Aug. 16, 1966 W. L. KENNEDY, SR. 3,266,785

FUEL INJECTOR

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FIG. 1.

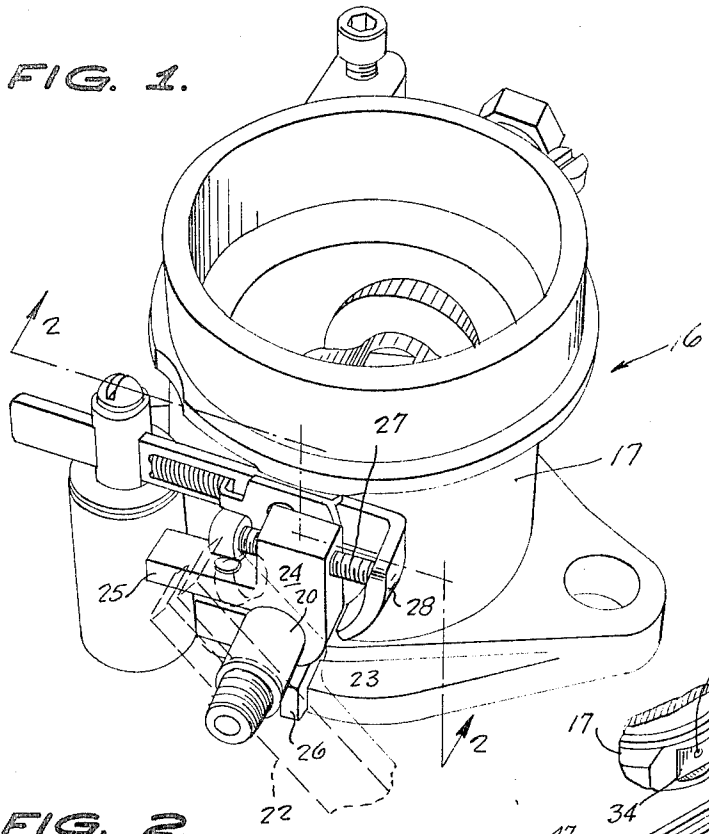
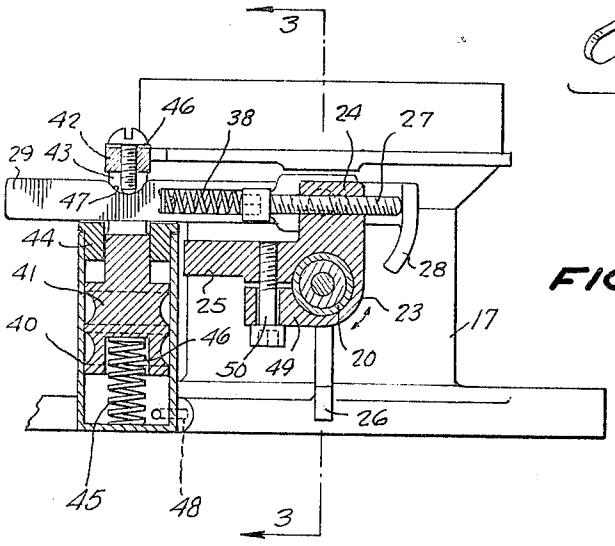


FIG. 2.



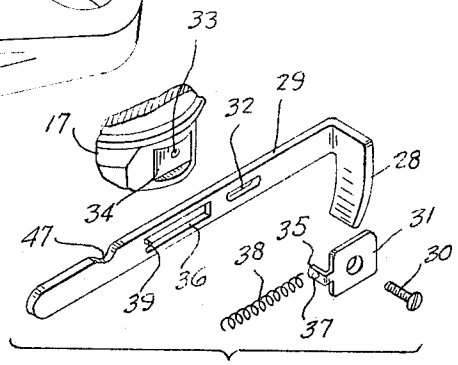
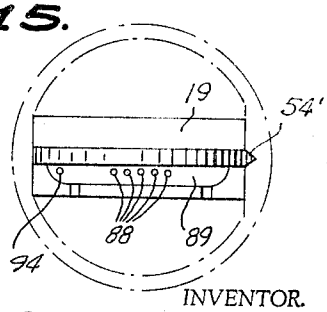


FIG. 11.

FIG. 15.



INVENTOR.
WALTER L. KENNEDY, SR.

BY

McMorrow, Berman & Davidson
ATTORNEYS.

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FIG. 3.

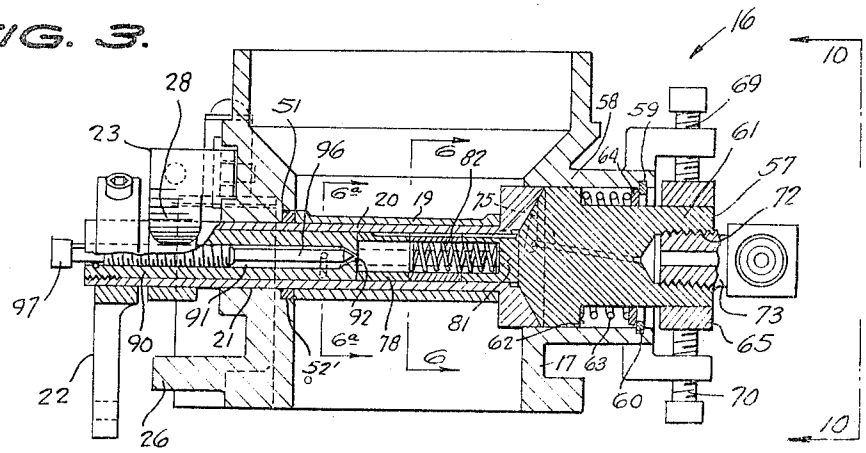


FIG. 4.

