Sept. 12, 1967 W. L. KENNEDY, SR 3,341,185

FUEL INJECTOR

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FIG. 1.

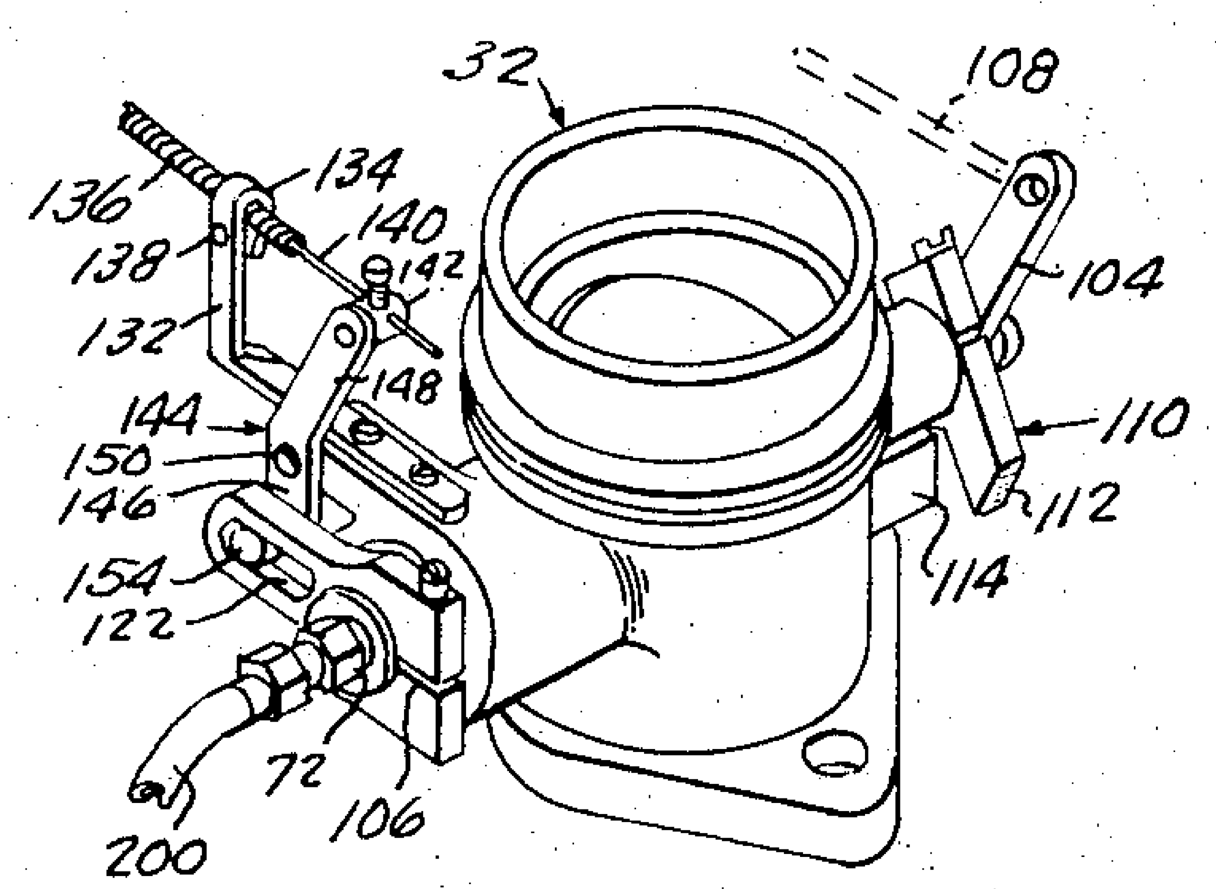


FIG. 23.

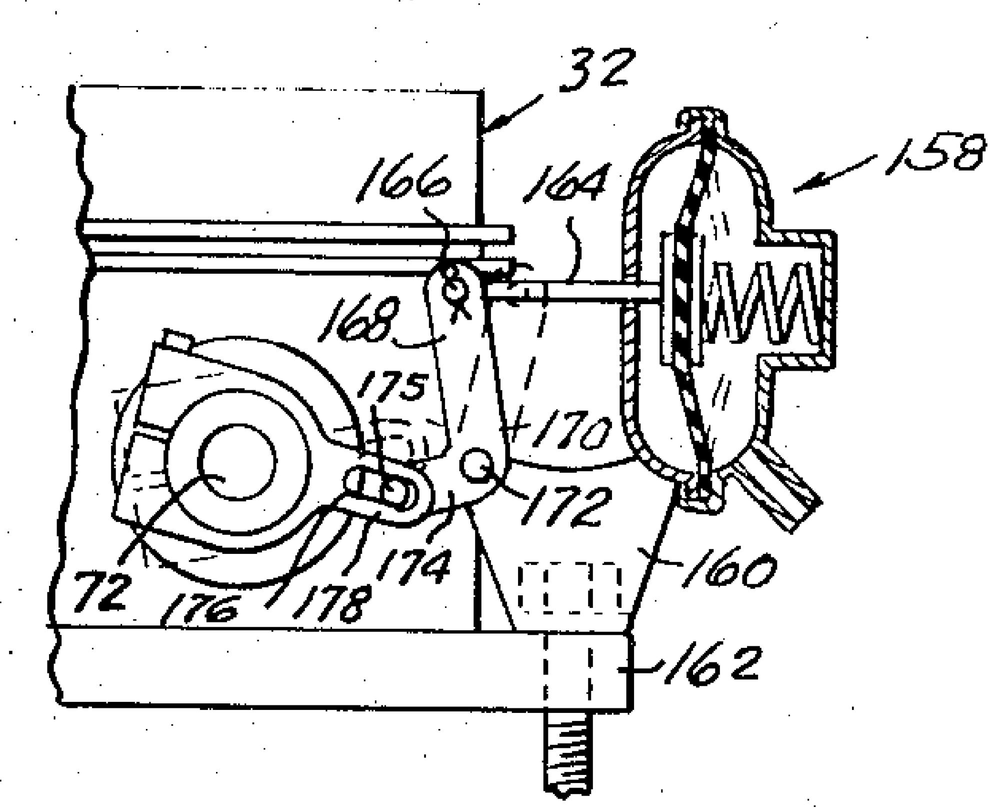


FIG. 2.

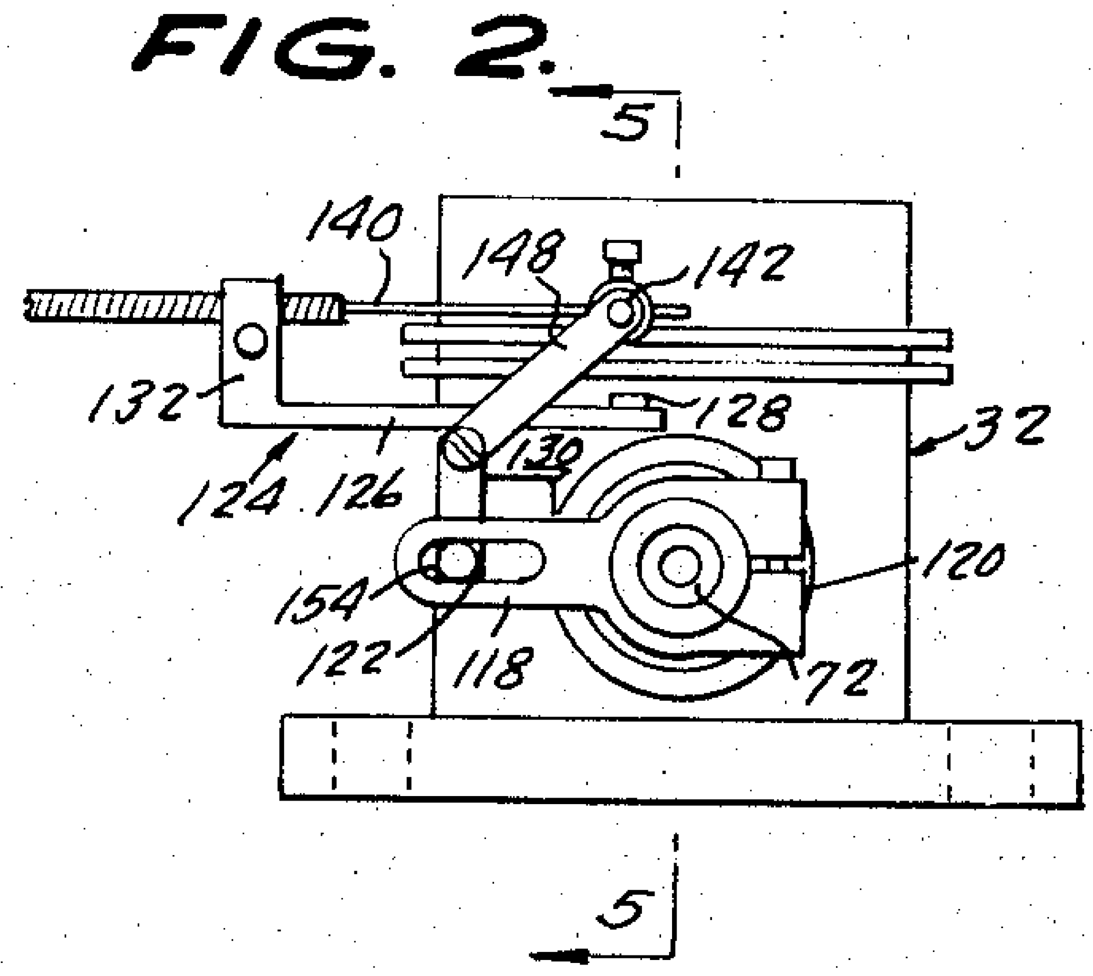


FIG. 3.

