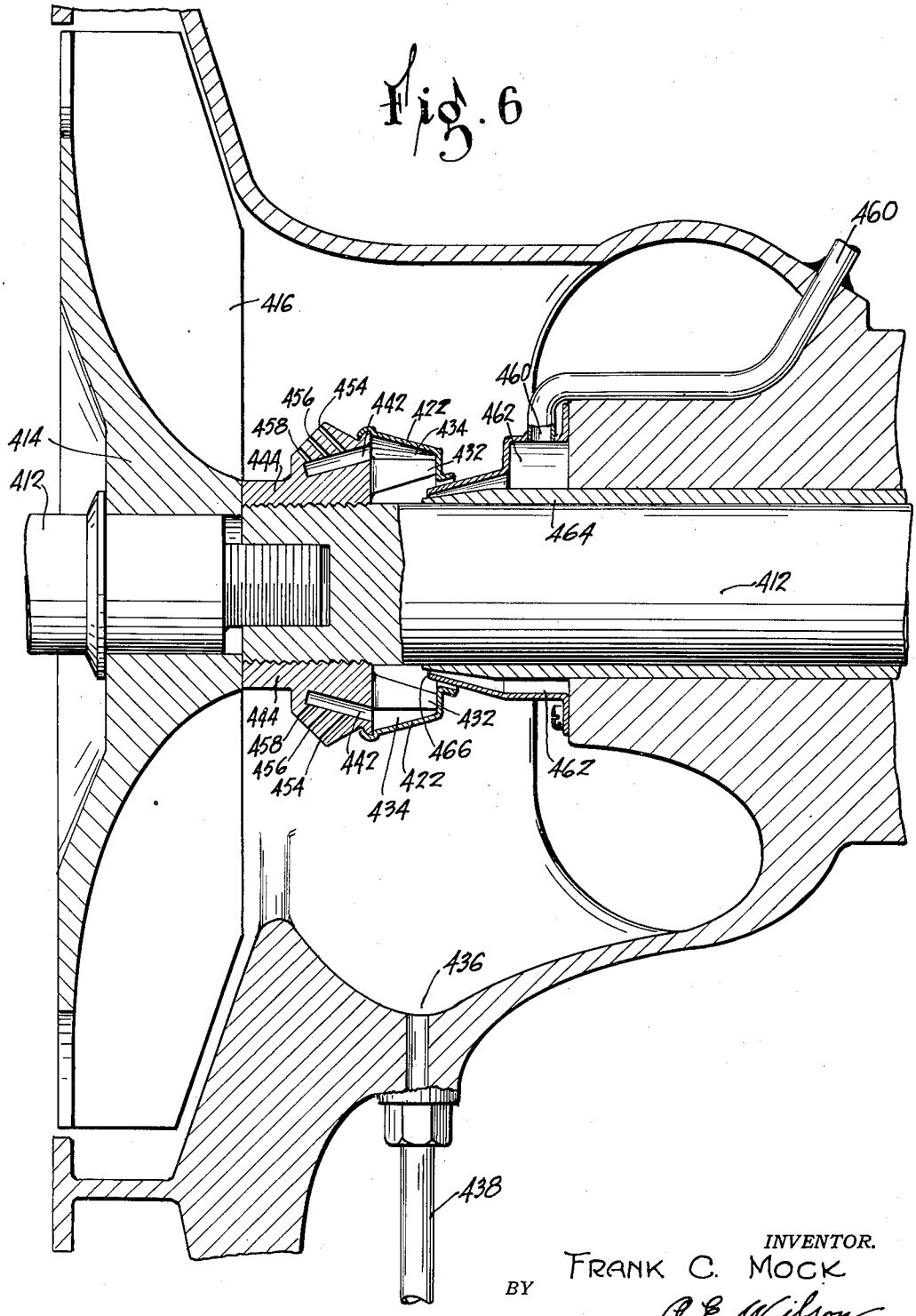
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Filed Nov. 21, 1938 3 Sheets-Sheet 3

Fig. 6



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UNITED STATES PATENT OFFICE

2,294,313

CHARGE-FORMING DEVICE

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Application November 21, 1938, Serial No. 241,596

18 Claims. (Cl. 261—89)

This invention relates to charge-forming devices, and more particularly to means for supplying a combustible mixture of fuel and air to engines.

