Aug. 8, 1961 M. C. BROWN ET AL 2,995,351

CARBURETOR

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FIG. 1.

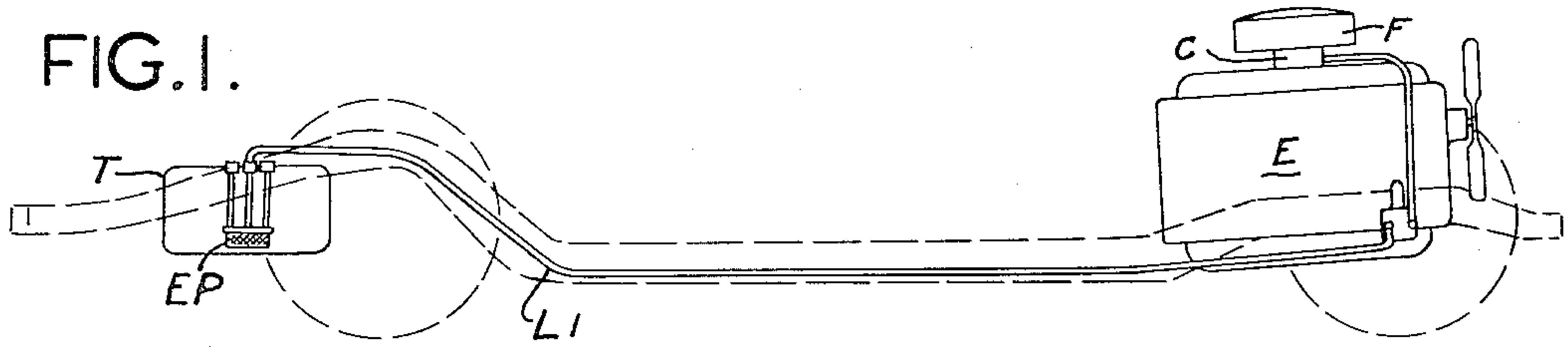



FIG. 2.

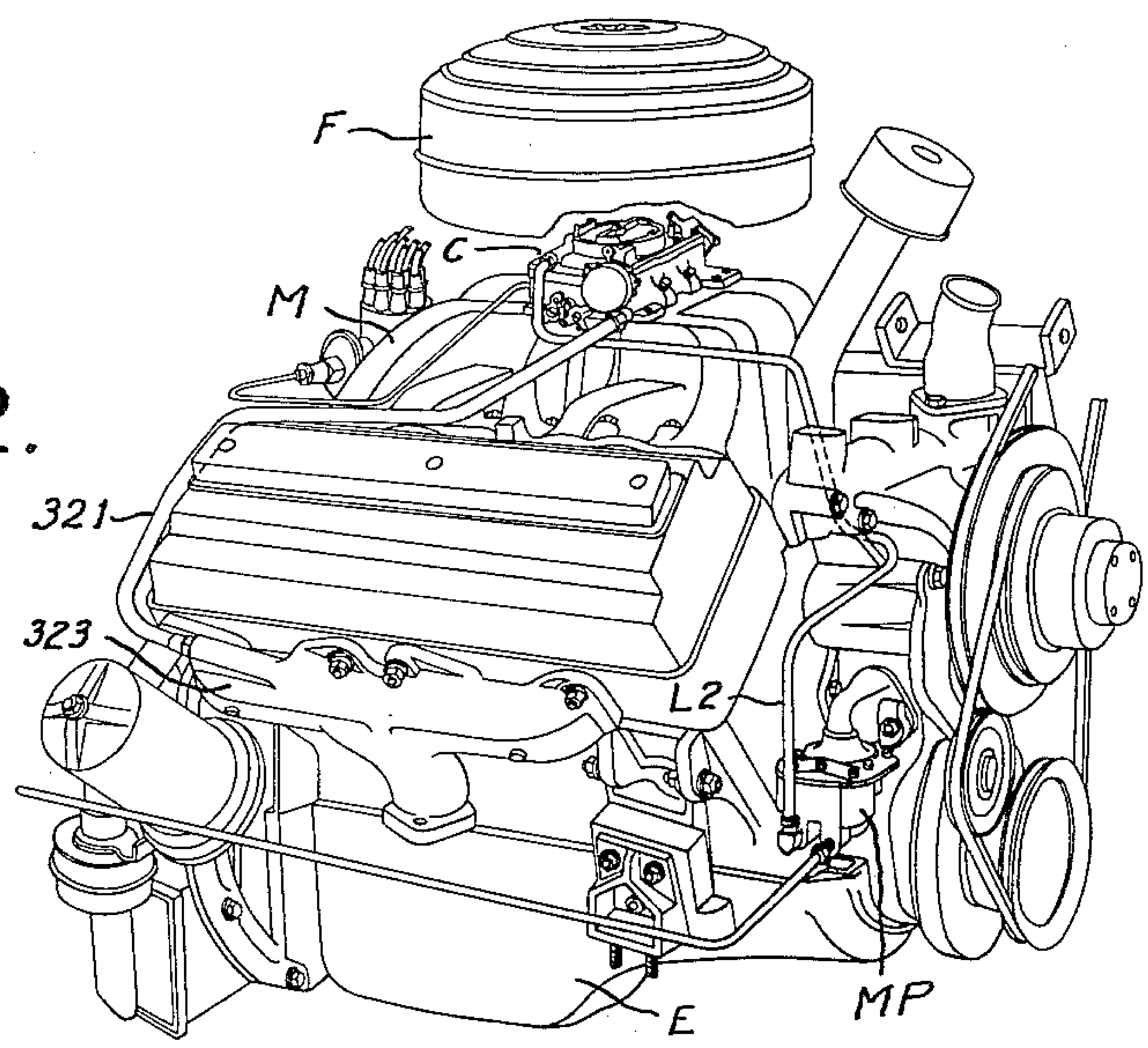
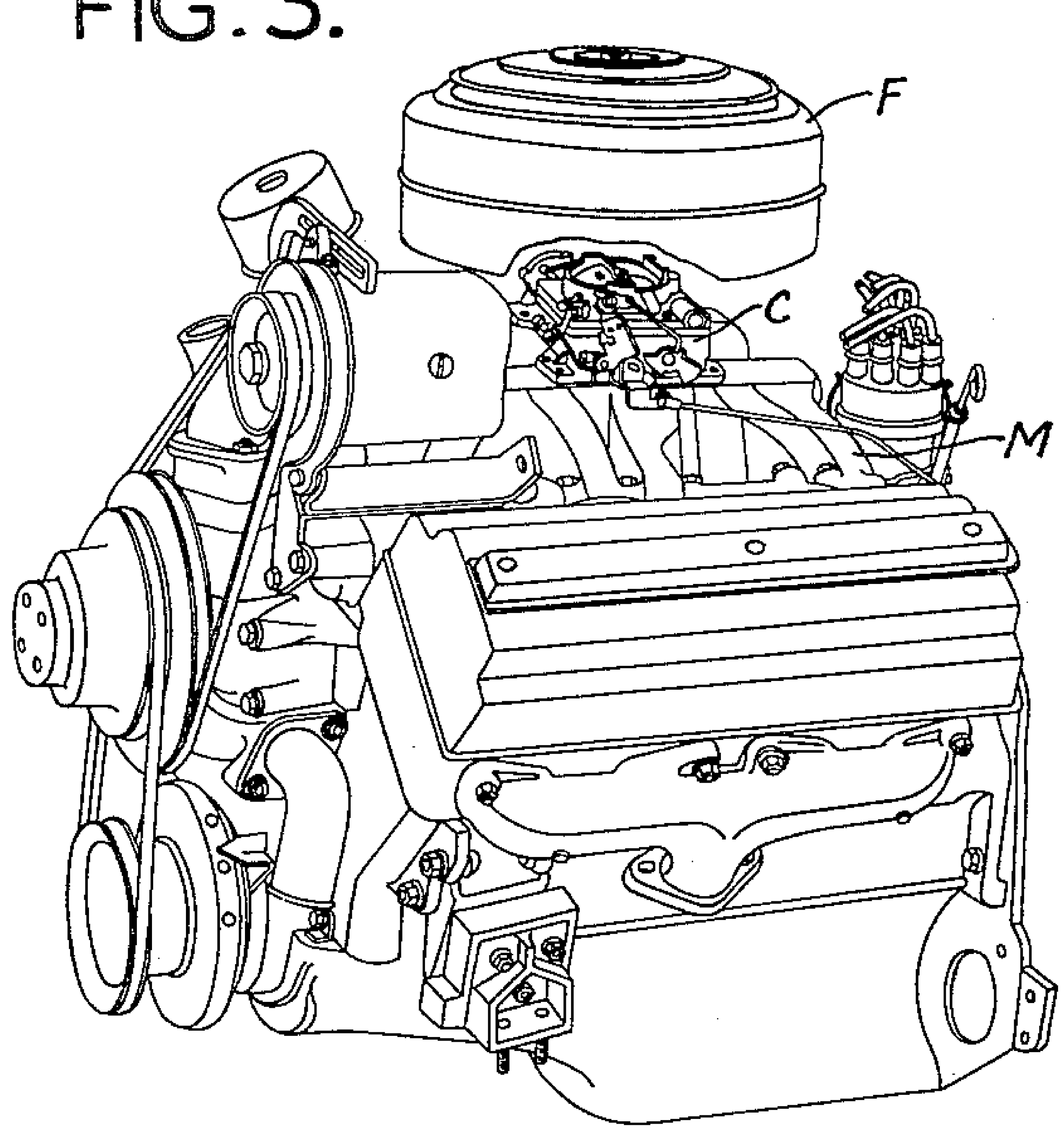