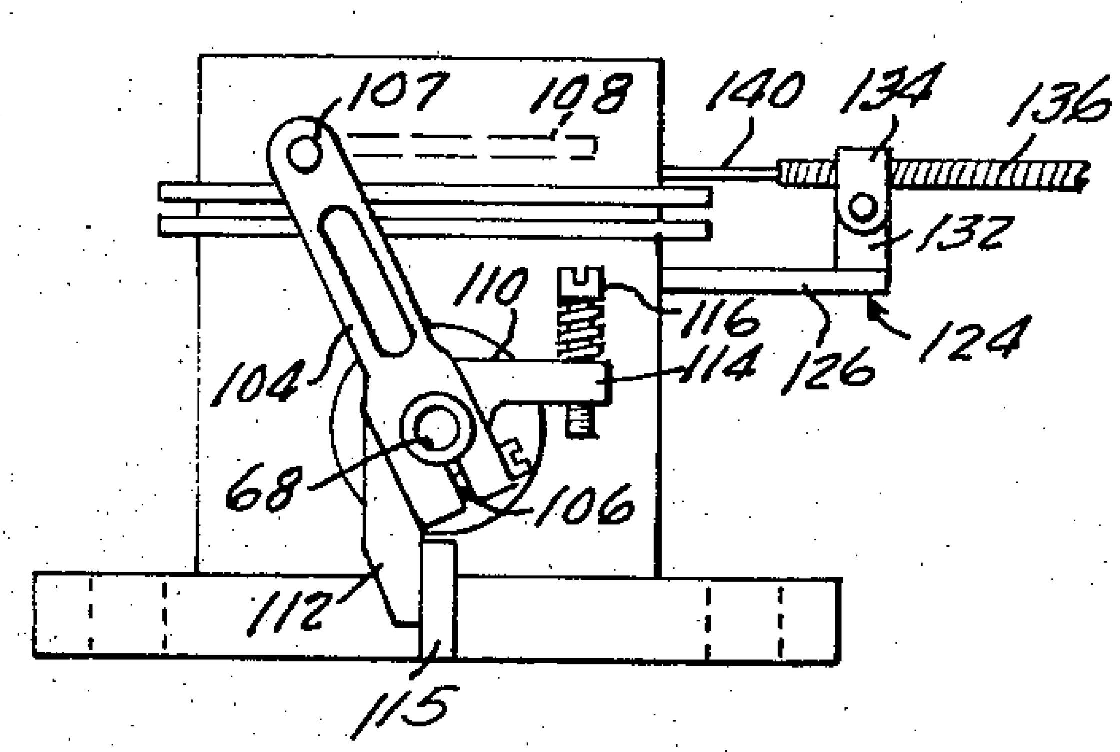
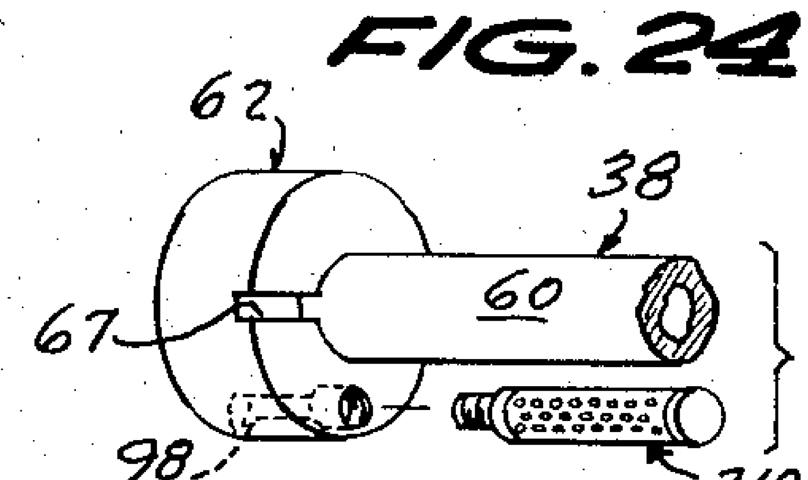


FIG. 24.



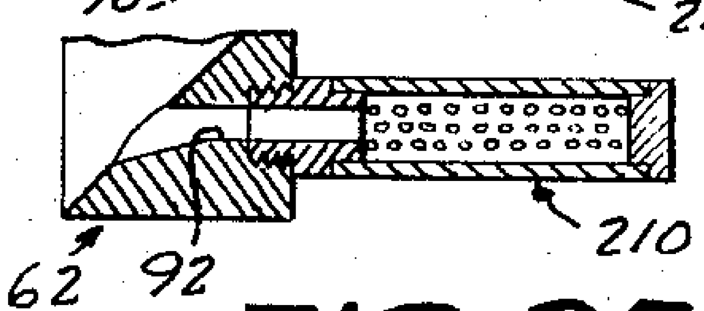


FIG. 25.

FIG. 4.

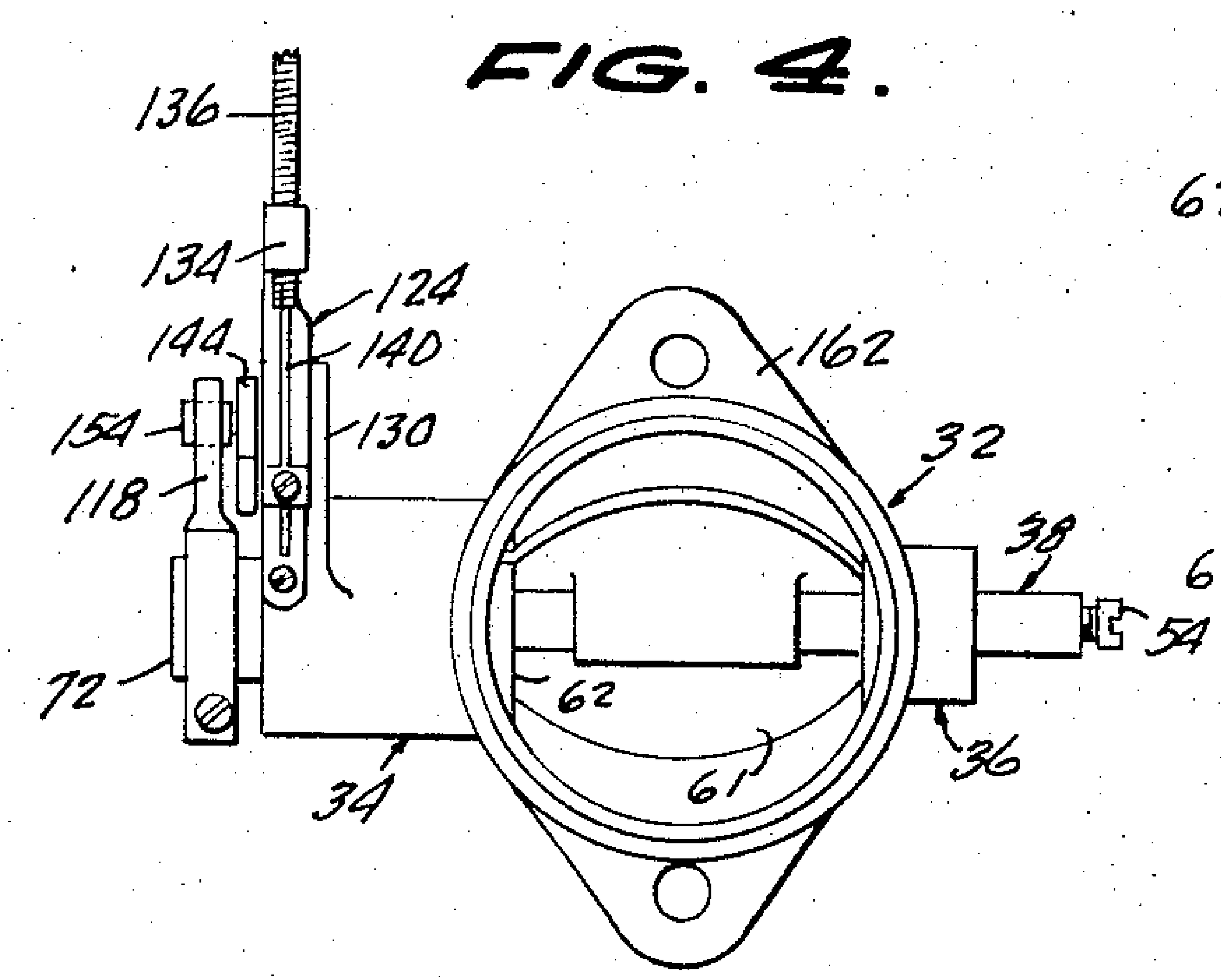


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FIG. 5.