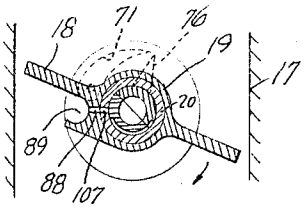


FIG. 6.

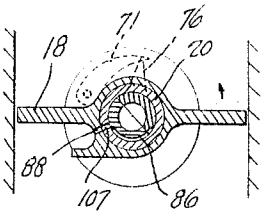


FIG. 8.

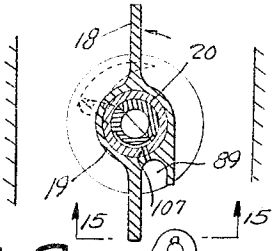


FIG. 5.

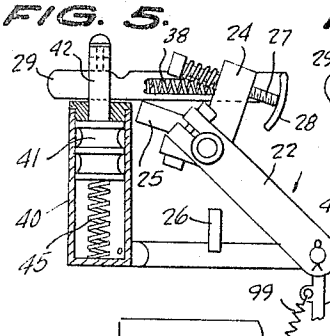


FIG. 7.

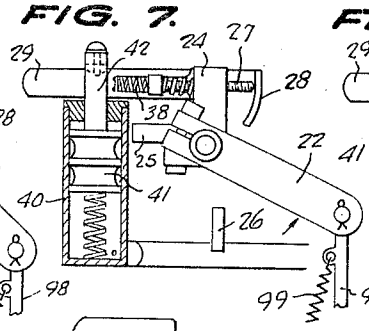


FIG. 9.

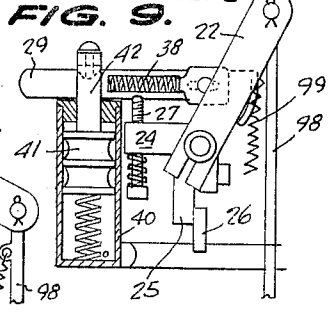


FIG. 10.

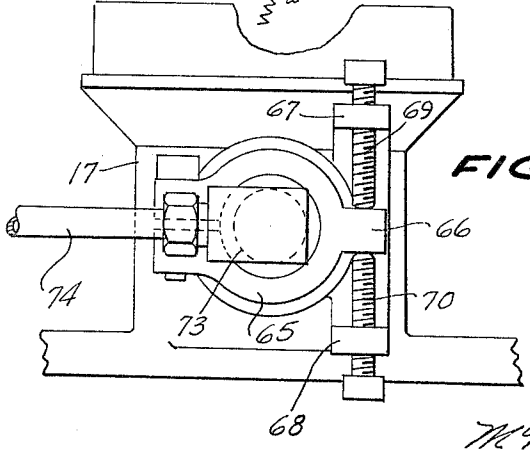
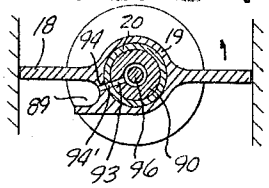


FIG. 6a.



INVENTOR.
WALTER L. KENNEDY, SR.

BY

McMorrow, Berman & Davidson
ATTORNEYS.

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FIG. 12.