FIG. 3.





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CARBURETOR

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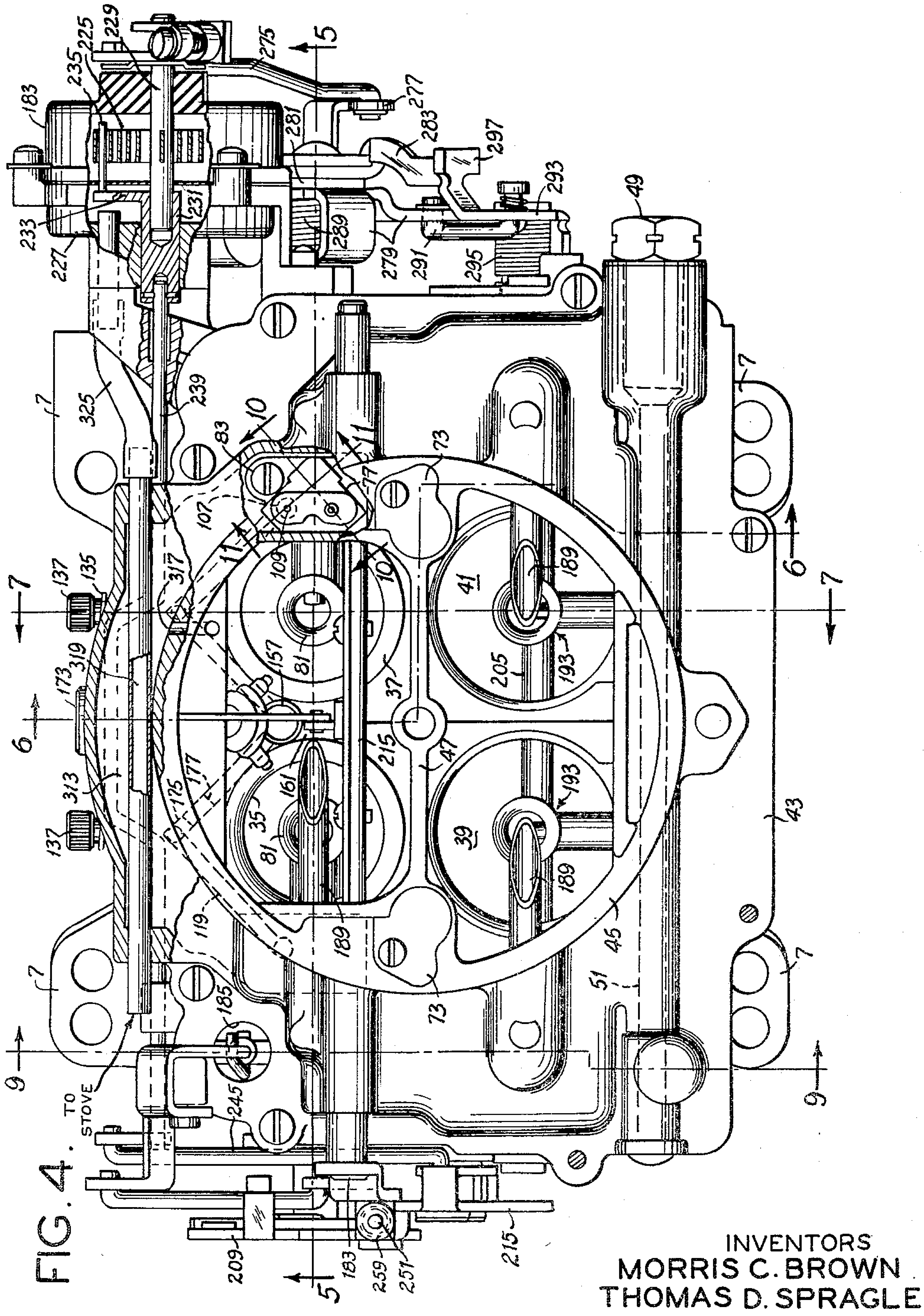

FIG. 4.

