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R. M. HAZEN ET AL
CHARGE FORMING DEVICE

2,580,384

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3 Sheets-Sheet 1

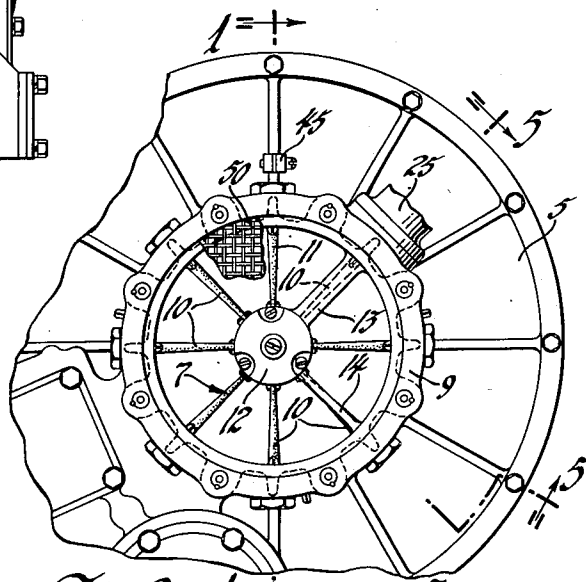
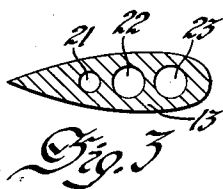
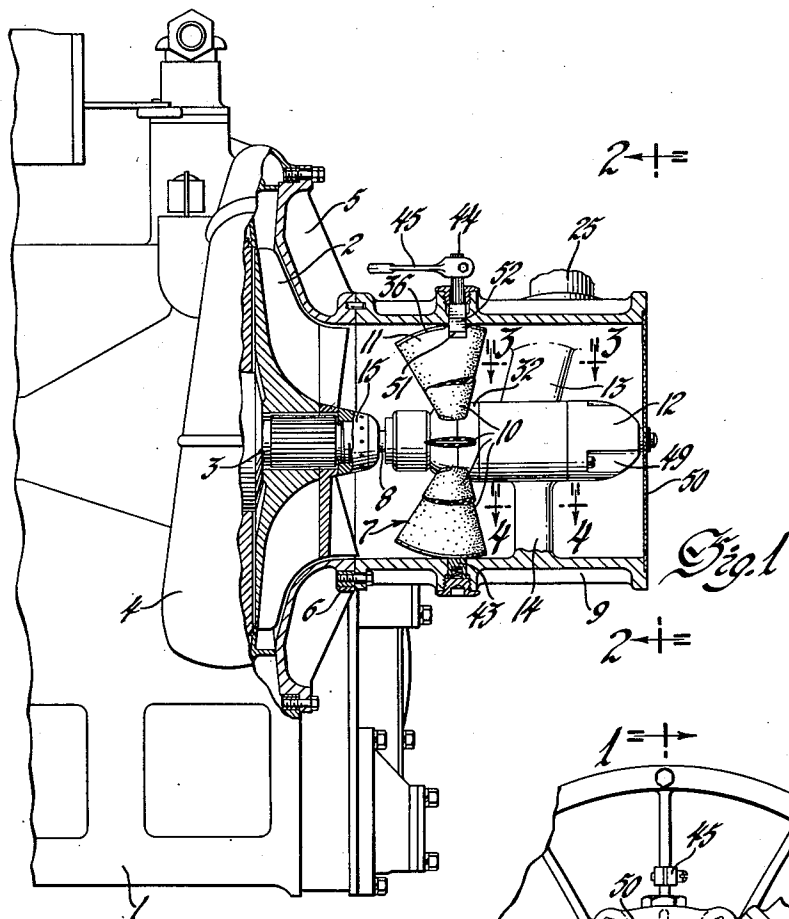