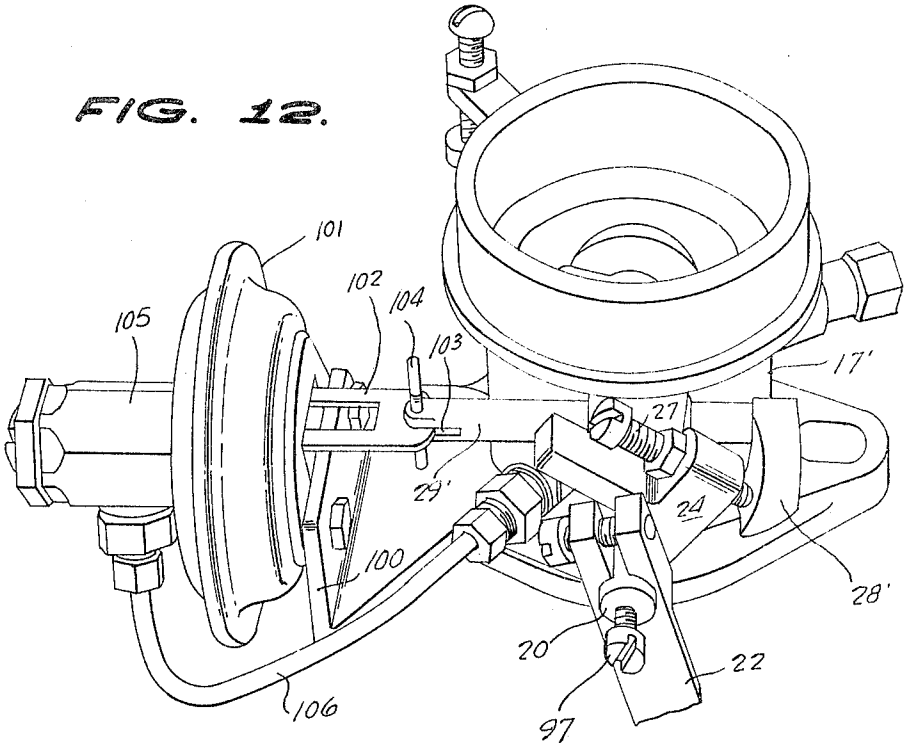


FIG. 13.

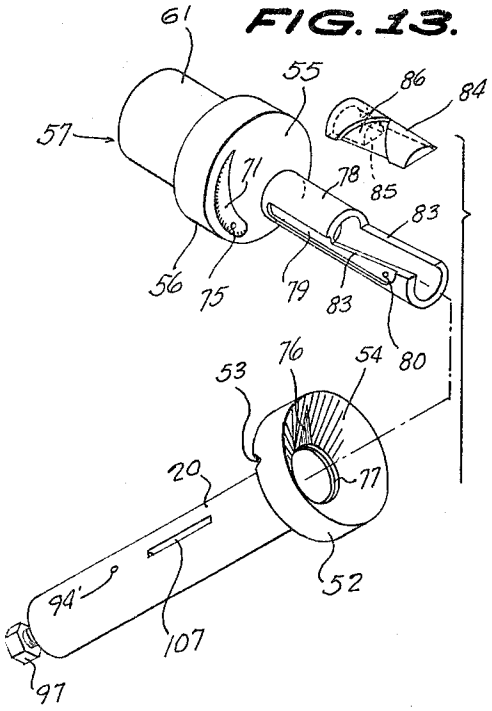
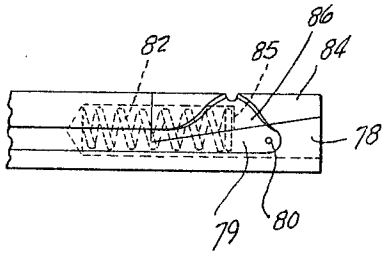


FIG. 14.



INVENTOR.
WALTER L. KENNEDY, SR.

BY

McMorrow, Berman & Davidson

ATTORNEYS.

United States Patent Office 3,266,785 Patented August 16, 1966

3,266,785

FUEL INJECTOR

Walter L. Kennedy, Sr., Berkley, Mich.
(6039 Rolton Court, Waterford, Mich. 48095)

Filed Apr. 17, 1964, Ser. No. 360,707
14 Claims. (Cl. 261—41)

This invention relates to a fuel injector for internal combustion engines, and more particularly to an improved fuel metering device adapted to be employed with an internal combustion engine and being of the type having idling control means responsive to the operation of the engine.

A main object of the invention is to provide a novel and improved fuel injection device for an internal combustion engine, the device being relatively simple in construction, providing accurate metering of the fuel passing therethrough, having a minimum of moving parts, being adaptable for use with a wide range of internal combustion engines, such as those employed in automobiles, motor trucks, marine craft, and the like, and being provided with means to assure a continuous metered supply of fuel while the associated engine is idling and to cut off such supply when the engine is not operating.

A further object of the invention is to provide an improved fuel injection device for an internal combustion engine arranged to provide positive accurately metered flow of fuel to the engine under idling conditions thereof and to cut off such flow when the engine is not operating, the device being composed of relatively inexpensive parts, being easy to install, being reliable in operation, and providing improved engine performance as well as fuel economy.

A still further object of the invention is to provide an improved fuel injection device for an internal combustion engine, the device being relatively compact in size, being durable in construction, being easy to adjust, being substantially leakproof, and being arranged so that transmission of fuel therethrough is automatically shut off responsive to the stopping of the associated engine.

A still further object of the invention is to provide an improved fuel injection device for an internal combustion engine, said device being provided with improved means to prevent transmission of fuel therethrough unless the associated engine is developing vacuum, whereby the supply of fuel to the engine is automatically shut off when the engine is not running or is stalled.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a perspective view of an improved fuel injection device constructed in accordance with the present invention, shown in normal operating position, namely, in a position wherein the associated engine is running.

FIGURE 2 is a fragmentary vertical cross-sectional view taken substantially on the line 2—2 of FIGURE 1.

FIGURE 3 is a transverse vertical cross-sectional view taken substantially on the line 3—3 of FIGURE 2.

FIGURE 4 is a transverse vertical cross-sectional view taken through the intermediate portion of the butterfly valve and associated supporting structure of the fuel injector of FIGURES 1 to 3, illustrating the approximate position of the butterfly valve when the associated engine is shut off, with the accelerator pedal of the engine released.