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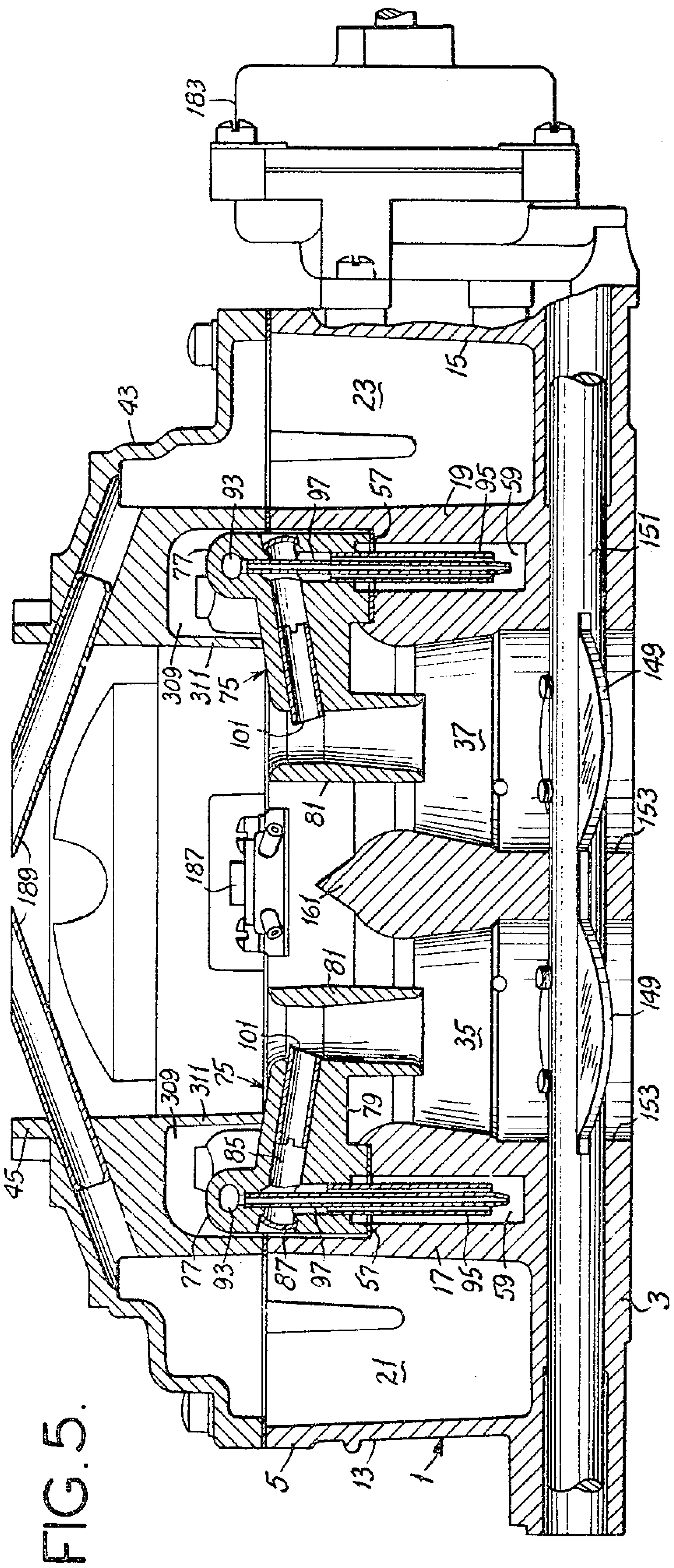


FIG. 5.

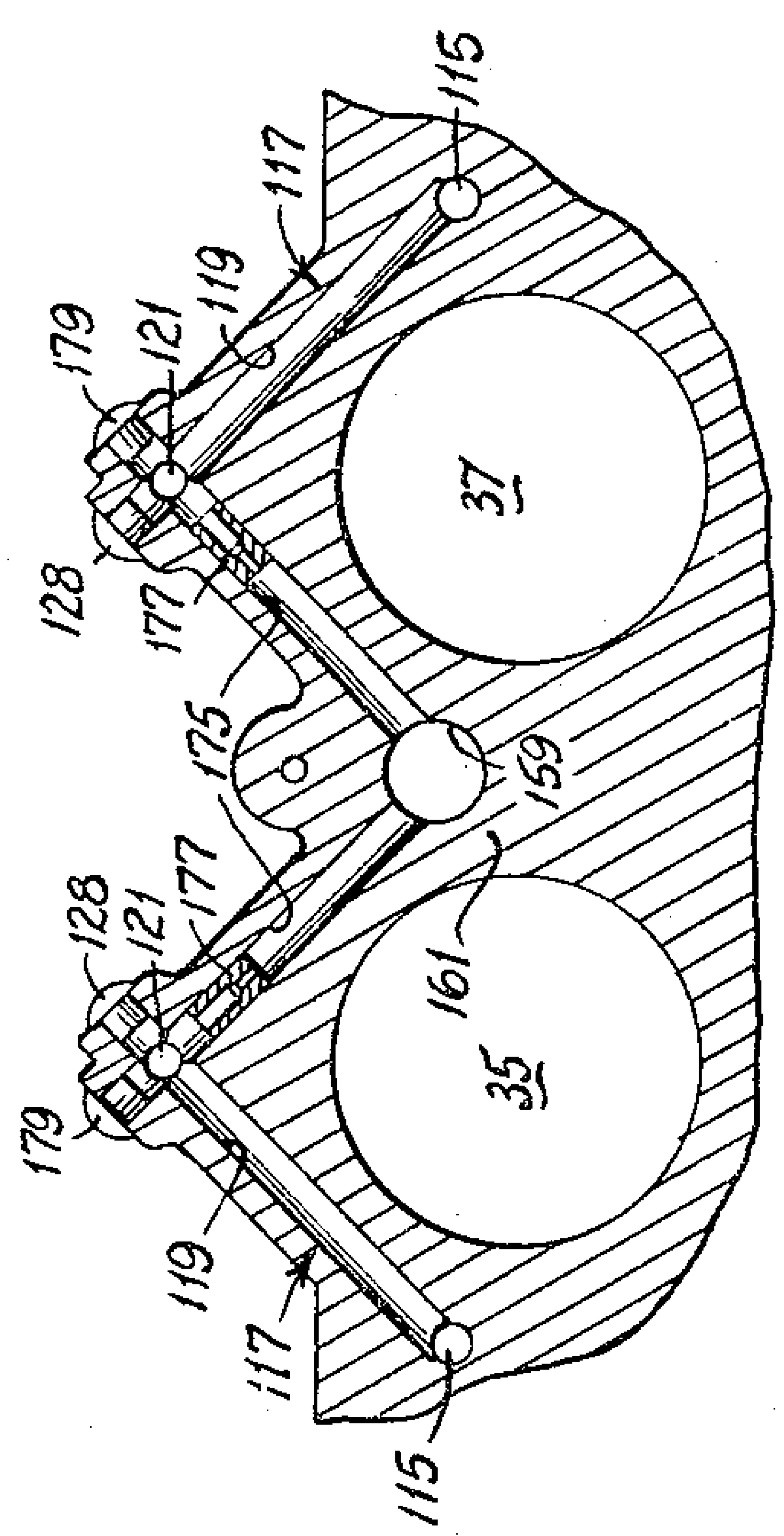


FIG. 12.

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FIG. 6.