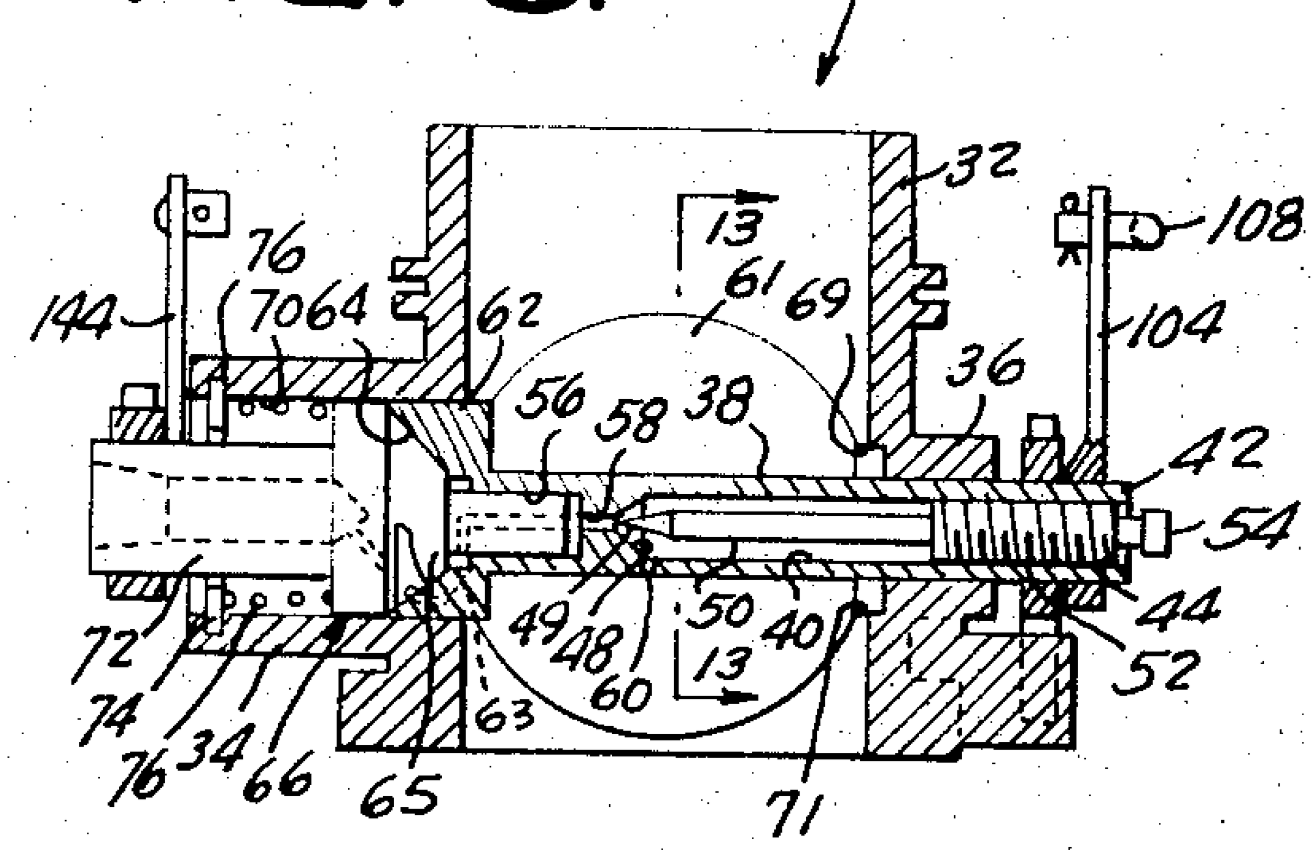


FIG. 6.

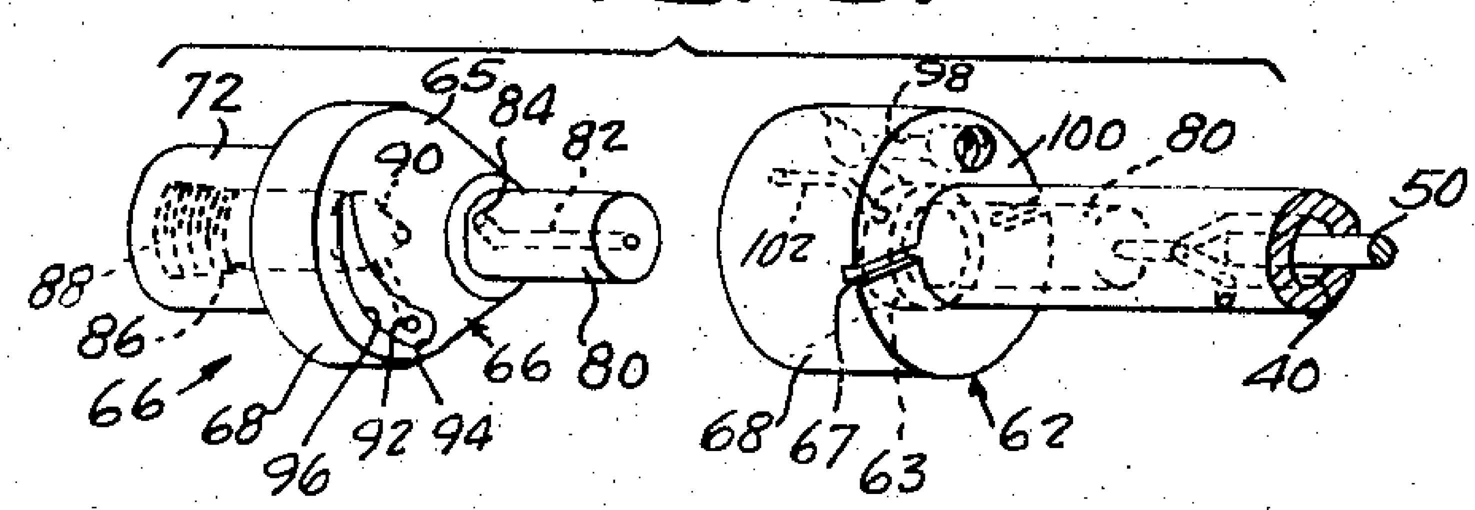


FIG. 7.

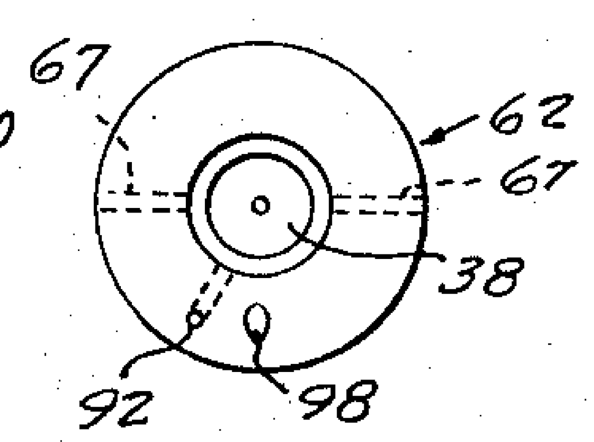


FIG. 8.

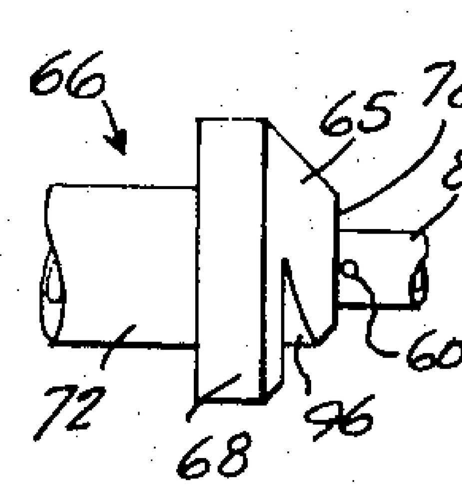


FIG. 9.

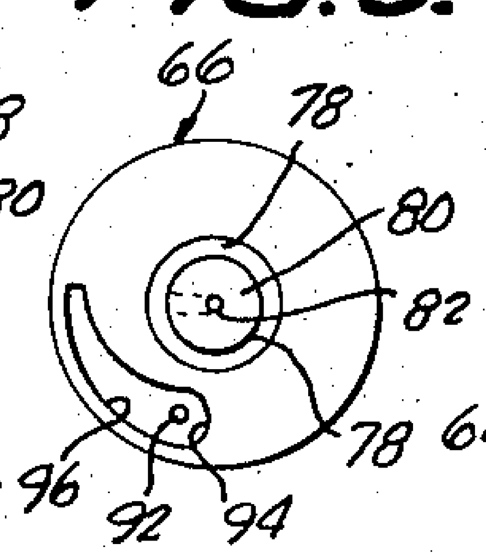


FIG. 10.

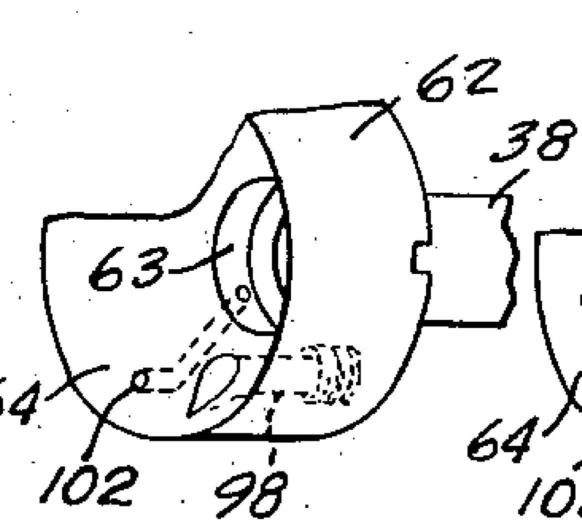


FIG. 10a.