The device of the invention is designed primarily for use with engines which employ superchargers to supply fluid to the combustion chambers of the engine at super-atmospheric pressure, such, for example as aircraft engines.

It has been found difficult to supply a combustible mixture to the cylinders of supercharged engines in such a manner that all of the cylinders receive a charge of fuel and air in the same proportion. This is particularly true in engines of the radial type, where the force of gravity tends to settle the heavier fractions of the fuel to the lower cylinders, or in the case of inline engines, to the cylinders nearest to the point of admission of the charge.

An object of this invention is therefore to provide a charge forming device in which uniform combustible charges are admitted to each of the cylinders of the engine.

A further object of the invention is to provide novel means for injecting liquid fuel to the midpoint of the supercharger, and distributing it outwardly to mix with the air supplied to the supercharger by means of centrifugal force of the rotating supercharger.

Another object is to provide fuel distributing means which will thoroughly atomize varying quantities of fuel supplied and distribute it evenly over the working circumference of the supercharger.

Yet a further object of the invention is to provide novel means for more thoroughly atomizing the fuel and distributing it more evenly to the cylinders of the engine than has been done heretofore.

Another object is to provide a supercharging carbureting device in which liquid fuel may be supplied to the supercharger at the midpoint thereof and discharged at several points spaced longitudinally of the supercharger shaft as well as radially thereof to mix with the air passing over the blades of the supercharger to more thoroughly atomize the liquid supplied.

A further object is to provide a novel supercharger spinner nut having impeller blades adapted to receive liquid fuel and to cause it to rotate to distribute the fuel outwardly under the action of centrifugal force.

Other objects and advantages of this invention will be apparent from the following detailed description, considered in connection with the accompanying drawings, submitted for purposes of illustration only and not intended to define the scope of the invention, reference being had for that purpose to the subjoined claims.

In the drawings, wherein similar reference characters refer to similar parts throughout the several views:

Figure 1 is a sectional view of a supercharging device embodying this invention;

Figure 2 is a view similar to Figure 1, showing a modified form of the invention;

Figure 3 is a view similar to Figure 2 showing a still further modified form;

Figure 4 is a sectional view taken on the line 4—4 of Figure 3;

Figure 5 is also a sectional view similar in many respects to Figure 2 showing another modified form of the invention; and

Figure 6 is a sectional view illustrative of how the invention may be applied to an engine in which the diffuser or spinner nut cannot be applied to the end of the supercharger shaft.

Referring now particularly to the embodiment of the invention disclosed on Figure 1, it will be observed that an engine casing 10 surrounds a supercharging device. The main or an auxiliary shaft 12 of the engine projects into the casing 10, and is provided with a bladed impeller 14 having radially extending blades 16. The blades 16 receive air from an air inlet passage 18, and direct it at an increased pressure to the intake manifold which communicates with the cylinders of the engine.

Means including a fuel nozzle 20 may be provided to supply liquid fuel to the supercharger. Any desired pressure inducing means may be employed to discharge the liquid fuel from the nozzle 20, either at constant pressure or at varying pressures dependent on the speed or rotation of the engine. In one desirable embodiment of the invention, the nozzle 20 may discharge into the end of the nut 44 which clamps the impeller 14 to the shaft 12, or into a cap 22 carried thereby. The cap 22 may be provided with a plurality of radially spaced orifices 24, 26, 28 and 30 formed in stepped surfaces in the cap 22, so that liquid fuel will be discharged at several points at varying radial distances from the axis of rotation.

The nut 44 is provided with a plurality of radially extending blades 32 designed to pick up the fuel discharged by the nozzle 20 and set it to rotating so that it may be metered through the aforementioned orifices by centrifugal force.