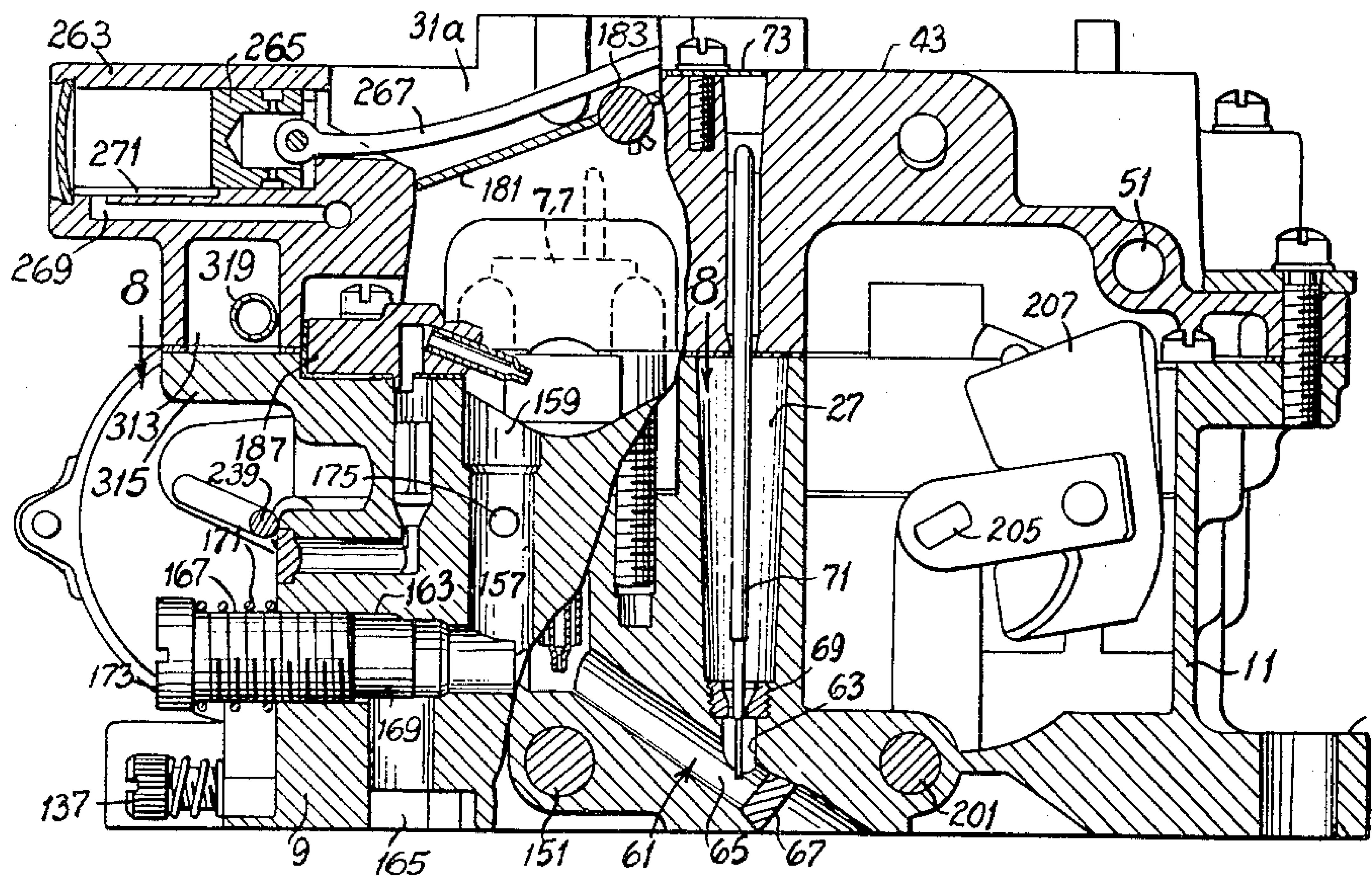


FIG. 7.