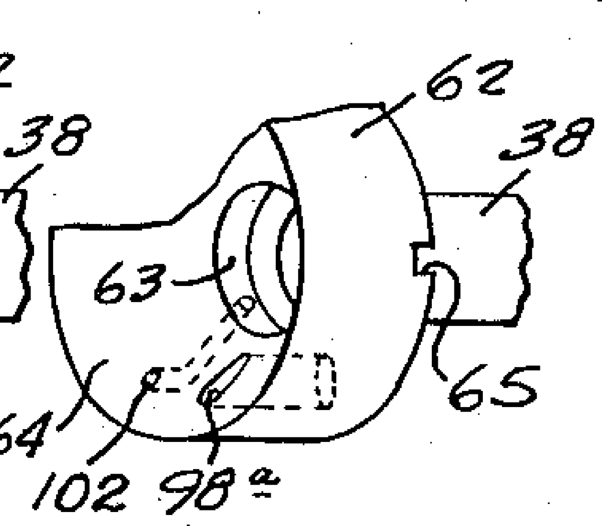


FIG. 11.

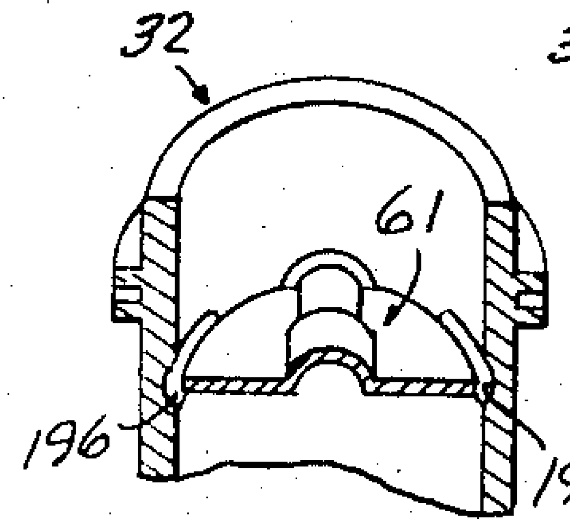


FIG. 12.

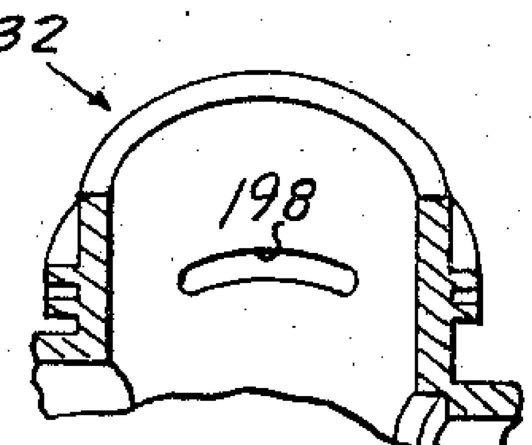


FIG. 13.

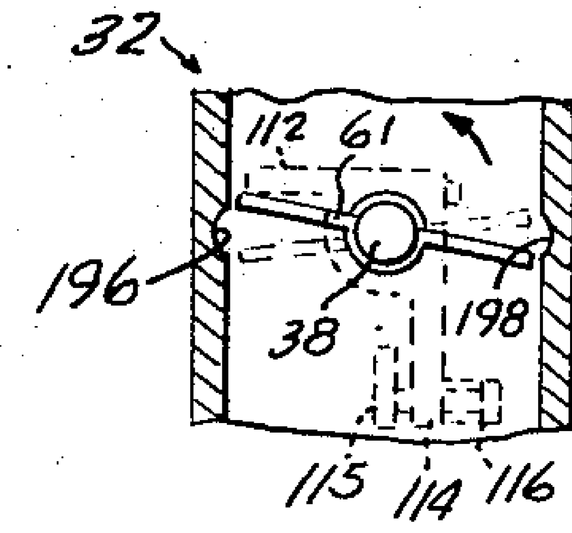
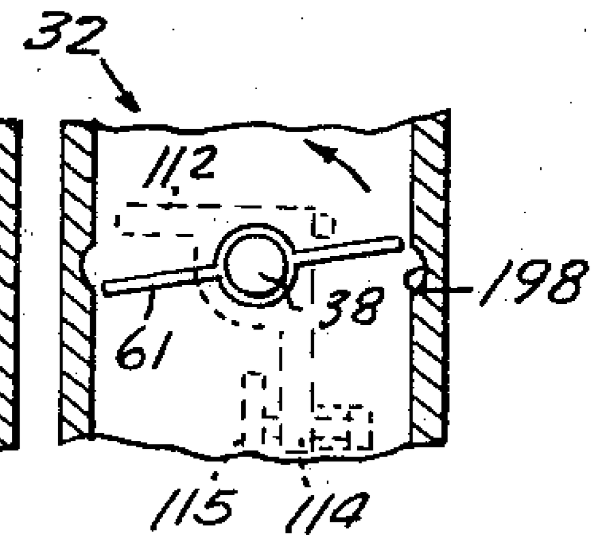


FIG. 14.



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FUEL INJECTOR

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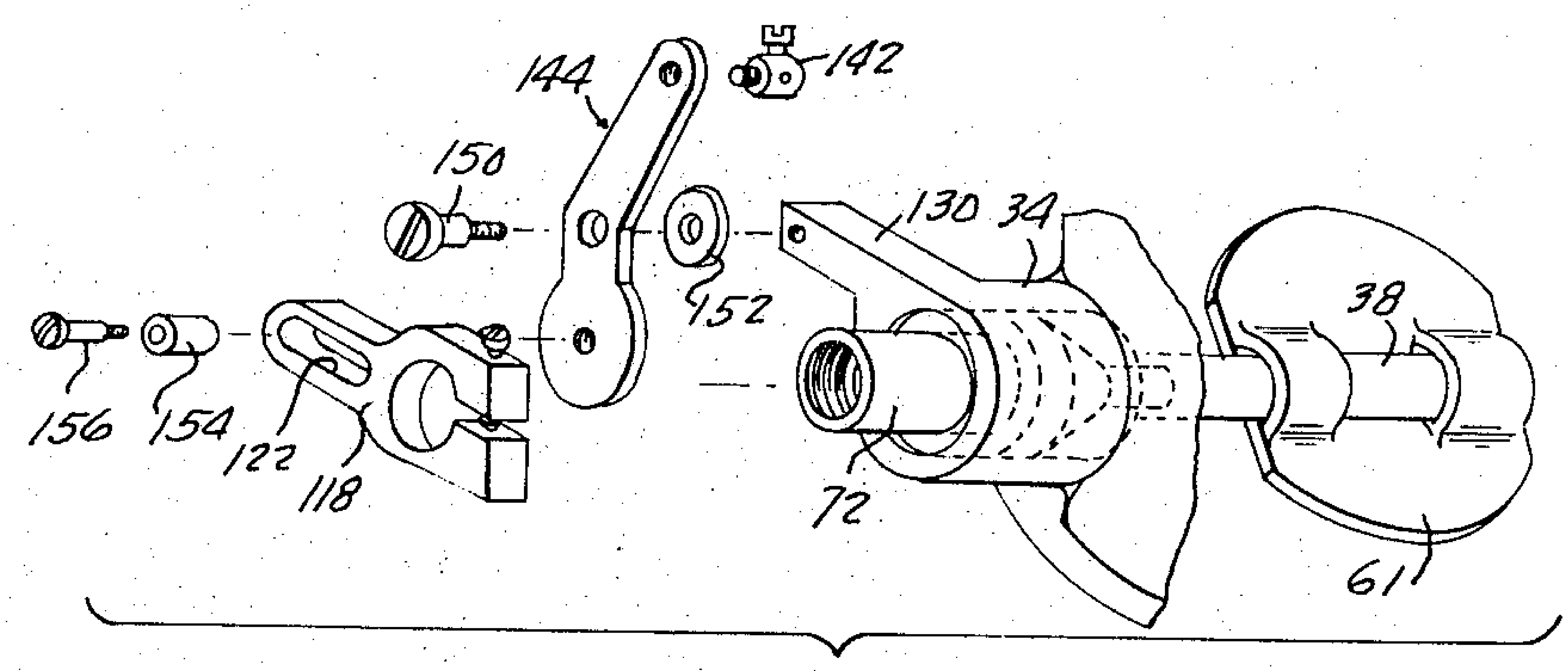


FIG. 15.

FIG. 16.

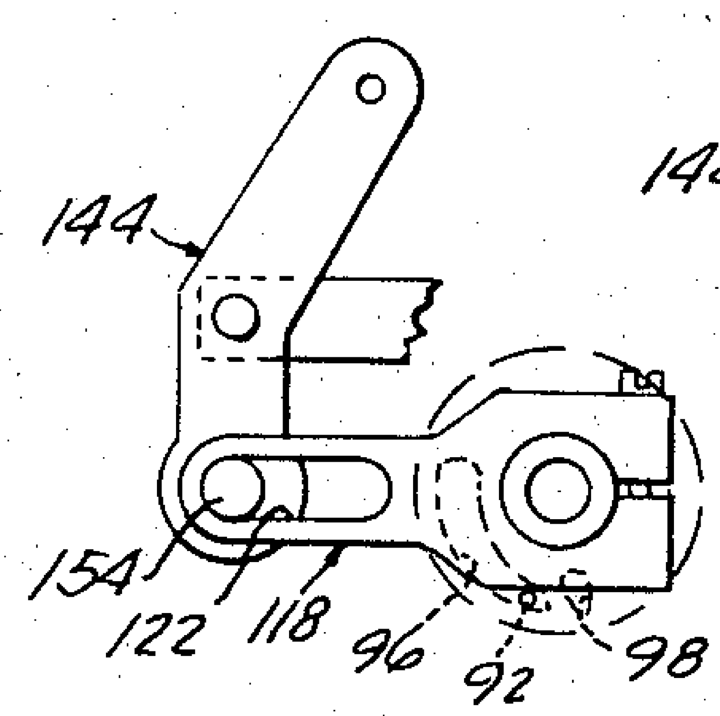


FIG. 17.