Fig. 2
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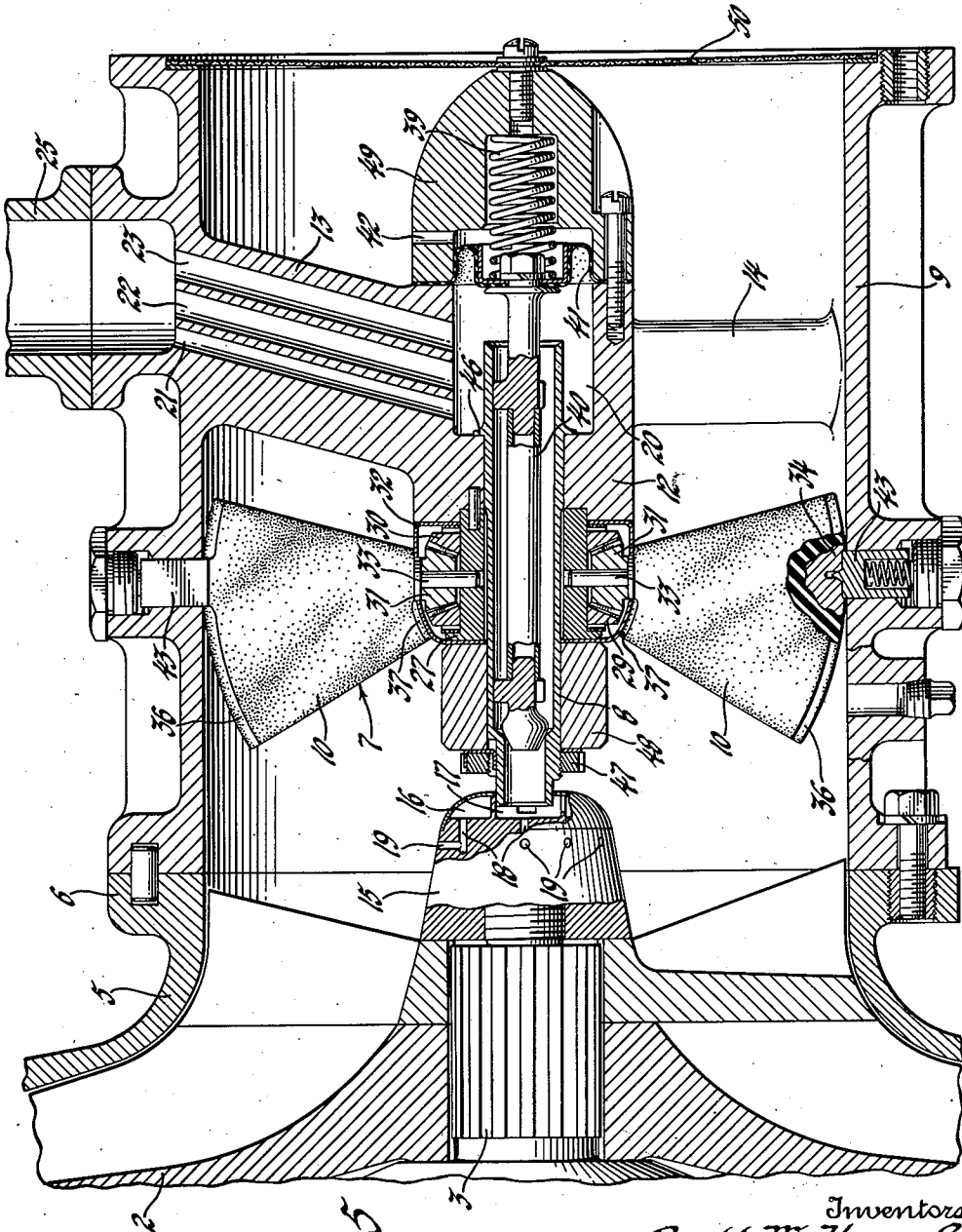