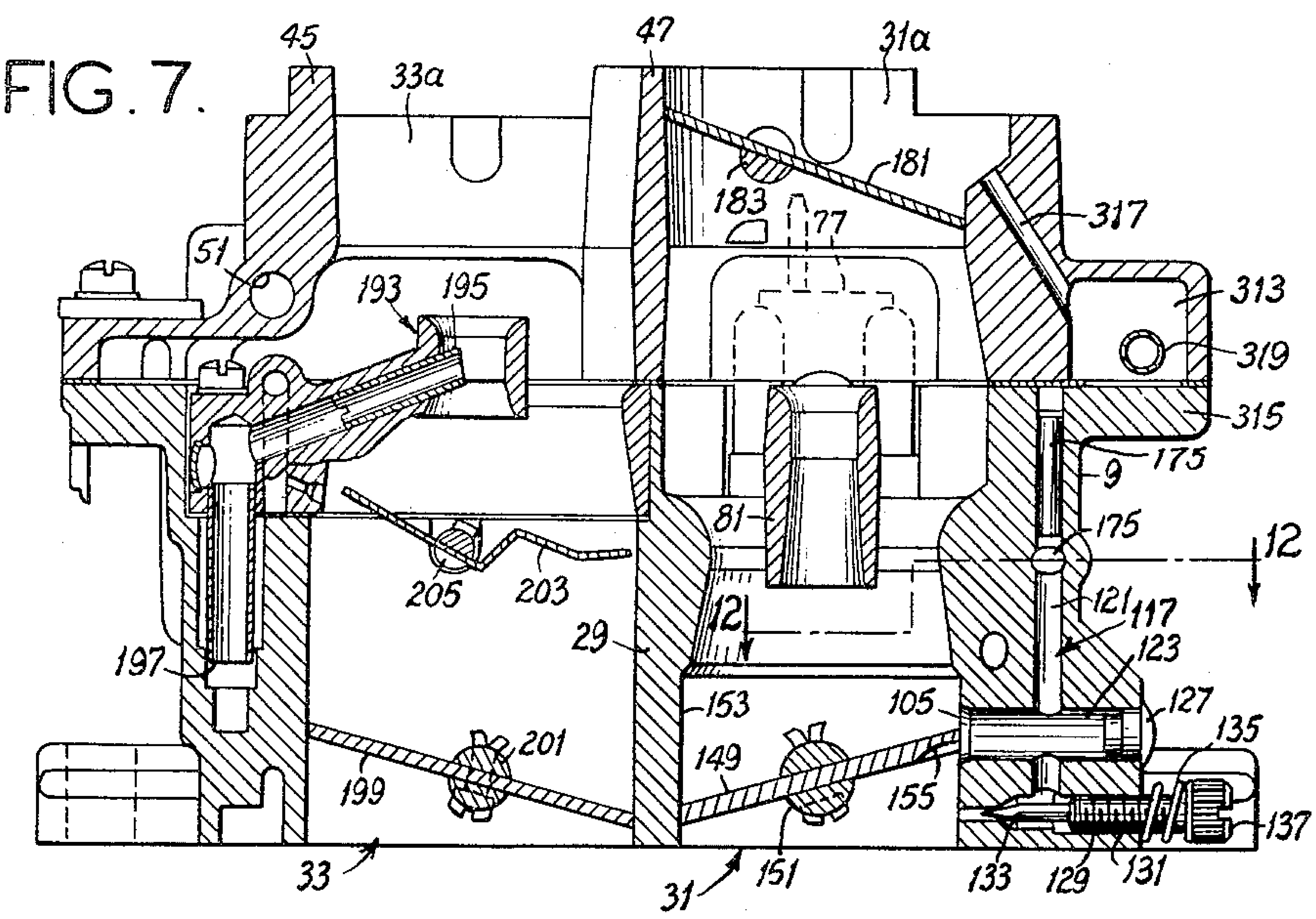


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FIG. 8

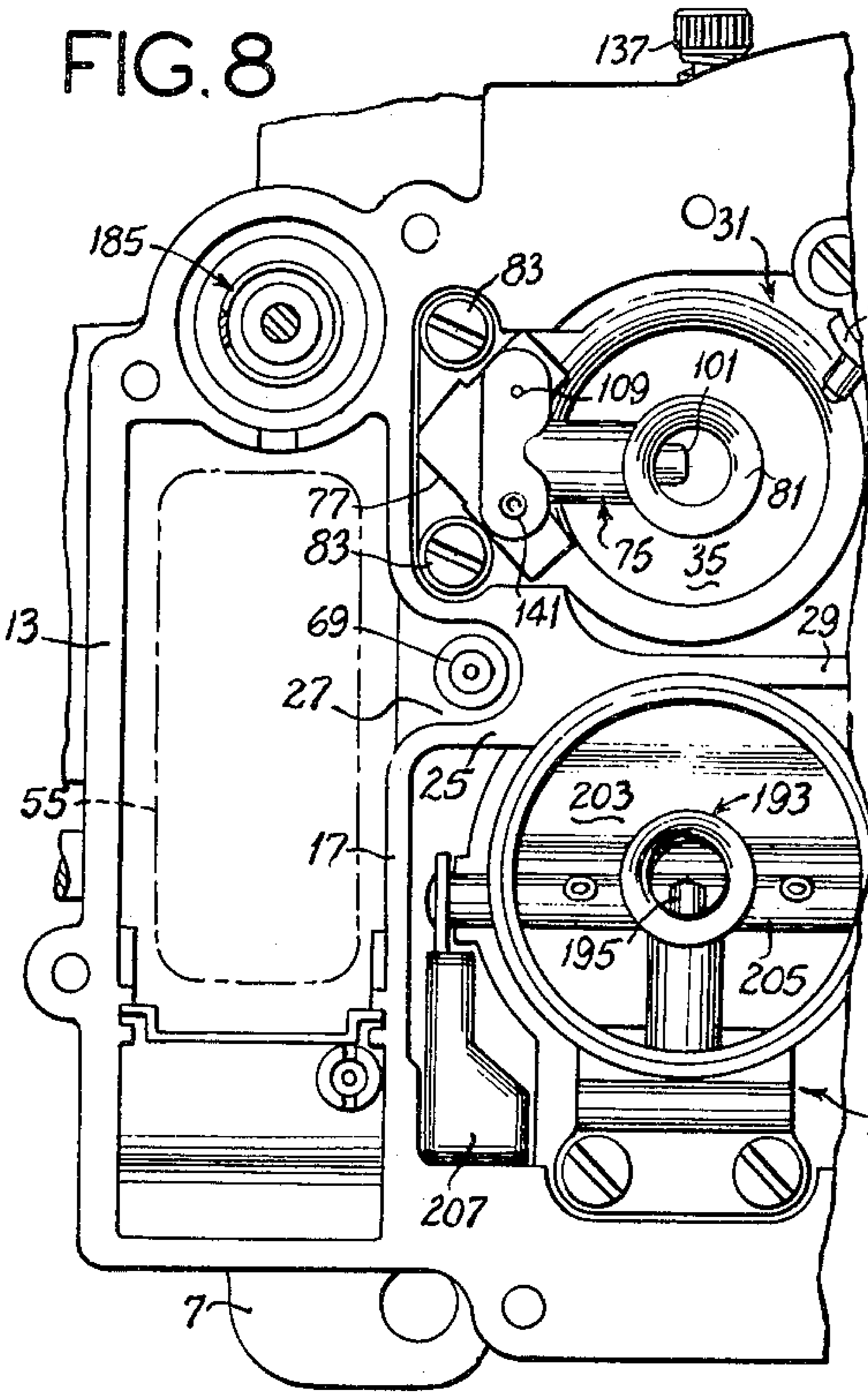



FIG. 10.

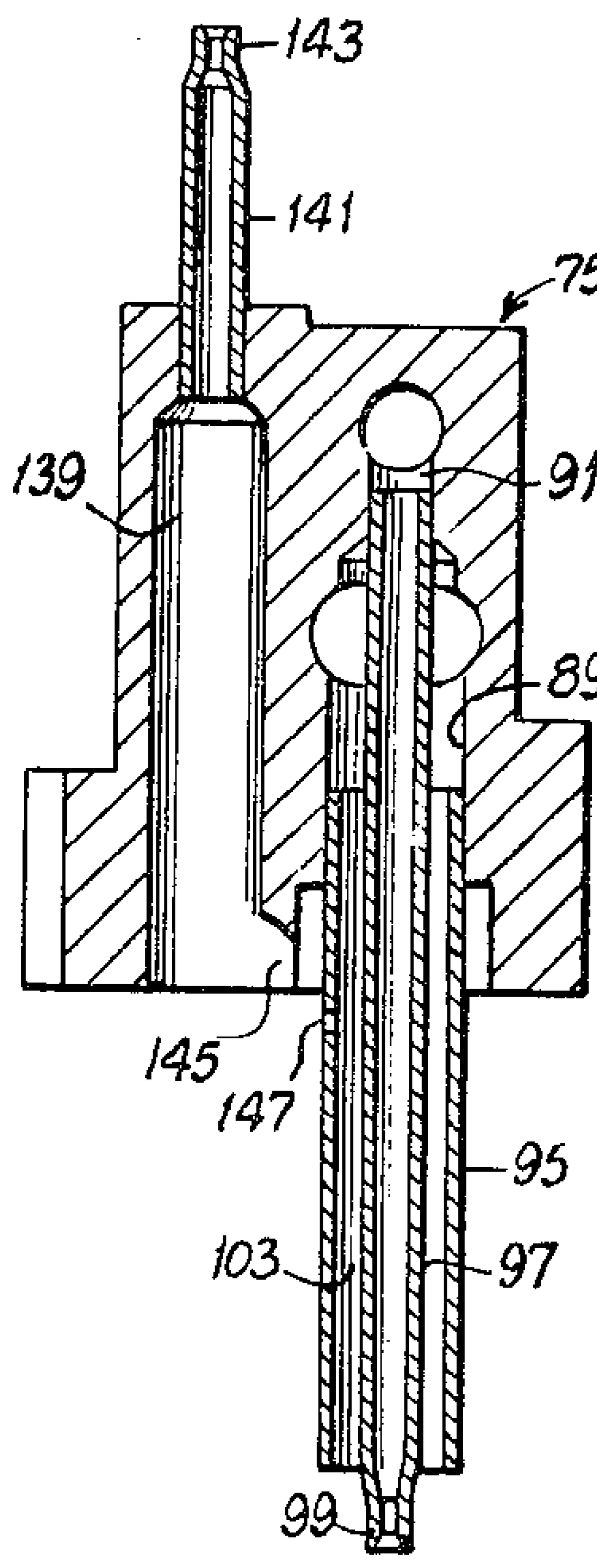
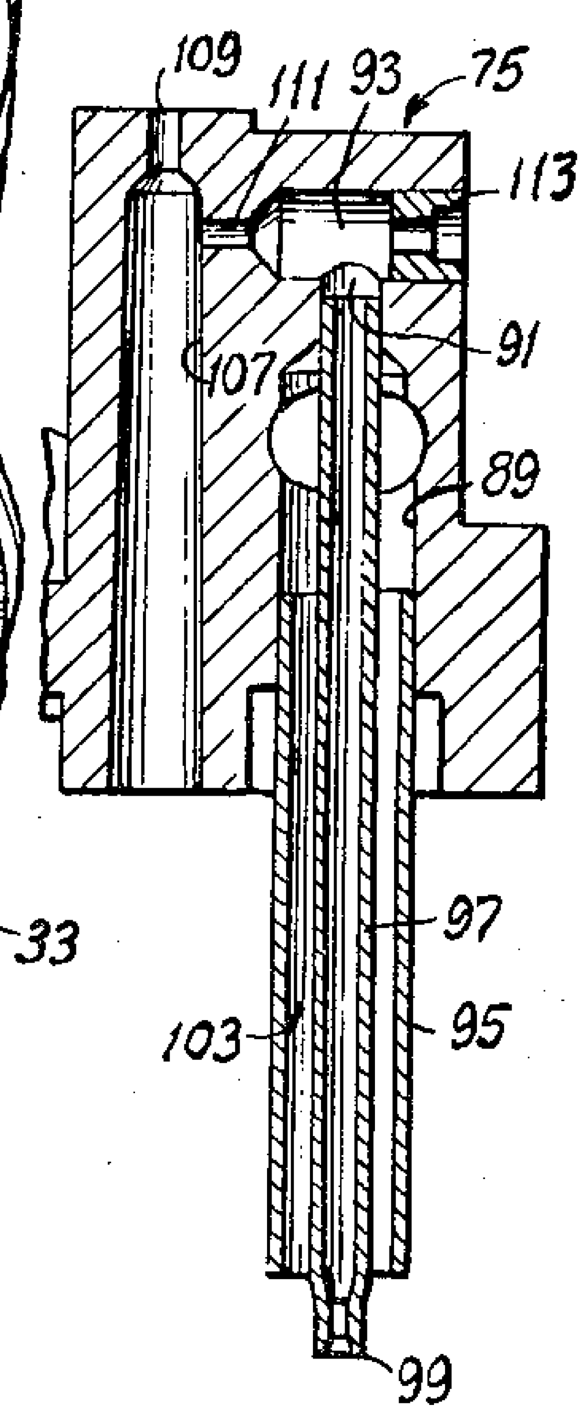