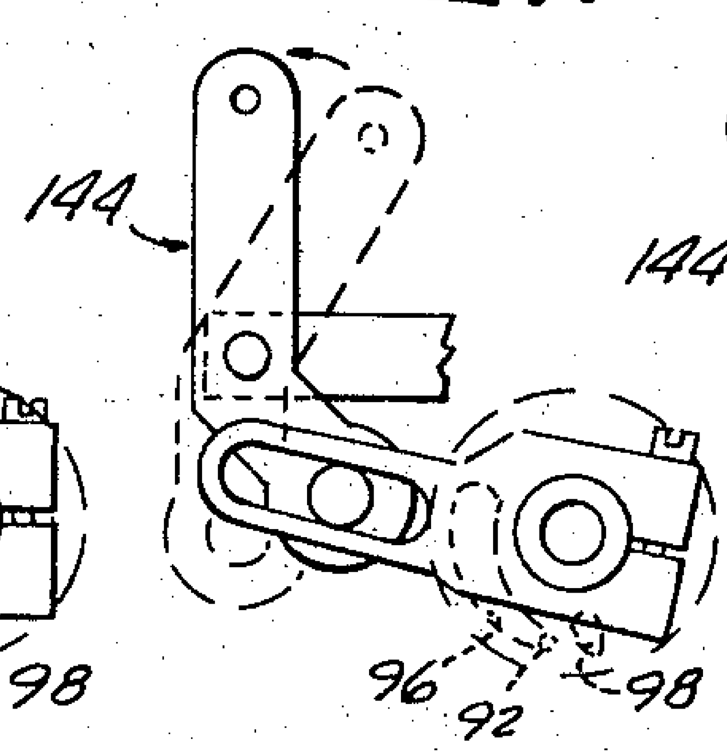


FIG. 18.

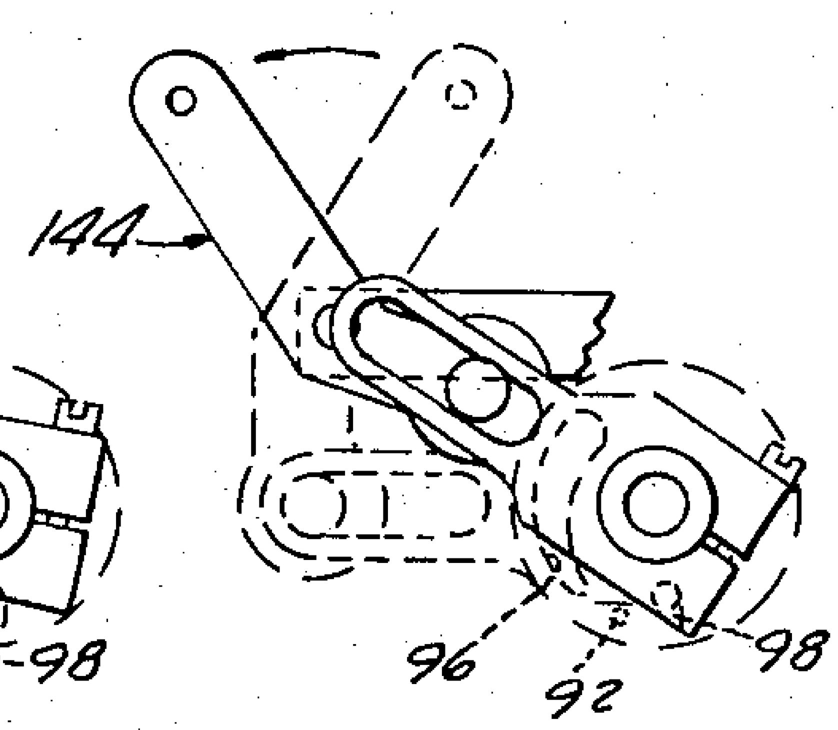


FIG. 19.

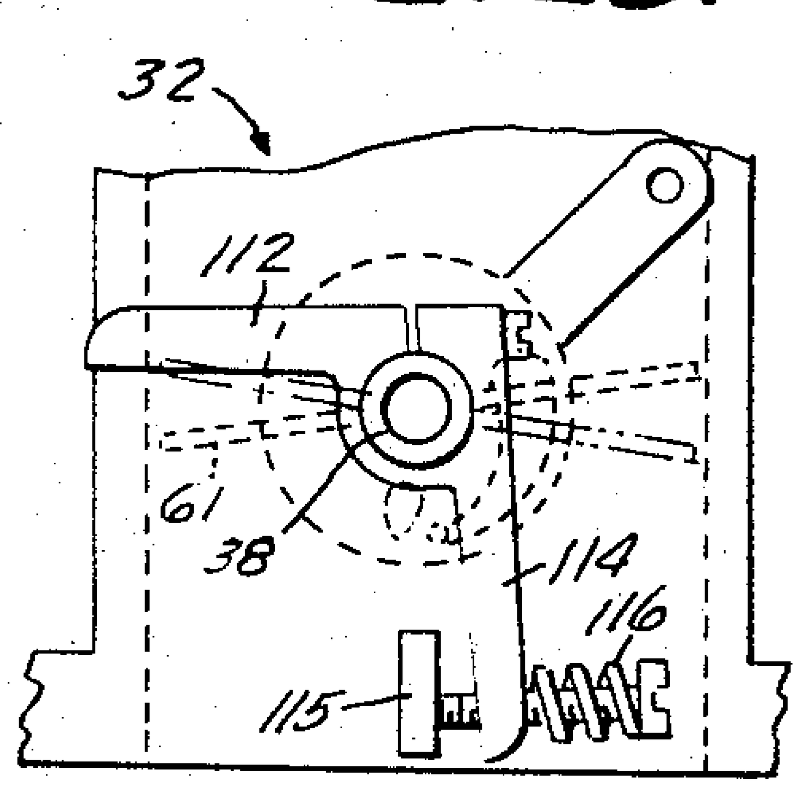


FIG. 20.

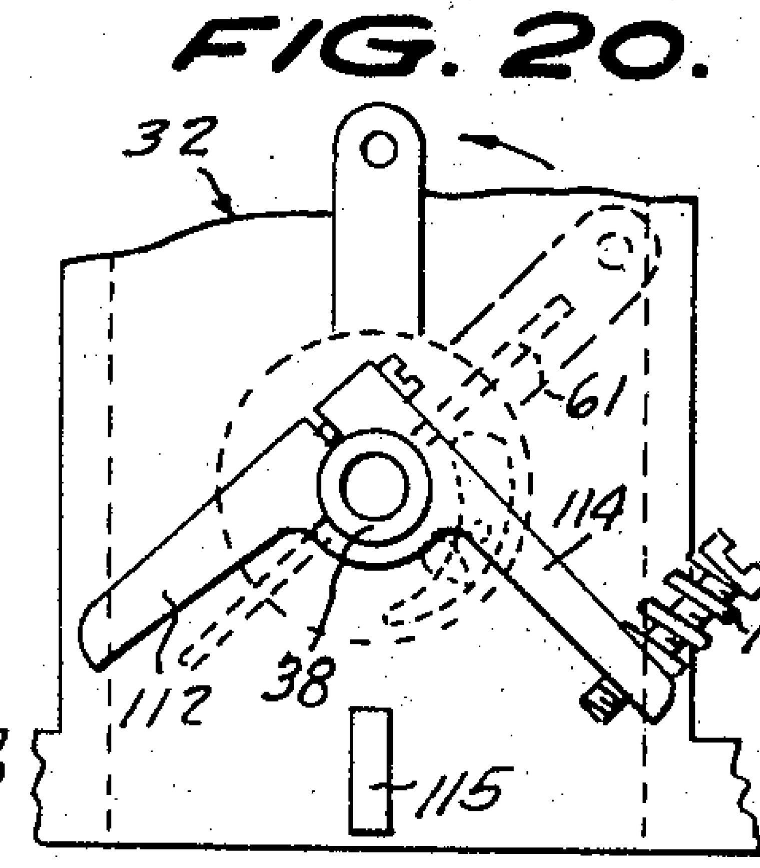


FIG. 21.