The operation of this device is as follows: Assume that the engine is running, and that fuel

is being discharged from the nozzle 20 into the cap 22. The liquid fuel impinges on the radially extending blades 32 of the nut 44, and is caused to rotate with the impeller 14 by the blades, and is thrown outwardly by centrifugal force to a space 34. When small quantities of fuel are supplied, it is practically all discharged through the orifices 24, which are spaced furthest out from the center line of the shaft 12. If increased quantities of fuel are supplied, the space 34 fills up to a point where the orifices 26 also discharge fuel. If further increased quantities of fuel are supplied, the space 34 continues to fill up, and the orifices 28 and 30 which are adequate for maximum quantity of fuel discharge will come into action. The fuel is held to the outer portion of the space 34 by centrifugal force.

Attention is called to the fact that if all of the fuel discharge orifices be positioned at a single radial distance from the center of rotation, there is a possibility that at small fuel flow, all of the discharge orifices will not receive fuel; and conversely, that at maximum fuel flow, the area of the orifices will not be adequate and the fuel will overflow unsymmetrically out of the entrance to the cap 22, thus resulting in uneven distribution. Where a plurality of rows of discharge orifices are positioned at varying radial distances from the center of rotation, this condition is overcome, and varying quantities will be discharged evenly over the entire working area of the impeller.

It will be understood that the size of the orifices 24, 26, 28 and 30 may be varied in any desired manner to give the desired results. If desired, the blades 32 may extend outwardly to the outer edge of the casing 22 and the space 34 therefore eliminated.

The fuel discharged from the fuel orifices 24, 26, 28 and 30 is, as will be obvious, directed radially outwardly from the shell 22 by centrifugal force, and will be broken up and thoroughly atomized by the rush of air drawn from the air inlet passage 18, and directed by the impeller blades 16 to the intake manifold of the engine.

When the engine is stopped, any excess or unused fuel in the cap 22 or discharged by the nozzle 20 will drain out into the sump 36 and be discharged by a fuel conduit 38 to the ground.

The embodiment of the invention illustrated on Figure 2 is similar in many respects to that illustrated on Figure 1 and corresponding parts have therefore been given corresponding reference numerals with the addition of 100. It will be noted that the spinner cap 122 has straight side walls and that a single bank of orifices 140 are provided. The radially extending blades 132 receive fuel from the fuel nozzle (not shown), and discharge it to the space 134 which communicates with longitudinally extending passages 142 formed in the nut 144 which holds the impeller 114 on the shaft 112.

Attention is called to the fact that the nut 144 is provided with orifices 146, communicating with the passages 142. The orifices 146 are preferably inclined at an angle as shown. The longitudinally extending passages 142 also communicate with angularly disposed passages 148 formed in the hub of impeller 114. The angularly disposed passages 148 formed in the impeller 114 may communicate with the working face of the impeller by means of ducts 150 and 152 spaced longitudinally of the impeller and directed radially thereof.

In the operation of this embodiment it will be observed that fuel may be discharged at the working surface of the impeller blades, and also at points spaced forwardly of the working surface of the blades. Complete atomization of the fuel and air is thus assured. Attention is called to the fact that as increased quantities of fuel are supplied, the fuel will be progressively discharged from the points of least centrifugal force.

The embodiment illustrated on Figure 3 is similar in many respects to that illustrated on Figure 2, and corresponding parts have therefore been given corresponding reference numerals with the addition of 100. It will be observed that in this embodiment fuel will be discharged radially from the orifices 240 formed in the cap 222 and also from the orifices 250 and 252 in the impeller blades.

In the embodiment illustrated in Figure 5, the fuel supplied to the spinner cap 322 is discharged through the nut 344 by means of spaced angularly disposed orifices 354, 356 and 358. The blades 332 discharge the fuel to the space 334, which communicates with the slanting longitudinally extending passages 342 in the nut 344. Fuel will first be discharged through the orifices 354 which are farthest from the center-line of the shaft 312 and therefore subjected to greater centrifugal force. As increased quantities of fuel are supplied the orifices 356 will come into action, and subsequently the orifices 358 will come into action. It will be observed that the orifices 354, 356 and 358 are angularly disposed to discharge the fuel at an angle into the working area of the impeller. It has been found that fuel discharged into the supercharger inlet in this manner also gives very satisfactory atomization of the fuel.