Fig. 5

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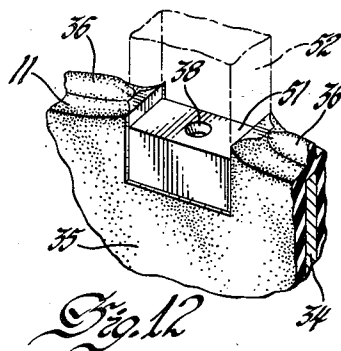
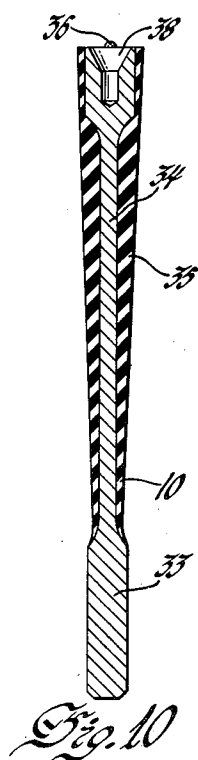
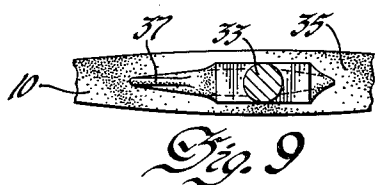
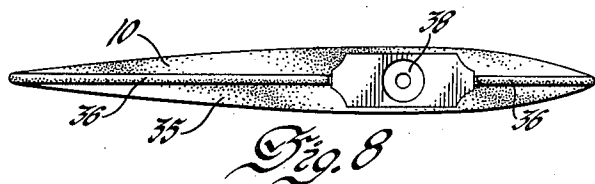
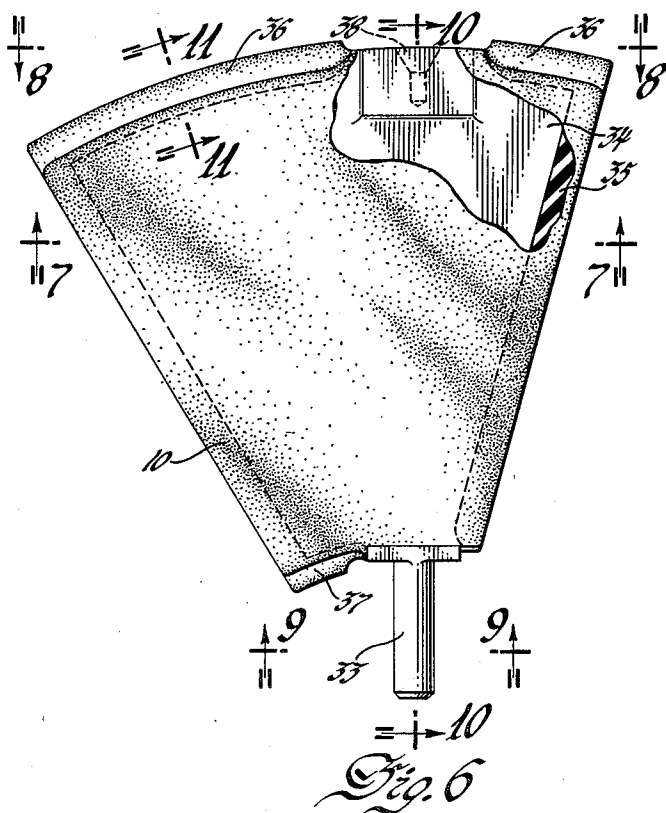
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UNITED STATES PATENT OFFICE

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CHARGE FORMING DEVICE

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5 Claims. (Cl. 261—24)

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This invention relates to fluid transfer systems of the type which incorporate a rotary axial flow or centrifugal impeller, and particularly to apparatus for regulating the flow of fluids through such systems.

While the apparatus as a whole is specifically adapted to supercharged internal combustion engines, it has certain features which are broadly applicable to fluid flow regulation generally.

In such fluid transfer systems, maximum operating efficiency in terms of mass-rate of flow requires that the fluid be subjected to the minimum amount of turbulence in entering the impeller. Turbulence imposed on a gaseous fluid at that point results in the gas temperature being materially higher at the impeller outlet than would be the case without such turbulence. In the application of such transfer systems to supplying compressed air or combustible mixture to the cylinders of an internal combustion engine, any avoidable fluid temperature rise is particularly undesirable since it not only reduces the mass-rate of flow but also reduces the pressure at which the air or mixture can be introduced into the engine without detonation. Further, in carburetor internal combustion engines incorporating supercharger impellers of the centrifugal type, it is advantageous in obtaining a uniform explosive mixture to add the fuel to the intake air at the center of the vortex formed by the rotating impeller.