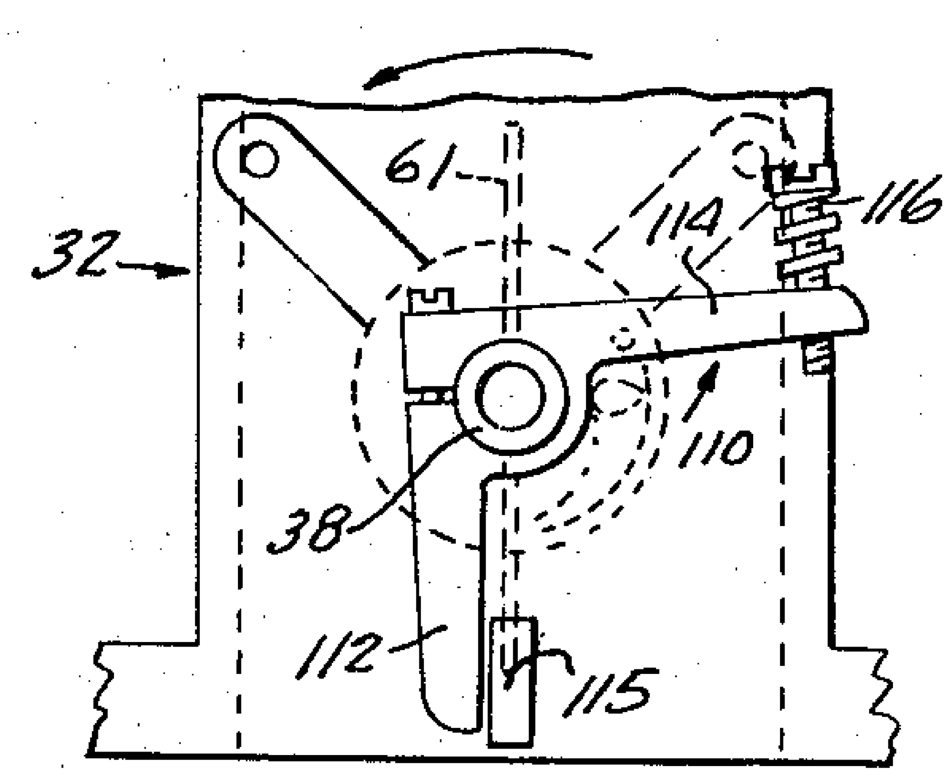
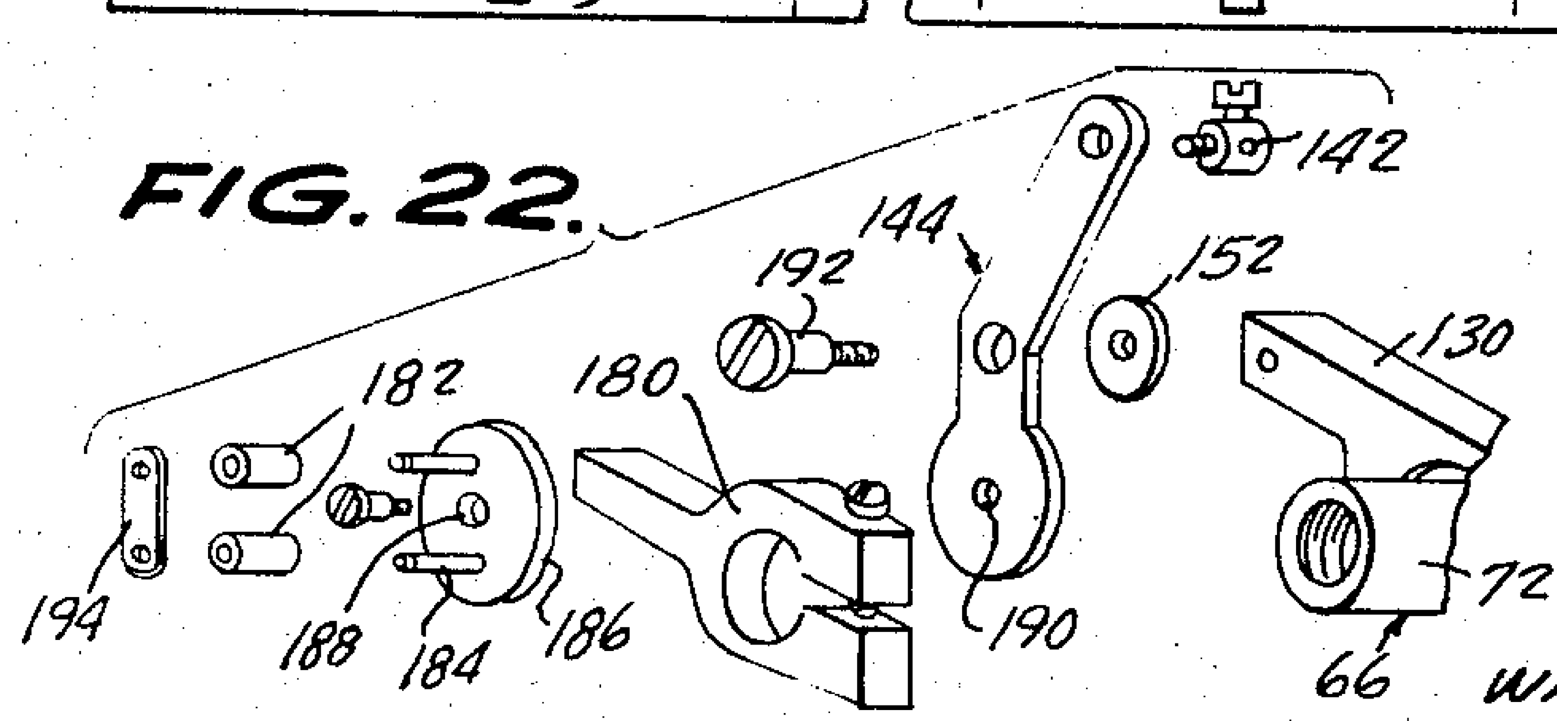


FIG. 22.



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United States Patent Office

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3,341,185

FUEL INJECTOR

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Filed July 29, 1966, Ser. No. 568,834
9 Claims. (Cl. 261—41)

ABSTRACT OF THE DISCLOSURE

A carburetor device employing a butterfly valve in an air conduit and having an associated rotary fuel metering member which has circumferentially spaced fuel passages, including an idler passage, and a partial to full throttle main passage, adapted to be registered with a main jet at different times, the main jet having circumferentially tapered inlet recess means, in communication therewith, which, on rotation of the metering member away from the smaller end of the recess, toward the larger end of the recess, gradiently increases the rate of fuel injected.

This invention relates to a fuel injector for internal combustion engines.

The primary object of the invention is the provision of a generally superior and more efficient and fuel economizing device of the kind indicated, which is less expensive to manufacture than prior comparable devices, has fewer and simpler parts which are more easily assembled, and has more positive action, and enhanced ease of operation, because of a reduction of friction between its moving parts, and its requirement of only light throttle pressure.

Another object of the invention is the provision, in a device of the character indicated above, of means associated with its butterfly valve shaft, which serves to store a small amount of fuel which is available for instant engine starts, while preventing waste of fuel through bleeding when the device is in fuel-off position.

A further object of the invention is the provision of a device of the character indicated above, wherein more exact and positively controlled feed of fuel is obtained by the employment of a rotary fuel metering member which has circumferentially spaced fuel passages, consisting of an idler passage, and a partial to full throttle main passage, adapted to be registered with a main jet at different times, the main jet having circumferentially tapered inlet means, in communication therewith, which, on rotation of the metering member away from the smaller end of the recess, toward the larger end of the recess, gradiently increasing injection of fuel is obtained.

In the drawings:

FIGURE 1 is a perspective view of a device of the present invention, showing a throttle rod, such as operated by a pedal in an automotive vehicle, and a control cable associated with the device;

FIGURE 2 is a side elevation of FIGURE 1;

FIGURE 3 is an elevation of the side of the device opposite to that of FIGURE 2;

FIGURE 4 is a top plan view;

FIGURE 5 is a vertical section, taken on the line 5—5 of FIGURE 2;

FIGURE 6 is an enlarged exploded perspective view, partly broken away and in section, showing the metering rotor and the butterfly valve shaft;

FIGURE 7 is an end elevation of the valve shaft;

FIGURE 8 is a fragmeary side elevation of the rotor;

FIGURE 9 is an end view of the rotor, taken from the right of FIGURE 8;

FIGURE 10 is a fragmentary perspective view of another form of valve shaft;

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FIGURE 10*a* is a view, like FIGURE 10, showing a further form of valve shaft;

FIGURE 11 is a fragmentary vertical section, taken through the tube of the device and the butterfly valve;

FIGURE 12 is a view, like FIGURE 11, minus the valve, and showing air monitoring grooves;

FIGURE 13 is a fragmentary vertical section, taken on the line 13—13 of FIGURE 5, showing the butterfly valve in idle position;

FIGURE 14 is a view, like FIGURE 13, showing the butterfly valve in a throttled position;

FIGURE 15 is an enlarged and exploded perspective view of the butterfly valve, its shaft, the metering rotor, and the operating lever linkage therefor;

FIGURES 16, 17, and 18 are fragmentary side elevations, showing progressive positions of the control lever linkage, from full rich fuel mixture position, lean position, and fuel-off position, respectively;

FIGURE 19 is a schematic view, showing the butterfly valve in idle position;

FIGURE 20 illustrates the half-throttle position of the valve;

FIGURE 21 shows the full-throttle position of the valve;

FIGURE 22 is a group perspective view of another form of control lever linkage;

FIGURE 23 is a fragmentary side elevation, showing the control lever linkage, as operated by a vacuum motor;

FIGURE 24 is a fragmentary perspective view, showing a form of butterfly valve shaft wherein the main jet includes a foraminous screen or spray device; and,

FIGURE 25 is an enlarged fragmentary longitudinal section, taken through FIGURE 24.

Referring in detail to the drawings, and first of FIGURES 1 through 21 thereof, the illustrated injector **30** comprises an open-ended tube **32**, formed with external diametrically opposed tubular bosses **34** and **36**, whose bores open through the wall of the tube **32**.