The embodiment illustrated in Figure 6 is designed in such a manner as to adapt applicant's fuel supply means to an engine wherein the main shaft or an auxiliary shaft of the engine 412, extends beyond the supercharger, thereby rendering it impossible to discharge fuel into the center of a cap carried by the impeller retaining nut 444. In this embodiment of the invention fuel may be supplied by means of a fuel inlet 460 to a casing 462 surrounding a shaft or bushing member 464. The fuel overflows the inner lip 466 of the casing 462, and is discharged onto the blades 432 of the cap 422 carried by the nut 444. The fuel is thrown outwardly by the blades 432 into the space 434 which communicates with the longitudinally extending passages 442 formed in the nut 444. The fuel will then be discharged through orifices 454, 456 and 458 communicating with the passages 442 in a manner similar to that discussed in connection with the embodiment illustrated in Figure 5.

Any excess fuel discharged after the engine has been stopped will collect in the sump 436, and be discharged to the ground by way of the discharge pipe 438 in a manner similar to that discussed in connection with the embodiment of Figure 1.

It will be observed in connection with the embodiment illustrated in some of the figures, that fuel will be discharged into the impeller blade space while the engine is operating, and that when the engine is not running, any discharge caused by the operation of fuel pumps or otherwise will drain into an entrance sump such as that illustrated at 436 on Figure 6.

Attention is called to the fact that as the fuel is thrown outwardly from the discharge orifices

by centrifugal force, a suction is exerted in the orifices and conduits connecting the discharge ducts with the point of discharge from the fuel supply nozzle to insure a supply of fuel being delivered to the discharge orifices. This force is dependent on the centrifugal force of the rotating parts and the suction exerted by the air moved by the impeller.

While the invention has been described with particular reference to several illustrated embodiments, it is not applicant's intention to limit the scope of the invention to the specific features disclosed, nor otherwise than by the terms of the following claims.

I claim:

1. A charge forming mechanism for a device having a rotatable shaft, rotatable means associated with the shaft comprising a plurality of concentrically disposed chambers, means to supply fuel to the inner chamber, means to discharge the fuel radially to the outer chamber, and fuel discharge orifices in the outer chamber positioned at various distances from the axis of rotation and spaced longitudinally therealong.

2. A carburetor for combustion engines having a rotatable shaft and a supercharger including an impeller driven by the rotatable shaft, comprising means including a nut to clamp the impeller to said shaft, means associated with said nut to receive liquid fuel, means including orifices at various distances from the axis of rotation to discharge liquid fuel from said fuel receiving means under the action of centrifugal force, a sump to receive excess fuel, and means to discharge the excess fuel outside of the engine casing.

3. A charge forming device for an engine having a rotatable shaft, a member carried by the shaft and having a longitudinally extending passage inclined inwardly toward the axis of rotation the means to supply fuel to the passage adjacent the outwardly positioned portion thereof, and fuel discharges orifices communicating with said longitudinally extending passage at varying distances from the axis of rotation.

4. A charge forming device for an engine having a rotatable shaft comprising an impeller driven by said shaft, a member carried by and rotatable with said shaft, means to supply fuel to said member, radially extending blades to direct fuel outwardly in said member, means including longitudinally extending passages projecting into the impeller, and radially spaced discharge orifices communicating with the longitudinally extending passages to discharge fuel at varying points dependent on the amount of fuel supplied to said member.

5. A charge forming device for an engine having a rotatable shaft and an impeller driven by said shaft, comprising means including a locking nut and a member carried by and rotatable with said shaft, means to supply fuel to said member, radially extending blades to direct fuel outwardly in said member, and radially spaced discharge orifices in said nut to discharge fuel in front of the impeller under the influence of centrifugal force, fuel being discharged from varying points spaced outwardly of said nut dependent on the amount of fuel supplied to said member.

6. In a charge forming device, a fuel distributing member comprising a shell adapted to engage a rotatable member and having radially stepped surfaces including a plurality of fuel discharge orifices in each stepped surface, and a plurality of radially extending blades adapted to direct fluid outwardly toward said stepped surfaces under the influence of centrifugal force.