FIGURE 5 is a vertical cross-sectional view taken in a longitudinal vertical plane through the vacuum-controlled idling locking cylinder of the fuel injector with the parts in the positions corresponding to FIGURE 4,

namely, with the associated engine inoperative and the associated accelerator linkage in a released position.

FIGURE 6 is a vertical cross-sectional view similar to FIGURE 4 but taken on the line 6—6 of FIGURE 3, namely, showing the parts in engine-idling positions.

FIGURE 6*a* is a transverse vertical cross-sectional view taken substantially on the line 6*a*—6*a* of FIGURE 3.

FIGURE 7 is a fragmentary vertical cross-sectional view, similar to FIGURE 5, but showing the parts associated with the vacuum-controlled cylinder in positions corresponding to FIGURE 6.

FIGURE 8 is a vertical cross-sectional view similar to FIGURES 4 and 6 but showing the butterfly valve in fully opened position providing maximum fuel mixture transmission through the engine.

FIGURE 9 is a fragmentary vertical cross-sectional view similar to FIGURES 5 and 7, but showing the parts in positions corresponding to the condition illustrated in FIGURE 8.

FIGURE 10 is a fragmentary end elevational view taken substantially on the line 10—10 of FIGURE 3.

FIGURE 11 is a perspective view showing the idle locking bar and associated elements, as employed in the fuel injector of the present invention, the parts being shown in separated positions.

FIGURE 12 is a perspective view of a modified form of fuel metering device constructed in accordance with the present invention.

FIGURE 13 is a perspective view of the metering shaft and associated elements, as employed in the fuel metering device of the present invention, with the parts shown in separated positions.

FIGURE 14 is an enlarged fragmentary elevational view of the inner end portion of the metering shaft of the fuel injector device of the present invention.

FIGURE 15 is a bottom plan view of the butterfly shaft taken substantially on the line 15—15 of FIGURE 8.

Referring to the drawings, and more particularly to FIGURES 1 to 11, 13, 14 and 15, 16 generally designates an improved fuel injection device according to the present invention. The main body of the device 11 is designated at 17, and the butterfly valve thereof is designated at 18. The butterfly valve 18 has an integral sleeve-like mounting portion 19 which is fixedly secured on a hollow supporting sleeve 20 which extends rotatably through a horizontal bore 21 in a side wall of the body 17 and to the outer end portion of which is secured the operating arm 22 which is connected by conventional linkage means to the accelerator pedal of the associated vehicle, the arm 22 being biased in a clockwise direction, as viewed in FIGURE 1, by the conventional biasing spring means associated with the connecting linkage between the accelerator pedal and the shaft 20. When the accelerator pedal is depressed, the arm 22 is rotated counterclockwise, as viewed in FIGURE 1, namely in an upward direction, to similarly rotate shaft 20 counterclockwise against the biasing force of the accelerator linkage spring means.

Secured on the external portion of hollow shaft 20 inwardly adjacent the arm 22 is a control arm, designated generally at 23, said control arm being generally L-shaped and having the respective finger portions 24 and 25 extending at right angles to each other. The finger 25 is of substantial length and is located so as to engage a fixed stop projection 26 integrally formed on the lower portion of body 17 to limit the counterclockwise rotation of the hollow shaft 20, as viewed in FIGURE 1, to a position corresponding to that illustrated in FIGURE 8, wherein the butterfly member 18 is in a sub-

stantially vertical position, allowing maximum fluid flow through the fuel injector body **17**. This represents the full throttle conditions of the fuel injector device, whereas FIGURE 4 shows the butterfly member **18** in its normal position wherein the associated engine is not operating.

The finger member **24** is provided with the adjustable idling abutment screw **27** which is threadedly engaged through the member **24** and extends parallel to the finger **25**, the end of the screw **27** being engageable with an arcuately curved stop flange **28** formed on the end of a lock bar **29**. The lock bar **29** is supported horizontally and is slidably connected to the main body **17** by a retaining screw **30** which extends through the central aperture of a guide plate **31** and a longitudinal slot **32** formed in bar **29**, the screw **30** being threadedly engaged in a tapped hole **33** provided in a guide recess **34** formed in the wall of body **17**, as shown in FIGURE 11. The recess **34** is shaped to slidably receive the bar **29** and to guide the bar horizontally, cooperating with the screw **30** and the slot **32** to allow horizontal movement of bar **29** relative to body **17**, the movement being limited by the slot **32**. The plate **31** is provided with a finger **35** projecting at right angles to the plate **31** and slidably engaging in another longitudinal slot **36** formed in the bar **29**. The finger **35** is provided with a projection **37** engaging in one end of a biasing coiled spring **38**, the other end of the coiled spring engaging over a projection **39** formed in the opposite end edge of slot **36**. Thus the coiled spring **38** exerts a biasing action on the bar **29** urging said bar to the left, as viewed in FIGURE 11, namely, in a direction to cause the flange **28** to bias arm **23** and shaft **20** in a counterclockwise direction, as viewed in FIGURE 1, in opposition to the bias exerted on arm **22** by the spring means associated with the accelerator linkage system. However, under ordinary conditions the clockwise bias on the arm **22** is much stronger than and overcomes the biasing force exerted by the spring **38**.