It is, therefore, an object of this invention to provide an improved flow regulating apparatus for rotatably impelled fluid transfer systems which will minimize fluid turbulence at the impeller entrance by effecting a pre-rotation of the fluid in the direction of the impeller rotation.

It is a further object to provide such a flow regulating apparatus which includes means for effectively sealing off virtually all flow in the fully closed position.

It is a further object to provide such a flow regulating apparatus which includes means, axially aligned with the pre-rotated fluid, for conveying and regulating the flow of a second fluid which is to be subsequently mixed therewith.

It is a further object to provide such a flow regulating apparatus particularly adapted for use in carburetor internal combustion engines which incorporate centrifugal supercharger impellers and in which the fuel is added to the intake air at the center of the vortex formed by the rotating impeller.

It is a further object to provide such a flow regulating apparatus which is adapted for ready

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installation in place of pre-existing conventional regulating apparatus on supercharged engines.

It is a further object to provide such a flow regulating apparatus which embodies features of ease of operation, sturdiness of construction, and simplicity in original assembly and repair.

For a complete understanding of the invention reference is made to the following description, together with the drawings which illustrate a particular application thereof, in which:

Figure 1 is a side elevational view of one end of an internal combustion engine with our improved flow regulating apparatus installed thereon, certain parts being broken away and shown in section on line 1—1 of Figure 2;

Figure 2 is an end elevational view taken as indicated by the line 2—2 of Figure 1, with all but a portion of the screen at the inlet end of the air duct broken away;

Figure 3 is an enlarged detail sectional view taken on the line 3—3 of Figure 1;

Figure 4 is an enlarged detail sectional view taken on the line 4—4 of Figure 1;

Figure 5 is an enlarged sectional view taken on the line 5—5 of Figure 2, with certain parts shown in elevation;

Figure 6 is a side elevational view of one of the air flow regulating vanes forming a part of our invention, with parts broken away and in section;

Figure 7 is a sectional view taken on line 7—7 of Figure 6;

Figure 8 is an end elevational view taken as indicated by the line 8—8 of Figure 6;

Figure 9 is a partial view taken as indicated by the line 9—9 of Figure 6;

Figure 10 is a sectional view taken on line 10—10 of Figure 6; and,

Figure 11 is a fragmentary sectional view taken on line 11—11 of Figure 6.

Figure 12 is a fragmentary perspective view of the outer end of another of the air flow regulating vanes.

In Figures 1, 2 and 5 of the drawings is shown the accessory drive end of an internal combustion engine 1, including a centrifugal supercharger impeller 2 driven from the engine crankshaft (not shown) through the shaft 3. The impeller 2 is splined to the shaft 3 and held thereon by a fuel slinger nut 15, which is provided with a rearwardly open chamber 17 and a connecting annular chamber 16 having passageways 18 and 19 leading outward therefrom to the vicinity of the impeller entrance. Also shown are the housing 4 and cover plate 5 which enclose the impeller and form a diffusing chamber from which the gaseous fuel

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and air mixture compressed by the impeller is delivered to intake manifold or manifolds (not shown) of the engine.

Heretofore, in engines of this general type, an inlet duct in the shape of an elbow is bolted at one end to the flange 6 on the cover plate 5, with the outer end of the elbow turned upward and serving as a mount for a carburetor with a conventional butterfly throttle valve therein for regulating the flow of the air or air and fuel mixture to the impeller 2. A fuel supply conduit from the carburetor is generally passed through the wall of the duct to connect with the chamber 17 in the fuel slinger nut 15.