7. In a charge forming device, a fuel distributing member comprising a shell adapted to engage a rotatable member and having radially stepped surfaces including a plurality of fuel discharge orifices in each stepped surface, and a plurality of radially extending blades adapted to direct fluid outwardly toward said stepped surfaces under the influence of centrifugal force, there being an area uninterrupted by blades adjacent said stepped surfaces.

8. In a charge forming device for a combustion engine, rotatable means forming a chamber having discharge orifices positioned at various distances from the axis of rotation, means to supply fuel to the chamber adjacent the orifices positioned at substantially the greatest distance from the axis of rotation, and blades within the chamber to centrifugally discharge fuel through said orifices.

9. In a charge forming device for an engine, a rotatable casing having a fuel inlet and stepped outer surfaces and provided with spaced orifices in said stepped surfaces, and impeller means within the casing to effect rotation of fuel in the casing and direct it outwardly.

10. In a charge forming device for engines having a rotatable shaft, a nut on said shaft and including means to receive liquid fuel, blades carried by said means to direct fuel outwardly, angularly disposed passages in said nut relative to the axis thereof and adapted to receive fuel impelled by the blades, and means including spaced orifices communicating with said angularly disposed passages to discharge liquid fuel into the air under the influence of centrifugal force.

11. In a charge forming device, a rotatable casing having inner and outer concentric chambers, means for delivering fuel to said inner chamber, a plurality of impeller blades carried by said casing and positioned between said chambers to receive fuel from the inner chamber and deliver it to the outer chamber, and fuel orifices for discharging fuel from the outer chamber.

12. A charge forming device for an engine having a rotatable shaft and a supercharger driven by the shaft, comprising a casing carried by the shaft adjacent the supercharger inlet, means to supply fuel to said casing, orifices in the casing positioned at various distances from the axis of rotation and adapted to discharge fuel into the air supplied to the supercharger, and blades inside of said casing to rotate the fuel to develop a centrifugal metering force through said orifices.

13. In a charge forming device for an internal combustion engine, a rotatable member including a chamber, means to supply fuel to said chamber, a plurality of blades in said chamber adapted to direct the fuel outwardly, said blades being spaced from the outer wall of the chamber to form an annular portion uninterrupted by blades, and fuel discharge orifices in said member supplied with fuel from said annular portion.

14. In a charge forming device for an internal combustion engine, a rotatable member including a chamber, means to supply fuel to said chamber, a plurality of blades in said chamber adapted to direct the fuel outwardly, passages interconnecting the spaces between the blades adjacent the outer wall of the chamber for permitting the fuel to distribute itself circumferentially in the

chamber, and fuel discharge orifices in said member.

15. The invention defined in claim 14 wherein the discharge orifices are at various distances from the axis of rotation.

16. In a charge forming device for an engine, rotatable means forming a chamber, a plurality of fuel discharge orifices in said rotatable means receiving fuel from said chamber at various distances from the axis of rotation, and means for supplying fuel to said chamber adjacent the orifices receiving fuel from the chamber at the greatest distance from the axis of rotation, said chamber, orifices, and supplying means being so constructed and arranged that fuel at low rates of supply to the chamber will be forced by centrifugal action to collect adjacent to and to discharge from only those orifices receiving fuel from the chamber at substantially the greatest distance from the axis of rotation.

17. In a charge forming device for an engine, engine driven rotatable means including a fuel chamber, fuel discharge orifices in the wall of said chamber, means to supply fuel to the chamber inwardly of said orifices, a fuel passage in the rotatable means communicating with the chamber inwardly of said orifices and outwardly of the supplying means, and discharge orifices communicating with said fuel passage.

18. In a charge forming device for an engine having a rotatable shaft and a supercharger driven thereby, means including a stationary member forming an annular chamber surrounding the shaft adapted to receive fuel from a source, means for discharging fuel into the air entering the supercharger, and a plurality of blades carried by the shaft receiving fuel from said chamber and impelling it to the discharging means.

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