Formed rigidly with the body **17** is a vertical cylinder **40** containing a piston **41** having the upwardly projecting piston rod **42** which is formed with a vertical slot **43** slidably receiving the bar **29**, as shown in FIGURE 2. The cylinder **40** is provided with a top wall **44** formed with a central bore through which the rod **42** slidably extends, said top wall **44** limiting the upward movement of the piston **41**, for example, to the position shown in FIGURE 5. A coiled spring **45** is provided below the piston **41**, the top end of the spring being received in a recess **46** formed in the bottom of piston **41**, and the lower end of the spring bearing on the bottom wall of cylinder **40**, as is clearly shown in FIGURE 2. The piston **41** is thus biased upwardly toward the position shown in FIGURE 5 wherein said piston is in its uppermost limiting position engaging the top wall **44**.

A detent screw **46** is threadedly engaged through the top of the piston **42**, extending downwardly into the slot **43** and being lockingly engageable in a notch **47** formed in the top edge of the bar **29**. The cylinder **40** is provided at its lower end portion with a connection conduit **48** which is connected to the intake manifold of the associated internal combustion engine so that the cylinder will be evacuated by the vacuum created in said intake manifold when the engine is operating, causing the piston **41** to be lowered against the force of the biasing spring **45**. Under these conditions, illustrated in FIGURE 2, the screw **46** engages in the notch **47**, locking the bar **29** against horizontal sliding movement. When bar **29** is thus locked, the screw **27** abuts against the frame **28**, holding the shaft **20** in a predetermined position, illustrated in FIGURES 6 and 7, the clockwise biasing force on the arm **22** being insufficient to overcome the locking action provided by the vacuum in cylinder **40**, which holds the screw **46** in locking engagement in the notch **47**. As will be presently explained, the condition illustrated in FIGURES 6 and 7 represents the idling position of the fuel injector device **16**, whereas the condition illustrated in FIGURES 4 and 5 represents the cut-off position of the fuel injector device.

As shown in FIGURE 2, the arm **23** is secured on the hollow shaft **20** by the provision of a clamping arm **49** provided with a clamping screw **50** which extends through the arm **49** and is threadedly engaged in the finger portion **24**, these elements defining a split collar whereby the member **23** may be adjustably secured on the hollow shaft **20**.

As shown in FIGURE 3, the butterfly valve supporting sleeve **19** has its left end in engagement with a resilient deformable sealing ring **51** received in an annular recess **52'**, definining a counterbore around the inner end portion of the bore **21** in the wall of body **17**, the opposite end of the sleeve **19** engaging against an enlarged annular head member **52** integrally formed with the hollow shaft **20**, the head member **52** being formed with a V-shaped radial groove **53** at its inner surface which receives a correspondingly shaped locking projection **54'** formed on the end of the sleeve **19**. The head **52** is provided with the frusto conical outwardly flaring outer sealing surface **54** which is sealingly and rotatably engaged by a correspondingly shaped frusto conical surface **55** provided on the enlarged head portion **56** of a metering shaft member, generally designated at **57**. The head member **52** of hollow shaft **20** and the head member **56** of metering shaft **57** are rotatably received in a horizontal sleeve portion **58** formed integrally with the body **17** and provided with a snap ring recess **59** at its outer end portion in which is positioned a snap ring **60**. The head member **56** is formed with the reduced end portion **61** which extends outwardly through the sleeve **58** and which thereby defines an inner annular shoulder **62**. A coiled spring **63** surrounds the portion **61**, bearing between shoulder **62** and a bearing washer **64** which abuts the snap ring **59**. The spring **63** thus exerts an inward biasing force on the member **57**, urging the frusto conical surface **55** against the cooperating frusto conical sealing surface **54**, as well as urging the hollow shaft **20** leftwards, as viewed in FIGURE 3.

A positioning collar **65** is clampingly secured on the outer end portion of the cylindrical member **61**, said positioning collar being provided with an outwardly projecting lug **66**. The body **17** is integrally formed with a pair of vertically spaced opposing arms **67** and **68** located respectively above and below the projection **66**, and respective vertical positioning screws **69** and **70** are threadedly engaged through the arms **67** and **68** and extend into engagement with opposite side portions of the lugs **66**, whereby the metering shaft **57** may be held in rotated adjusted position around the axis of the sleeve **58**. The frusto conical surface **55** of head member **56** is provided with a circumferentially tapering metering recess **71** whose position may thus be angularly adjusted.

The outer end portion of cylindrical member **61** is formed with an internally threaded bore **72** in which is engaged the fuel supply connection fitting **73** which is in turn connected to the fuel supply conduit **74**, as shown in FIGURE 10. The head member **56** is provided with a passage **75** connecting the fuel supply connection recess **72** to the larger end of the metering recess **71**.

The frusto conical sealing surface **54** is provided with an inwardly flaring tapered recess **76** whose smaller end portion is located to overlap with the tapering metering recess **71**. The inner end of recess **76** communicates with an annular groove **77** formed at the inner portion of the frusto conical surface **54**, as shown in FIGURE 13.