In our improved construction shown, the throttle valve 7 comprises a plurality of angularly spaced, variable pitch radial vanes of streamlined section pivotally mounted at their outer ends in the walls of a cylindrical duct 9, which is coaxial with the impeller 2 and secured to the flange 6 on the cover plate 5, and journaled at their inner ends in a streamlined annular housing 12 supported coaxially within the duct 9 by streamlined struts 13 and 14. The duct 9, struts 13 and 14 and housing 12 may preferably be made as a single casting. Extending coaxially of the throttle valve 7 through the housing 12 is a fuel inlet conduit or pipe 8 which connects the chamber 17 with a chamber 20 in the housing 12. Cored passageways 21-23 extending through the strut 13 connect chamber 20 with a conduit 25 leading from the engine's fuel supply system (not shown). Fuel flow through the pipe 8 is controlled by a valve 40 slidable therein and urged toward closed position by a spring 39 but which is openable by fuel pressure acting against a flexible diaphragm 41 exposed to pressure in the outer end of the duct 9 through a bleed hole 42.

In the particular design shown, seven slave vanes 10 and one master vane 11 are employed; however, it is to be understood that a greater or lesser number of slave vanes may be used without departing from the essence of the invention. Each of the slave vanes 10 as shown in detail in Figures 6-11 comprises a sector shaped and relatively rigid frame or body 34 enclosed within an outer covering or sheath 35 of soft rubber or similar resilient material, and each is pivotally supported at its outer end by a spring pressed pivot member 43 mounted in the wall of duct 9 and engaging a conical bearing socket 38 formed in the body 34 of the vane. The master vane 11 differs from the vanes 10 only in that its outer end is provided with a rectangular slot 51 (see Figure 12) which accommodates a tongue 52 on the inner end of the control shaft 44 which is journaled in the walls of the duct 9 and to which is connected the control lever 45. The outer edge of the rubber sheath 35 has a lip 36 formed integral therewith, as shown in Figure 11, which serves as a seal between the outer edge of the vane and the wall of the duct when the throttle valve is in closed position. A similar lip 37 is provided on the inner edge of the vane.

Each of the vanes 10 and 11 is provided with a trunnion 33 secured to its inner end, which journals in a sleeve-like member 27 which encircles a portion of the pipe 8 and is locked against rotation with respect to the housing 12; and each of the trunnions 33 has a pinion 31 fixed against rotation with respect thereto and in mesh with two oppositely facing ring gears 29 and 30 which are rotatably mounted on the member 27. The vanes are all turned to the same angle of pitch during assembly. A split annular casing 32 encloses the

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gears and pinions and provides a surface on which the lip 37 on the inner end of each vane seals when the throttle valve is in closed position.

The casing 32 and its enclosed parts are held together and secured to the housing 12 by the fuel inlet pipe 8, which is provided at one end with a threaded nut 47 and spacer sleeve 48, and adjacent its other end with a shoulder 46 engaging the housing within the chamber 20. The diaphragm 41 and spring 39 are held in place by a rounded-end cap 49 which is removably secured to the up-stream end of the housing 12 and serves as a support for the air screen 50.

As is believed already clear from the description heretofore given, movement of the control lever 45 in response to a change in the power demands on the engine directly changes the pitch of the master vane 11 by causing it to rotate about a pivotal axis extending through its trunnion 33 and the control shaft 44. As its trunnion rotates the pinion 31 secured thereto causes a rotation of ring gears 29 and 30 in opposite directions on the member 27 which, in turn, causes each of the other pinions 31 to rotate and effect an equal and corresponding change of pitch of the slave vanes 10. In the fully closed position of the throttle valve the radially extending side edges of the vanes slightly overlap and serve as seals between one another, and as has been said the lips 36 and 37 on each vane contact the surfaces of the duct wall and the casing 32, respectively so that duct 9 is tightly closed to the passage of air. At all except the fully open and the fully closed positions of the throttle valve the vanes impart a swirling motion to the flow of air there-through, in the same direction of rotation as that of the impeller, thereby minimizing turbulence at the entrance to the impeller. Fuel from the conduit 25 is conducted through the passageways 21-23 into the chamber 20 from whence it is delivered coaxially of the throttle valve through the pipe 8 to the fuel slinger 15 at the impeller entrance, the rate of fuel delivery being regulated by the valve 40 which is controlled by the fuel pressure acting on diaphragm 41.