Journalled through the boss **36** is a butterfly valve shaft **38**, formed with an axial counterbore or blind bore **40** extending from its outer end **42**, and threaded, as indicated at **44**, to its outer end. The inner end of the counterbore **40** is conical to serve as a seat **48** for the point **49** of a needle valve **50**, having an enlarged diameter outer end portion **52**, threaded in the threads **44**. A fixed slotted screw head **54**, on the outer end of the needle valve, provides for its adjustment toward and away from the valve seat **48**. Another counterbore or blind bore **56** is formed in the other end of the shaft **38**, and a small axial idler fuel passage **58** leads from the apex of the seat **48**, into the counterbore **56**. An idler fuel port **60** opens to the bottom of the shaft **38**, and leads from the counterbore **40**, at a location close to the valve seat **48**. A butterfly valve **61** is suitably fixed on the shaft **38**, and spans the interior of the tube **32**.

The shaft **38** has an enlarged diameter cylindrical head **62**, on its inner end, which is journalled in the inner end of the larger diameter boss **34**. The head **62** is formed, in its outer end, with a frusto-conical recess **64**, which communicates with the adjacent end of the counterbore **56**, and has an annular groove **63**, at its apex, which surrounds and is open to the counterbore **56**, which constitutes a secondary idler fuel recess.

Conformably and rototably engaged in the frusto-conical recess **64** is the frusto-conical inner end **65** of a fuel metering rotor **66**, which has a smooth cylindrical body **68**, which is journalled in the bore **70** of the boss **34**, and has, on its outer end, a reduced diameter axial tubular fuel intake nozzle **72**. A snap ring **74** is engaged in an internal annular groove **76**, in the bore **70**, at a point spaced outwardly from the rotor body **68**, and serves to compress a coil spring **76**, between the ring and the body **68**, which is circumposed on the nozzle **72**. This arrangement causes the frusto-conical end **65**, of the rotor, to constantly fit conformably in the frusto-conical recess **64**, whereby leakage otherwise due to wear of the engaged parts or displacement thereof is precluded. On the smaller flat inner end **78** of the rotor **66** is an axial reduced diameter solid boss **80**, which fits rotatably in the counterbore **56**, and is concentrically spaced from the secondary or idle fuel recess **64**. The boss **80** is formed with an axial idler fuel passage **82**, which, at its outer end, has a lateral arm **84** which opens to the recess **64**. The inner end of the head **62**, on the valve shaft **38**, is formed with diametrically aligned slots **67**, which accept the edge of the butterfly valve **61**. The valve shaft **38** has a fixed thrust collar **69** which seats in an accommodating recess **71**, in the wall of the tube **32**.

The fuel intake nozzle **72** is provided with an axial bore **86**, having a flared, open outer end portion **88**, and a tapered closed inner end **90**. The rotor body **68** is formed with a longitudinal main fuel passage **92** which leads from the nozzle bore **86**, near its inner end, to the larger end **94** of a comma-shaped main fuel recess **96**. The recess **96** extends around one side of the body **68** and has substantially the same radius of curvature as the body **68**.

The butterfly valve shaft **38** is formed with a longitudinal main fuel discharge passage **98**, which opens, at one end, to its flat inner end **100**, and opens at its other end to the frusto-conical recess **64**. As shown in FIGURE 10, the passage **98** can be of cylindrical cross section, or of oval cross section, as shown in FIGURE 10*a*, at **98***a*. A secondary fuel passage **102**, in the body **68**, leads from the idler fuel recess **63** to the frusto-conical recess **64**, at a location spaced circumferentially from the main fuel discharge passage **92**.

Provision for rotating the butterfly valve shaft **38**, relative to the tube **32**, and relative to the metering rotor **66** can take the form of a normally upstanding lever **104**, clamped, as indicated at **106**, on the exposed outer end of the shaft **38**, the lever **104** being provided with a hole **107**, at its upper end, affording pivotal connection means for a throttle rod **108**, such as an accelerator pedal spring-retracted rod. Suitably fixed on the shaft **38** inwardly of the lever **104** is a stop **110**, having a pendant arm **112**, adapted to make stop engagement with a stop lug **115**, projecting from the tube **32**, at a location below the shaft **38**. The stop **110** has a normally horizontal arm **114** carrying an adjustable spring-positioned idler stop screw **116**, adapted, at times, to engage the stop lug **115**.

For rotating the metering rotor **66** relative to the butterfly shaft **38**, and relative to the tube **32**, a lever **118** is suitably clamped, as indicated at **120**, on the exposed outer end of the fuel intake nozzle **72**, and is formed with a closed longitudinal slot **122**. A reclining L-shaped bracket **124** has its horizontal leg **126** secured, as indicated at **128**, upon a lateral horizontal arm **130**, on the boss **34**, and the upper end of its vertical bracket leg **132**, is curved to form a holder **134** for a cable shield **136** and is equipped with a set screw **138**. A flexible wire **140** extends out of the shield **136** and is pivotally connected, as indicated at **142**, to the upper end of a normally upright lever **144**.

The lever **144** has a normally erect lower portion **146**, and a canted upper portion **148**, to the upper end of which the wire **140** is secured. The lever **144** is pivotally supported, intermediate its ends, as indicated at **150**, to the outer side of the horizontal arm **130**, with a washer **152** intervening between the lever and the arm **130**. The lower lever portion **146** has a roller **154**, engaged in the slot **122** of the lever **118**, which is journalled on a headed pin **156**, secured to the lower end of the portion **146**.

The longitudinal movements of the wire **140**, and hence rotation of the rotor **66** can be produced, in the manner of a carburetor choke rod or wire, suitably mounted within the associated vehicle, or the rotation of the rotor **66** can be produced by means of a vacuum motor **158**, as shown in FIGURE 23. In the latter case, the motor **158** is adapted to be mounted on a bracket **160**, secured upon the mounting flange **162**, of the tube **32**, with its endwise movable actuating rod **164** pivoted, as indicated at **166**, to the upright leg **168**, of an L-shaped lever **170**, pivoted intermediate its ends, as indicated at **172**, on the bracket **160**. The horizontal leg **174**, of the lever **170**, has a lateral roller **175** engaged in the slot **176** of a lever **178** fixed on the intake nozzle **72** of the rotor **66**.

FIGURE 22 shows an alternate lever system for the rotor **66**, which differs from that described above, and shown in FIGURES 1 and 2, only in that the lever **180**, fixed on the fuel intake nozzle **72** of the rotor **66** is devoid of a slot, and dual rollers **182** are provided to roll on opposite sides of the lever **180**. The rollers **182** are journalled on diametrically opposed pins **184** on a disc **186** having a central opening **188**, adapted to register with a central opening **190** of the lever **144**, to receive a headed pin **192** threaded into the opening **190** and passing freely through the opening **188**. A retaining bar **194** straddles the outer ends of the pins **184** and is suitably secured thereto, to retain the rollers on the pins.

As shown in FIGURES 11 to 14, the tube **32** is provided with interior coplanar air by-pass or air equalizing idler air grooves **196** and **198**, which are preferably of concave cross section, and are located on a horizontal plane, relative to the butterfly valve **61**. The relations of the edges of the butterfly valve **61** relative to the interior of the tube **32**, and relative to the grooves **196** and **198** are shown in FIGURES 13 and 14. When the valve **61** is positioned in a conventional idle position, as shown in FIGURE 14, the grooves do not materially affect the conventional flow of air, in the tube **32**, around the valve as it is further rotated to feed more gas. However, when the butterfly valve **61** is set in subnormal idle position, as shown in FIGURE 13, in full lines, the air flow around the valve remains constant as the valve **61** is rotated, in the direction of the arrows, until the valve **61** reaches the position shown in FIGURE 14.

The idler air grooves **198** serve to provide an equal and constant inflow for the duration of travel of the butterfly valve **61**, from a subnormal idle position, of FIGURE 13, to a conventional idle position thereof, shown in FIGURE 14. By providing an equal and constant air flow, around the valve **61**, during the initial travel of this valve, from subnormal idle position to conventional idle position, a constant and smooth idle speed is maintained, until the main fuel recess **96** starts to register with the main fuel passage **98**, and the secondary or full throttle range comes into operation.

With the butterfly valve **61** set in the conventional idle position, shown in FIGURE 14, the slightest rotation of the valve toward open throttle position increases the air flow and thereby leans the idle air to fuel mixture, causing a flat or lean spot in operation, until the main recess **96** begins to register with the main fuel passage **98** and the secondary range comes into operation. Without the presence of the idler air grooves **198**, the flat or lean spot would cause erratic engine operation, and, in some instances stall the engine. With the idler grooves **198**, the injector operates with extreme smoothness, in engine operation, throughout the entire range.

In operation, fuel being supplied, as by a flexible hose **200**, connected to the fuel intake nozzle **72**, under pressure, by either a mechanical or electrical pump (not shown) fuel passes through the main fuel passage **92** into the main fuel recess **96**. When the butterfly valve **61** and its shaft **38** are in idle position, the idler fuel passage **102** is registered with the smaller end of the main fuel recess **96**, so that fuel passes through the idle fuel passage to the point of the needle valve **50**, which is adapted to be adjusted for the desired amount of fuel to flow through the passage **58** into the counterbore **40** and the port **60**, to mix with the air flow determined by the position of the butterlfly valve, which is adapted to be adjustably positioned by means of the idle air screw **116**. The main jet **98** does not register with the main recess **96** when the butterfly valve is in either idle position.

When the butterfly valve **61** is rotated toward wide open position, by means of throttle lever **104**, the smaller or leading end of the main fuel recess **96** registers with the main fuel passage **98**, allowing fuel to enter the air stream of the main passage. The main passage **98** registers constantly with the main fuel recess **96**, excepting at or during the idle position of the butterfly valve. The main recess **96**, becoming progressively larger in cross section, as the butterfly valve is rotated toward open throttle position, a progressively larger amount of fuel is allowed to flow into the airstream within the tube **32**, so as to maintain a desired fuel-to-air ratio.