FIG. 11.



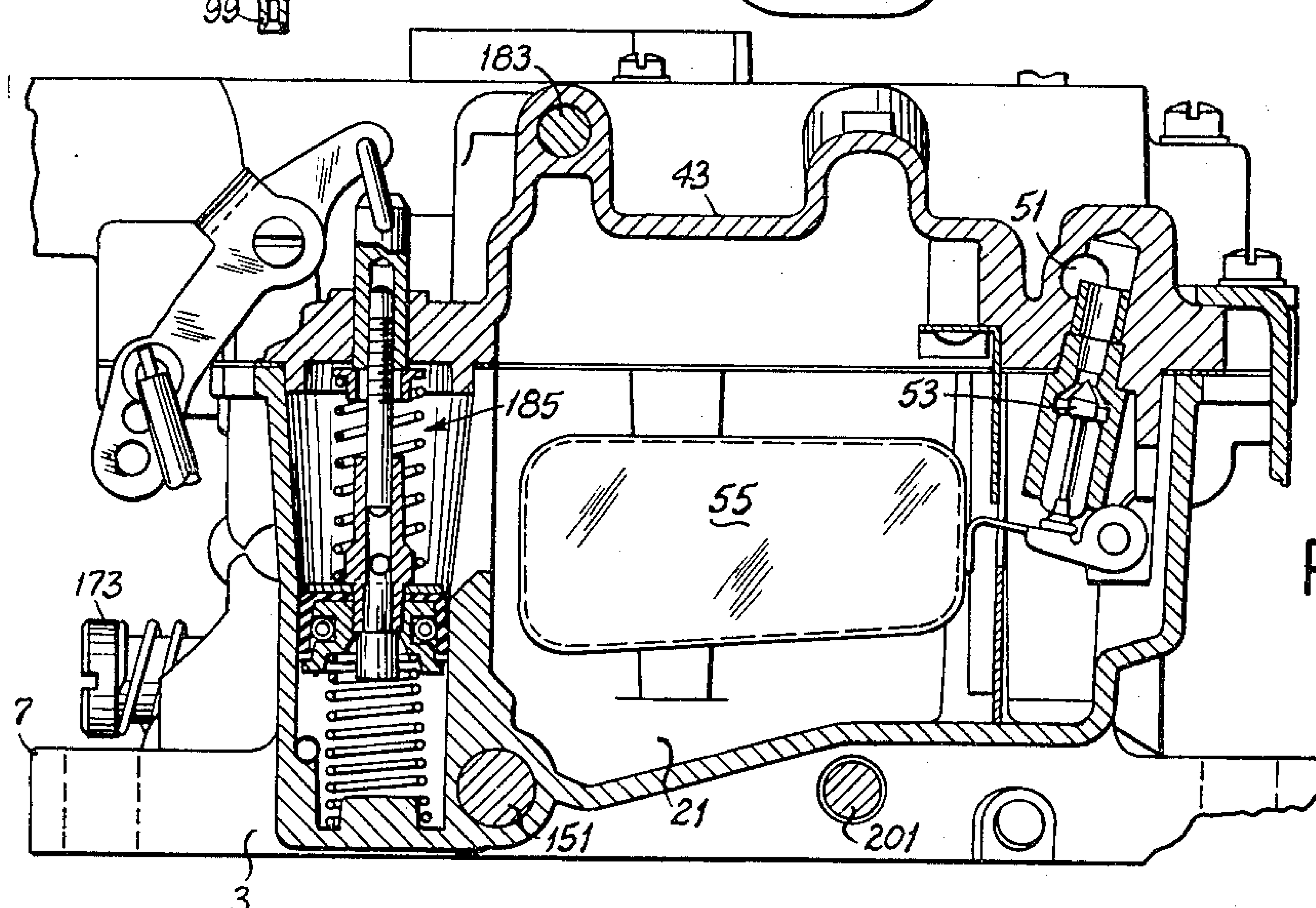




FIG. 9.

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FIG. 13.