The herein described application of our invention to the charging system of a supercharged carburetor internal combustion engine combines the advantages of a swirl-type throttle valve and impeller entrance fuel supply. In applying the invention to other transfer systems where it is not desired to introduce a second fluid at the impeller entrance, the construction can be greatly simplified by eliminating the various fuel passageways, valve 40 and other related parts heretofore described.

Gearing together the individual vanes of the throttle valve at their inner ends provides a very compact and simple assembly which has ease of operation and is relatively inexpensive to construct; and since all moving parts of the valve except the single control shaft 44 are enclosed within the duct 9, exposure of such parts to external injury and accumulation of foreign matter is avoided.

We claim:

1. In an internal combustion engine, a rotary supercharging impeller, a duct for conveying engine intake air to the impeller entrance, an annular housing within the duct and axially aligned therewith, a member rigidly supporting the housing relative to the duct and provided with a passage for conducting a fluid from the exterior of the duct to the interior of the housing, a conduit secured to the housing for conducting the fluid from the interior of the housing to the impeller

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entrance, a sleeve member on the conduit and locked against rotation relative to the housing, a throttle valve comprising a plurality of angularly spaced vanes disposed radially within the duct and provided at their inner ends with trunnions journaled in the sleeve member, pinions rotatably supported by the trunnions, a ring gear rotatable on the sleeve member and in mesh with each of the pinions, a flexible diaphragm secured to the housing and exposed on opposite sides to the pressure of the fluid within the housing and the pressure of the air outside the housing, valve means within the conduit for regulating the flow of the fluid therethrough and connected to the diaphragm for movement thereby in response to changes in said fluid and air pressures, spring means biasing said valve means toward closed position, and means accessible exteriorly of the duct for operating said throttle valve including a portion rotatable with one of the vanes.

2. In an internal combustion engine, a supercharging system including a rotatively driven impeller and a casing surrounding the impeller and having an inlet axially aligned with the impeller, rotatable means adjacent the inlet and coaxial with the impeller for effecting centrifugal distribution of engine fuel within the casing, a conduit connected to the casing at the inlet, a member within the conduit and coaxial with the impeller, a member supporting the first named member within the conduit, said first and second named members being provided with communicating passages through which engine fuel is conducted to said rotatable means from a point exteriorly of the conduit, a plurality of angularly spaced radially extending vanes, the inner and outer ends of each vane being pivotally supported by the first named member and conduit respectively and the inner end of each vane having a pinion gear secured thereto, a ring gear rotatably mounted on the first named member and in mesh with each of the pinions whereby pivotal movement of one vane effects corresponding pivotal movement of the other vanes, and a control member coaxially pivoable with said one vane and accessible exteriorly of the conduit for controlling the pivoted positions of all the vanes.

3. The invention defined by claim 2, with a fuel pressure responsive valve located in the passage in the first named member.

4. A coaxial swirl-type throttle valve and fuel metering device, including an air inlet duct, a support member disposed centrally in said duct and having a fuel passage a first portion of which extends longitudinally of said member and a sec-

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ond portion of which leads from the outside of said duct, a plurality of angularly spaced vanes extending radially outward from and pivoted in the support member, means accessible from the exterior of said duct for rotating said vanes to control the duct opening, a fuel valve in said first passage portion, a fuel valve control diaphragm closing one end of said first passage portion and subject on one side to pressure from the fuel in said passage and on the other side to the pressure of fluid in said duct, and an enclosing member for said diaphragm, said enclosing member being detachably carried by the support member independently of the throttle valve and the fuel passage for providing access to said fuel valve and said diaphragm.

5. A charge forming device comprising a rotary impeller and a passage through which fluid is conducted to the impeller, a supporting member centrally disposed in said passage and having a chamber with a fuel connection through the wall of said passage, a throttle valve for regulating the flow of fluid through the passage and comprising a plurality of angularly spaced variable pitch vanes extending radially from said member, means accessible from the exterior of said passage for varying the pitch of said vanes, a fuel valve in said chamber, a diaphragm in said chamber subject to the pressure differential between the fuel in said chamber and the fluid in said passage on the upstream side of said throttle valve, and closure means on said member on the upstream side of said throttle valve and of said fuel connection for providing access to said fuel valve and said diaphragm from the upstream side of the system.

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