When the butterfly valve **61** is in either idle position, in the tube **32**, the idler fuel passage **102** registers with the smaller end of the main fuel recess **96**, allowing only enough fuel flow, in the tube, for engine idling purposes, which is adjusted to a correct fuel-to-air ratio and engine r.p.m.'s by means of the needle valve **50** and the idler stop screw **116**. As the butterfly valve is rotated away from its subnormal idle position, air flow and idle fuel mixture remains constant and even, which leans out the fuel mixture.

The duration of rotation of the butterfly valve, from its idle position to the time of the registration of the main fuel passage with the main fuel recess, determines the richness of the fuel mixture, throughout the main fuel supply range, which remains constant during engine operation. This fuel-to-air ratio is adjusted by means of actuation of the main fuel adjusting lever **144**.

As shown in FIGURES 24 and 25, a tubular, closed end, perforated atomizer nozzle **210** may be screwed into the output and of the main fluid discharge passage **98**, for the purpose of breaking up and atomizing the fuel into the airstream within the tube **32**, below the butterfly valve **61**.

What is claimed is:

1. A fuel injector comprising an open ended tube having a continuous side wall, a butterfly valve shaft journalled through said side wall at one side of the tube and having a butterfly valve extending across the interior of the tube, said valve shaft having throttle accommodating lever means on its outer end, and adjustable idle stop means engageable with a part of said tube, said valve shaft having a first longitudinal bore opening to its outer end and a second longitudinal bore opening to its inner end, the part of the valve shaft between these bores being solid and formed with a reduced diameter idler fuel passage communicating with the bores, said part having a needle valve seat at its outer end, a needle valve threaded in said first bore and having a point cooperating with said valve seat, an enlarged diameter head on the inner end of the valve shaft, a lateral tubular boss on the side of the tube remote from the valve shaft, said boss having a bore larger in diameter than said valve shaft in which said head is journalled, said head being formed in the end thereof remote from the valve shaft with a frusto-conical recess and with an annular idler fuel recess surrounding and communicating with the smaller end of the frusto-conical recess, a fuel metering rotor slidably and rotatably journalled in the bore of the boss and having a frusto-conical inner end rotatably and conformably engaged in said frusto-conical recess, said rotor having a reduced diameter axial solid boss on its inner end, said solid boss being journalled in the second bore of the valve shaft and being circumferentially spaced from the side of said annular idler fuel recess, passage means providing communication between said second valve shaft bore and said idler fuel recess, a snap ring fixed in the bore of the tubular boss, a coil spring circumposed on the rotor and compressed between the ring and a part of the rotor and maintaining engagement of the frusto-conical end of the rotor in said frusto-conical recess, a reduced diameter

axial fuel inlet nozzle on the rotor and extending out of the bore of the tubular boss, adjustable rotary positioning means fixed on the said nozzle outside of the tubular boss, said positioning means being adapted to be operatively connected to control means, first fuel passage means traversing said rotor and providing communication between the bore of said nozzle and said frusto-conical end of the rotor, and second fuel passage means traversing the head on the valve shaft and providing communication between said frusto-conical recess and said annular idler fuel recess, said second passage means comprising at least two circumferentially spaced passages with which said first passage means is adapted to be registered in different rotated positions of said butterfly valve shaft.

2. A fuel injector according to claim **1**, wherein said first passage means comprises a main fuel discharge passage opening to the inner end of the valve shaft head and discharging into the bore of said tube at a location below the butterfly valve shaft.

3. A fuel injector according to claim **1**, wherein the passage means of the butterfly valve shaft head comprises a main longitudinal discharge fuel passage extending to the ends of the head and opening into the interior of the tube below the butterfly valve, and a secondary longitudinal fuel passage opening at one end to the outer end of the head and at its other end to the idler fuel recess.

4. A fuel injector according to claim **1**, wherein the passage means of the butterfly valve shaft head comprises a main longitudinal discharge fuel passage extending to the ends of the head and opening into the interior of the tube below the butterfly valve, and a secondary longitudinal fuel passage opening at one end to the outer end of the head and at its other end to the idler fuel recess, the fuel passage means of the rotor comprising a tapered comma-shaped main recess having a smaller end and a larger end, a main fuel passage formed in the rotor and providing communication between the main fuel recess and the bore of the fuel intake nozzle, said rotor being adapted to be rotated relative to the head of the butterfly valve shaft and the tube from an idle position wherein the smaller end of the main fuel recess of the rotor is registered with said secondary fuel passage to a full throttle position wherein said main fuel passage of the valve shaft head is registered with the larger end of the main fuel recess of the rotor.

5. A fuel injector according to claim **1**, wherein the passage means of the butterfly valve shaft head comprises a main longitudinal discharge fuel passage extending to the ends of the head and opening into the interior of the tube below the butterfly valve, and a secondary longitudinal fuel passage opening at one end to the outer end of the head and at its other end to the idler fuel recess, a closed end tubular perforated atomizer secured to the butterfly shaft head and communicating with the inner end of said main fuel discharge passage.

6. A fuel injector according to claim **1**, wherein said tube is formed with internal circumferentially extending air idler groove means, said groove means being disposed substantially in a plane positioned at right angles to the axis of the tube, said groove means serving to provide equalizing air flow around the edge of the butterfly valve as the butterfly valve is rotated from a subnormal idle position to a conventional idle position.

7. A fuel injector according to claim **1**, wherein the passage means of the butterfly valve shaft head comprises a main longitudinal discharge fuel passage extending to the ends of the head and opening into the interior of the tube below the butterfly valve, and a secondary longitudinal fuel passage opening at one end to the outer end of the head and at its other end to the idler fuel recess, wherein said tube is formed with internal circumferentially extending air idler groove means, said groove means being disposed substantially in a plane positioned at right angles to the axis of the tube, said groove means serving to provide equalizing air flow around the edge of the butterfly valve as the butterfly valve is rotated from a subnormal idle position to a conventional idle position.

8. A fuel injector comprising an open-ended tube, a butterfly valve shaft extending across and journalled through the walls of the tube, throttle means fixed on the outer end of the valve shaft, stop means fixed on the valve shaft, a stop lug on the tube, said stop means having circumferentially spaced first and second arms, said first arm being adapted to engage the stop lug in a first extreme rotated position of the valve shaft, said second arm carrying an idle adjusting stop screw engageable with said stop lug in an opposite extreme rotated position of the valve shaft, a butterfly valve fixed on the valve shaft within the tube and adapted to occupy a median horizontal position in the tube, said valve shaft being formed with a first blind bore opening to one end thereof, the end of the first blind bore remote from said one end being conical to form a valve seat, a valve needle threaded in said first blind bore and having a point facing the valve seat, said valve shaft being formed with a lateral idler fuel port opening to said first blind bore, said valve shaft being formed with a second blind bore opening to the end of the valve shaft remote from the needle valve, a small idler fuel passage formed in the material of the valve shaft and providing communication between the blind bores, the valve shaft having an enlarged diameter head on the end thereof remote from the needle valve, a frusto-conical axial recess formed in the outer end of the head, a fuel metering rotor slidably journalled on the wall of the tube, said rotor having a frusto-conical inner end engaged in said frusto-conical recess, spring means supported on the tube and biasing the rotor inwardly, said rotor having a reduced diameter fuel intake nozzle on its outer end, rotor rotating means associated with said nozzle, said rotor having a reduced diameter boss on its inner end engaged in said second blind bore, another idler fuel passage extending longitudinally in said boss and communicating at its inner end with said second blind bore, the other end of said other passage opening to the side of said boss, said frusto-conical recess being formed with a reduced diameter annular idler fuel recess at its apex and surrounding the boss, said other passage opening to said idler fuel recess, said head being formed with an idler fuel passage and a main fuel passage spaced therefrom and said rotor being formed with fuel passage means which registers only with said idler fuel passage during a portion of the arc of rotation of said butterfly valve shaft and with said main fuel passage during the remainder of said arc.

9. A device of the character described, comprising an open-ended tube having a side wall, a butterfly valve shaft journalled across the tube, a butterfly valve fixed on the butterfly shaft, said valve having a peripheral edge working close to the wall of the tube, said tube being formed with a pair of internal circumferentially extending air idler grooves, said grooves being disposed substantially in a plane positioned at right angles to the axis of the tube, means for positioning the butterfly valve in a subnormal idle position, in which it covers one of said grooves and uncovers the other, means for rotating the valve from said subnormal position to and through a conventional idle position in which it uncovers the said one groove and covers the other, said valve shaft having a main fuel passage and an idler fuel passage, and a fuel metering rotor rotatably mounted with respect to the shaft and having a fuel feed passage registrable with said main and idler fuel passages at relatively different angular positions of the rotor and shaft but so positioned as to register only with said idler fuel passage during the entire arc of rotation of the butterfly valve extending between said subnormal and conventional idle positions, said grooves serving to provide constant air flow around the edge of the butterfly valve as the butterfly valve is rotated from its subnormal idle position to its conventional idle position.

References Cited

UNITED STATES PATENTS

1,129,129	2/1915	Schmid et al.	261—44
1,129,864	3/1915	Haas	261—65 X
3,132,191	5/1964	Kennedy	261—44
3,202,404	8/1965	Brandwood et al.	261—44
3,220,709	11/1965	Pickron et al.	261—44

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