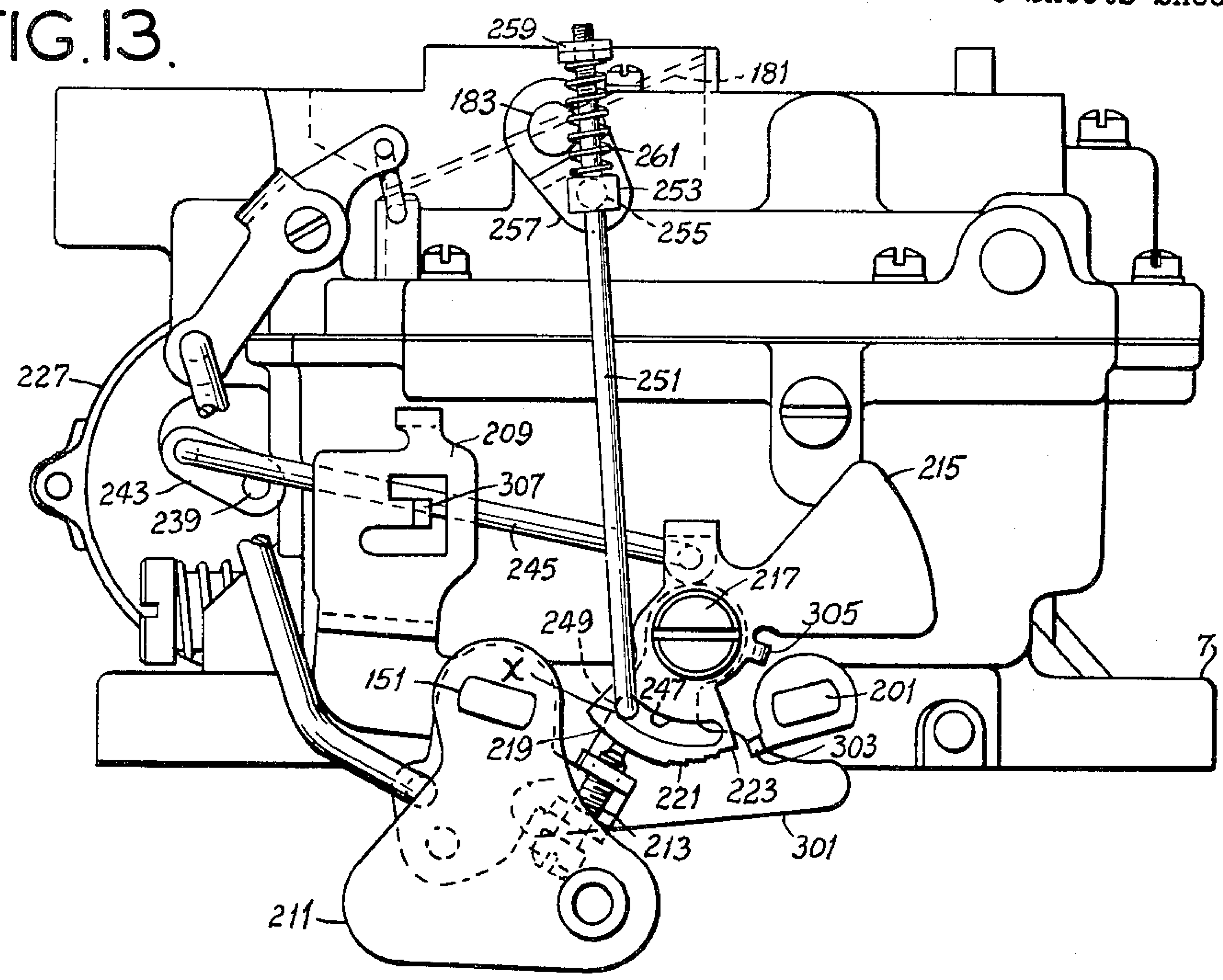
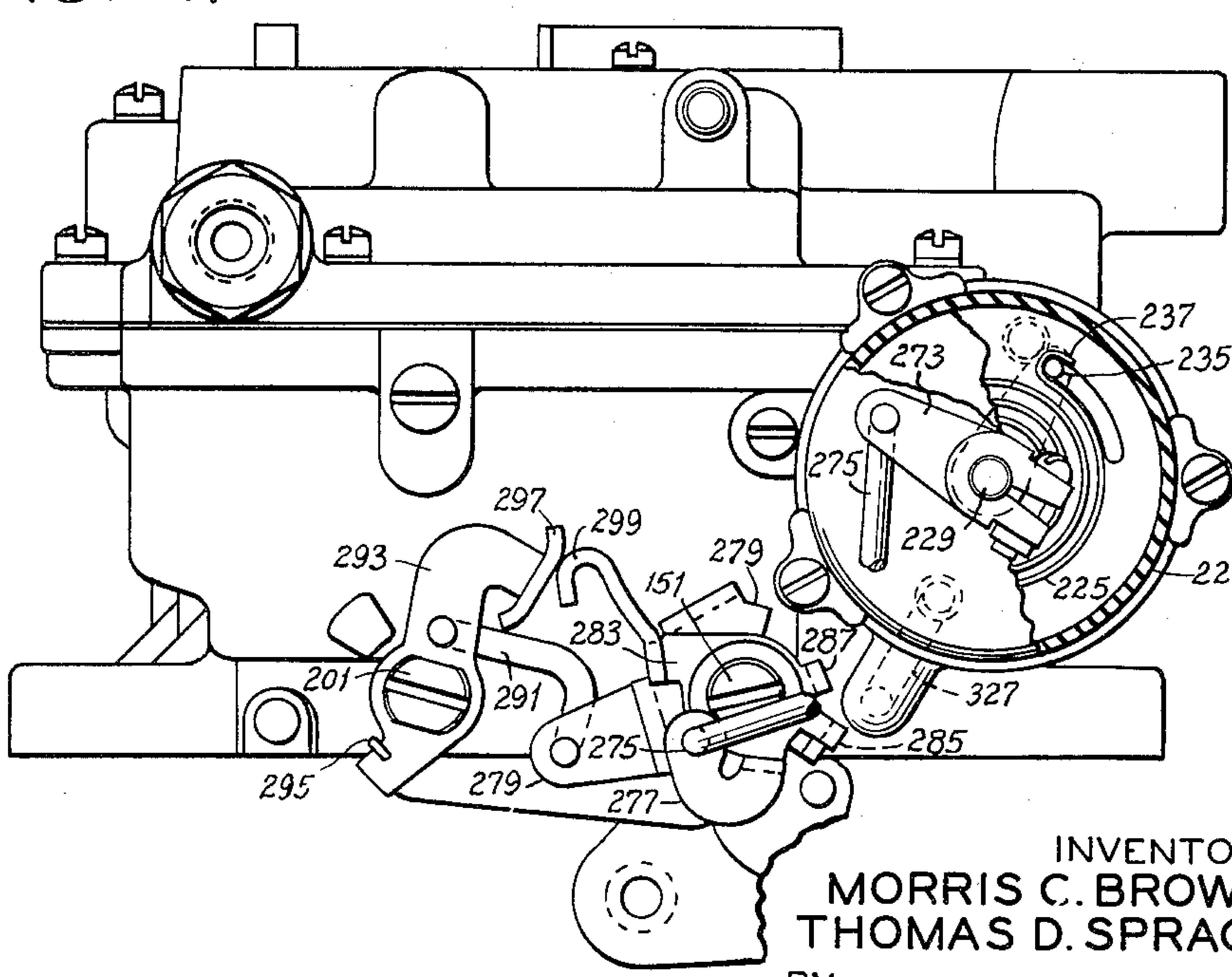



FIG. 14.

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United States Patent Office

2,995,351

Patented Aug. 8, 1961

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2,995,351

# CARBURETOR

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Filed Nov. 27, 1959, Ser. No. 855,890

12 Claims. (Cl. 261—145)

This invention relates to carburetors for internal combustion engines, and more particularly to a heat-exchange system for such a carburetor adapted during idling to preheat the air flowing through the carburetor prior to the mixing of the air with the fuel supplied by the carburetor for idling, and also adapted to modify the action of the choke control of the carburetor in accordance with the ambient temperature.

It will be understood that a carburetor for an internal combustion engine, such as the engine of an automotive vehicle, is conventionally provided with an idle system for by-passing the throttle valve of the carburetor to supply fuel and air to the mixture conduit of the carburetor downstream of the throttle valve when the latter is at idle. Such an idle system conventionally comprises a passage which opens into the mixture conduit via an idle port located to be partially covered by the throttle valve when the latter is seated. Fuel is supplied to this passage from the fuel bowl of the carburetor via an idle jet, for example, and air is bled into this passage for mixture with the fuel via one or more air bleeds.