The metering shaft member **57** is formed with the reduced axially extending inner sleeve portion **78** provided with the longitudinally extending recess **79** communicating at its rear end with the annular groove **77**, the forward end portion of the sleeve **77** being provided at the forward end of the groove **79** with an aperture **80** communicatively connecting the groove **79** with the interior of sleeve mem-

ber 78. The sleeve member 78 has a solid rear wall, as shown at 81, which acts as a bearing seat for one end of a coiled spring 82. The forward end portion of the member 78 is notched away, as shown at 83, 83, to define a forwardly and upwardly inclined bearing seat for a wedge-shaped sleeve segment 84 fitting in the notched seat defined by the elements 83, 83 and having the same curvature as the sleeve member 78. Wedge segment 84 is provided with a bearing shoulder 85 against which the forward end of spring 82 engages, urging the wedge member 84 forwardly, namely, to the right, as viewed in FIGURES 13 and 14. Due to the inclination of the opposite notched edges 83, 83, the biasing force of spring 82 urges the wedge element 84 outwardly into sealing engagement with the inside bore surface of sleeve 20, providing sealing contact of the member 84 with said inside bore surface while allowing the sleeve 20 to rotate relative thereto.

Wedge member 84 is formed with a generally triangular external recess 86 which registers with the forward portion of the groove 79. The hollow shaft 20 is provided with a longitudinal slot 107 which registers with a series of apertures 88 formed in the sleeve 19, leading to a channel-shaped longitudinally extending discharge nozzle 89 formed integrally on the sleeve member 19, the registering slot 107 and apertures 88 being rotatable into registry with the triangular recess 86 to provide injection of fuel into the interior bore of body 17 as the butterfly valve 18 is rotated in a counterclockwise direction from the position of FIGURE 6 toward the position of FIGURE 8. Since the apertures 88 are arranged longitudinally, an increasing number of these apertures are exposed to the recess 86 as the butterfly valve 18 is rotated counterclockwise from the position of FIGURE 6 toward the position of FIGURE 8, due to the triangular shape of recess 86. This provide a progressive increase in the supply of fuel a sthe butterfly valve 18 is rotated from the idling position of FIGURE 6 toward the full throttle position of FIGURE 8.

An idling sleeve member 90 is threadedly secured inside the hollow shaft 20, the idling sleeve 90 being formed with an interior bore 91 terminating in a frusto conical needle valve seat 92 defining a needle valve aperture communicating with the interior of the sleeve member 78. Idling sleeve 90 has a discharge aperture 93 communicating with registering idle apertures 94, 94' provided in sleeve members 19 and 20 to allow liquid fuel from the interior of sleeve 78 to discharge into the interior bore of body 17 to provide fuel for engine idling. An adjustable needle valve element 96 is threadedly engaged in the bore 91, said valve element having an exposed adjusting head 97, whereby the clearance between the tip of the valve element 96 and the seat 92 may be adjusted to provide a desired rate of flow of idling fuel. It will be noted however, that there will be no flow of fuel for idling unless some degree of registry exists between recess 76 and recess 71.

Under normal conditions with the engine shut off, the positions of the parts are those illustrated in FIGURES 4 and 5. Under these conditions the narrow end of the outwardly tapering recess 76 does not overlap the narrow end of the circumferentially tapering recess 71 so that fuel cannot flow into the sleeve 20 and therefore no fuel can be delivered to the interior of the body 17. The arm 22 is held in a clockwise rotated position by the accelerator linkage rod 98 under a force of the accelerator linkage biasing spring 99, as shown in FIGURE 5, the end of the screw 27 abutting the laterally extending projection 28, but the force of the accelerator linkage biasing spring 99 being substantially greater than that of the force of the locking rod biasing spring 38. When the operator steps on the accelerator pedal, the linkage rod 98 moves upwardly from the position of FIGURE 5, rotating the arm 22 in a counterclockwise direction, as viewed in FIGURES 5 and 7, stretching the spring 99 and rotating the butterfly valve through the position of FIGURE 6 toward the full throttle position of FIGURE 8. Until the engine starts, the spring 45 holds the piston 41 in an elevated position, as shown in FIGURE 5, but as soon as the engine begins to operate, vacuum develops in the intake manifold thereof, which is transmitted to the interior of the cylinder 40, causing the piston 41 to be drawn downwardly so that the lower end of locking screw 46 engages the top edge of locking rod 29. The spring 38 exerts a biasing force on the locking rod 29 which moves it to the left from the position of FIGURE 5 until the locking screw 46 engages in the notch 47, whereupon the rod 29 is held in the position of FIGURE 7, so that thereafter when the accelerator pedal is released with the engine running the arm 22 is limited in its clockwise rotation to the position shown in FIGURE 7 because of the engagement of the screw 27 with the laterally extending projection 28 on the end of the locking rod 29. In this position, as shown in FIGURE 6, the narrow end of the outwardly tapering, radially extending recess 76 overlaps the narrow end of the circumferentially tapering recess 71, allowing a sufficient amount of fuel to flow into the sleeve 20 by way of the groove 79 and thence by way of the aperture 80, the interior of sleeve 78, past the tip of needle valve 96 in seat 92, through bore 91 and through passages 93 and 94, 94' into the discharge channel-shaped space 89 into the interior of body 17 to allow engine idling. The bar 29 will remain locked in the position of FIGURE 7 as long as the engine continues to operate, namely, as long as vacuum is present in the cylinder 40. Thus, when the butterfly valve 18 is rotated toward the full throttle position of FIGURE 8, the bar 29 still remains locked in the same position as shown in FIGURE 7, namely, in the position providing subsequent idling of the engine if the accelerator pedal is released. This is illustrated in FIGURE 9, wherein the arm 22 is shown elevated by the link 98 to a position corresponding to the full opening position of the butterfly valve 18, shown in FIGURE 8. Under these conditions the finger 25 engages against the fixed stop lug 26 provided in the lower portion of main body 17.

As will be readily apparent, the position of the metering shaft 57 can be accurately adjusted by means of the positioning screws 69 and 70 which engage the lug 66 on collar 65. The idling position of the butterfly valve 18 can be regulated by adjusting the screw 27. The amount of idling fuel supplied to the interior of the body 17 under idling positions can be further adjusted to an accurate degree by adjusting the needle valve element 96 by means of its external actuating head 97.

Since only a relatively small degree of vacuum is required in the cylinder 40 to hold the piston 41 in a depressed locking condition, fluctuation of the vacuum in the cylinder does not affect the retention of the locking bar 29 in the position shown in FIGURES 7 and 9. Furthermore, such fluctuations of the vacuum do not affect the distribution of the fuel through the overlapping recesses 76 and 71 and through groove 79, recess 86 and apertures 88, since this is controlled only by the action of the accelerator linkage connected to the arm 22.

Whenever the engine is cut off or stops for any reason, the vacuum no longer exists in cylinder 40, allowing spring 45 to elevate piston 41, thereby unlocking the bar member 29. The accelerator linkage biasing spring 99 then causes the butterfly valve 18 to rotate to the position of FIGURE 4, limited by the engagement of the screw 27 with the laterally extending projection 28 on bar 29. The recess 76 is moved out of communication with the recess 71, cutting off the supply of fuel. Thus, the supply of idling fuel is automatically discontinued whenever the engine is stopped or becomes stalled for any reason.

In the form of the invention shown in FIGURE 12, the locking bar, shown at 29' has a laterally extending projection 28' engageable by the adjustable screw 27 on finger 24, as in the previously described form of the

invention. The main body, shown at **17'** is provided at one end of its base with an upstanding flange **100** on which is mounted a vacuum chamber **101** containing a flexible diaphragm of conventional construction. Connected to said diaphragm is an outwardly extending arm **102** which is received in a longitudinal slot **103** formed in the end of rod **29'** and which is pivotally connected thereto by a transverse connecting pin **104**. The inside of the vacuum chamber communicates with a housing **105** which in turn is connected by means of a conduit **106** to the lower portion of the interior of body **17'**, so that it is in communication with the intake manifold and is thus exposed to the vacuum developed therein when the engine operates. When such vacuum is developed, the diaphragm in the chamber **101** flexes to pull the arm **102** to the left, as viewed in FIGURE 12, moving the bar **29'** also to the left and carrying the laterally extending projection **28'** therewith. As long as the projection **28'** is held in its leftward position by the presence of vacuum in the chamber **101**, the butterfly valves and parts connected therewith are held in idling positions, namely, in positions wherein the narrow end portions of the recesses **76** and **71** overlap, allowing the flow of fuel into the interior of body **17'** to maintain idling. The vacuum chamber **101** is relatively large in size so that only a small amount of vacuum is required to maintain the bar **29'** in a leftward retracted position, so that, just as in the previously described form of the invention, fluctuation of the vacuum will not interfere with holding the bar **29'** in a position to insure supply of idling fuel as long as the engine is running.

While certain specific embodiments of an improved fuel injector have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially tapering metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a relatively narrow portion of said metering recess, and vacuum-responsive means to lock said butterfly shaft in said idling position.

2. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially tapering metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess locted to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a relatively narrow portion of said metering recess, a locking bar slidably mounted in said main body, an abutment element on said butterfly shaft, a projection on said locking bar engageable with said abutment element, and vacuum-responsive means engageable with said locking bar to lock said butterfly shaft in said idling position.

3. A fuel injection device comprising a main body formed with a passage for fuel mixture, a meeting shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, an abutment element on said butterfly shaft, a projection on said locking bar engageable with said abutment element, said locking bar being formed with a detent notch, and a vacuum-responsive element lockingly engageable in said detent notch and located to hold the locking bar in a position wherein said projection holds the butterfly shaft in said idling position.

4. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connected said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, an abutment element on said butterfly shaft, a projection on said locking bar engageable with said abutment element, said locking bar being formed with a detent notch, a cylinder secured to said body, a piston in said cylinder, and means on the piston lockingly engageable in said detent notch and located to hold the locking bar in a position wherein said projection holds the butterfly shaft in said idling position responsive to vacuum in said cylinder.

5. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like but-

terfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, an abutment element on said butterfly shaft, a projection on said locking bar engageable with said abutment element, said locking bar being formed with a detent notch, a vacuum cylinder secured to said body, a piston in said cylinder, said piston having a slotted piston shaft slidably receiving said locking bar, and a projection in said piston shaft lockingly engageable in said detent notch responsive to movement of the piston produced by vacuum in the cylinder, said detent notch being located so that said projection holds the butterfly shaft in said idling position when the projection in the piston engages in said detent notch.

6. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, a laterally extending projection on said locking bar, an adjustable abutment screw on said butterfly shaft located to engage said laterally extending projection, and vacuum-responsive means lockingly engageable with said locking bar and located to hold said locking bar in a position wherein said butterfly shaft is held in said idling position.

7. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, a laterally extending projection on said

locking bar, an arm secured to said butterfly shaft adjacent said laterally extending projection, an abutment screw threadedly mounted in said arm and being engageable with said laterally extending projection, and vacuum-responsive means to releasably hold the locking bar in a position wherein said butterfly shaft is held in said idling position.

8. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate the butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, a laterally extending projection on said locking bar, an arm secured to said butterfly shaft adjacent said laterally extending projection, an abutment screw threadedly mounted in said arm and being engageable with said laterally extending projection, and a vacuum-responsive member operatively engaged with said locking bar to releasably hold said locking bar in position wherein said butterfly shaft is held in said idling position.

9. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having discharge apertures registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge apertures, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, a laterally extending projection on said locking bar, an arm secured to said butterfly shaft adjacent said laterally extending projection, an abutment screw threadedly mounted in said arm and being engageable with said laterally extending projection, said locking bar being formed with a detent notch, and a vacuum-responsive member lockingly engageable in said detent notch and being located to releasably hold said locking bar in a position wherein said butterfly shaft is held in said idling position.

10. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft having an inner portion formed with a discharge recess, a sleeve-like butterfly shaft rotatably mounted on said inner portion and having a discharge aperture registrable with said discharge recess, said metering shaft having an annular face formed with a circumferentially extending metering recess, said butterfly shaft having an annular face sealingly engaging said first-

named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge aperture, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, a laterally extending projection on said locking bar, an arm secured to said butterfly shaft adjacent said laterally extending projection, an abutment screw threadedly mounted in said arm and being engageable with said laterally extending projection, said locking bar being formed with a detent notch, a vacuum cylinder secured to said body, a piston in said cylinder, and a locking element on said piston lockingly engageable in said notch, said locking element being located so that when it is engaged in said notch the locking bar is held in a position such that said laterally extending projection holds the butterfly shaft in said idling position.

11. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft being formed with a discharge recess, a butterfly shaft rotatably mounted on said metering shaft and having a discharge aperture registrable with said discharge recess, said metering shaft having an annular face formed with a metering recess, the butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge aperture, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, and vacuum-responsive means to lock said butterfly shaft in said idling position.

12. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft being formed with a discharge recess, a butterfly shaft rotatably mounted on said metering shaft and having a discharge aperture registrable with said discharge recess, said metering shaft having an annular face formed with a metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge aperture, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, a laterally extending projection on said locking bar, an arm secured to said butterfly shaft adjacent said laterally extending projection, an abutment screw threadedly mounted on and being engageable with said laterally extending projection, and vacuum-responsive means to releasably hold said locking bar in a position wherein said butterfly shaft is held in said idling position.

13. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft being formed with a discharge recess, a butterfly shaft rotatably mounted on said metering shaft and having a discharge aperture registrable with said discharge recess, said metering shaft having an annular face formed with a metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge aperture, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, an abutment element on said butterfly shaft, a projection on said locking bar engageable with said abutment element, and vacuum-responsive means engageable with said locking bar to lock said butterfly shaft in said idling position.

14. A fuel injection device comprising a main body formed with a passage for fuel mixture, a metering shaft mounted in a wall of said main body and projecting into said passage, said metering shaft being formed with a discharge recess, a butterfly shaft rotatably mounted on said metering shaft and having a discharge aperture registrable with said discharge recess, said metering shaft having an annular face formed with a metering recess, said butterfly shaft having an annular face sealingly engaging said first-named annular face and formed with a fuel-receiving recess located to overlap said metering recess, passage means communicatively connecting said fuel-receiving recess to said discharge aperture, fuel inlet means communicatively connected to said metering recess, means biasing said butterfly shaft to a position wherein said fuel-receiving recess is out of registry with said metering recess, means to rotate said butterfly shaft to an idling position wherein said fuel-receiving recess overlaps a portion of said metering recess, a locking bar slidably mounted on said main body, a laterally extending projection on said locking bar, an arm secured to said butterfly shaft adjacent said laterally extending projection, an abutment screw threadedly mounted in said arm and being engageable with said laterally extending projection, said locking bar being formed with a detent notch, a vacuum cylinder secured to said body, a piston in said cylinder, and a locking element on said piston lockingly engageable in said notch, said locking element being located so that when it is engaged in said notch the locking bar is held in a position such that said laterally extending projection holds the butterfly shaft in said idling position.

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HARRY B. THORNTON, *Primary Examiner.*

T. R. MILES, *Assistant Examiner.*