In cold weather, there may be a tendency toward rough idling until the idle fuel mixture reaches a stabilized operating temperature. If the humidity is relatively high, there may also be a tendency toward icing of the idle air bleeds and the idle port of the carburetor. This tendency is particularly prevalent when the temperature is from 32° F. to 45° F. and the relative humidity is above 80%.

It will be further understood that a carburetor is conventionally provided with a choke valve which acts as a restriction in the air inlet of the carburetor to provide an enriched air-fuel mixture during the cranking of the engine for starting purposes, and an automatic choke system including a thermostaic device responsive to engine temperature for controlling the opening of the choke valve, the arrangement being such that the choke valve gradually opens as the engine warms up, reaching full open position substantially when the engine has warmed up. The choke system usually further includes a fast idle cam for controlling the throttle opening at idle to provide a fast idle to prevent stalling, the cam also being controlled by the thermostatic device. The thermostatic device is usually mounted in a housing to which is conducted air heated by the engine (as, for example, in a stove on the exhaust manifold of the engine).

In cold weather and in the presence of icing conditions, it may be desirable to extend the warm-up period of the engine, i.e., to keep the fast idle cam from reaching its normal idle position (as distinguished from its fast idle position) until after the engine warm-up is completed.

Accordingly, it is an object of this invention to provide a heat-exchange system for preheating the idle bleed air more quickly to bring it up to its stabilized operating temperature for smoother engine operation during the warm-up period and to reduce the tendency toward icing, and, concurrently, to reduce the temperature of air conducted to the thermostat housing of the automatic choke control so that the operation of the latter is modified in the presence of icing conditions to extend the warm-up period, i.e., to modify the operation of the fast idle cam in such manner that it does not reach its normal idle position until after the engine warm-up is completed.

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In general, this object of the invention is attained by means of a heat-exchange system in which heat is taken from the air flowing to the thermostat housing to preheat the idle bleed air, with concurrent cooling of the air flowing to the thermostate housing to attenuate the operation of the thermostatic device.

The heat-exchange system of this invention is particularly useful in conjunction with an automatic choke system such as is disclosed in the copending coassigned Carlson et al. application, Serial No. 790,957, filed February 3, 1959, adapted to permit the choke valve to reach its fully open position before the engine has completely warmed up, while prolonging the operation of the fast idle cam until the engine has completely warmed up and is herein illustrated incorporated in a carburetor provided with such an automatic choke system.

Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is a view in elevation illustrating a carburetor of this invention mounted on the engine of an automotive vehicle;

FIG. 2 is a perspective view of the engine as viewed from one side thereof, also showing the carburetor;

FIG. 3 is a perspective view of the engine as viewed from the other side thereof, also showing the carburetor;

FIG. 4 is a plan view of the carburetor;

FIG. 5 is a vertical section taken on line 5—5 of FIG. 1;

FIGS. 6 and 7 are vertical sections taken on lines 6—6 and 7—7, respectively, of FIG. 4;

FIG. 8 is a horizontal half section taken on line 8—8 of FIG. 6, appearing as if the cover for the carburetor were removed;

FIG. 9 is a vertical section taken on line 9—9 of FIG. 4;

FIGS 10 and 11 are enlarged vertical sections taken on lines 10—10 and 11—11, respectively, of FIG. 4;

FIG. 12 is a horizontal section taken on line 12—12 of FIG. 7;

FIG. 13 is a view in elevation of the left side of the carburetor; and,

FIG. 14 is a view in elevation of the right side of the carburetor.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to the drawings, there is indicated at A in FIG. 1 an automotive vehicle having an engine E on which is a carburetor C. Fuel is supplied to the carburetor C from the fuel tank T of the vehicle. As shown there is an electric pump EP in the fuel tank for pumping fuel from the tank through a line L1 to a mechanical fuel pump MP (see FIG. 2) on the engine. Pump MP is operated by the engine and is adapted to pump fuel to the carburetor through a line L2. As shown, the carburetor C is of the type having two primary mixture conduits or barrels and two secondary mixture conduits or barrels, referred to as a four-barrel carburetor. It is mounted on the intake manifold M of the engine with the two primary barrels toward the front and the two secondary barrels toward the rear. An air filter F is mounted on the air horn of the carburetor.

Carburetor C comprises a main body casting 1 which is formed to provide a throttle body section 3 and a float bowl section 5 on the throttle body section. The throttle body section 3 has lugs 7 for attachment to the intake manifold of the engine on which the carburetor is used. The float bowl section is generally of rectangular shape in plan, its side walls being designated 9 and 11 and its end walls being designated 13 and 15. Partitions 17 and 19 extend between the side walls 9 and 11 adjacent the end walls 13 and 15 to define two float bowls 21 and 23, one at each end of the fuel bowl section 5. Each of the partitions 17 and 19 has a central inwardly directed offset 25 providing a vertically extending recess such as indicated at 27. A partition 29 extends between offsets 25 dividing the space bounded by side walls 9 and 11 and partitions 17 and 19 into a primary section 31 and a secondary section 33. The primary section is formed to provide two side-by-side primary mixture conduits or barrels 35 and 37, and the secondary section is formed to provide two side-by-side secondary mixture conduits or barrels 39 and 41. Each primary barrel is formed as a venturi. Secured to the top of the fuel bowl section is a float bowl cover 43 formed to provide a circular air horn 45. The horn has a diametrical partition 47 coplanar with partition 29 dividing it into a primary air inlet 31*a* above section 31 and a secondary air inlet 33*a* above section 33.

The cover 43 has a fuel inlet 49 and an inlet passage 51 connecting the inlet to the two float bowls 21 and 23. Entry of fuel to the bowls from passage 51 is controlled by two float valves 53, one for each bowl (see FIG. 9). Each of these valves is controlled by a float 55 in the respective bowl. The valves and floats may be of any suitable construction, their details not being critical so far as this invention is concerned. The bowl 21 supplies the barrel 35 and the bowl 23 supplies the barrel 37 via identical systems. Only the system for barrel 35 will be described, and it will be understood that the system for barrel 37 is identical.

Barrel 35 has an upwardly facing shoulder 57 at the side thereof toward the respective float bowl 21 (see FIG. 5). Extending down from this shoulder is a vertical well 59. The casting 1 is formed with a passage 61 from the bottom of recess 27 of bowl 21 to the bottom of the well 59. This passage is formed by drilling a vertical hole 63 extending down from the bottom of recess 27 to an intersection with an inclined hole 65 drilled from the bottom of throttle body section 3 to the lower end of the well. The outer end of hole 65 is plugged as indicated at 67. Threaded in the upper end of hole 63 is a metering jet 69. A metering rod 71 extends down in recess 27 and through the jet from a vacuum-responsive control contained in the float bowl section 5 under a cap 73. The metering rod and control are of known construction and need not be further described, details thereof not being critical so far as this invention is concerned. It will be understood that the control for the rod acts to move the metering rod up and down in response to change in intake manifold vacuum, for high speed fuel metering.

Shoulder 57 serves to support a nozzle body 75 (see FIGS. 5, 10 and 11) at the upper end of the primary barrel. This body comprises a casting formed to provide a head 77, an arm 79 extending from the head, and a boost venturi 81 at the outer end of the arm. The head is secured on shoulder 57 as by screws 83. A hole 85 is drilled through the head 77 and the arm 83 from the outside of the head to open into the boost venturi 81. The outer end of this hole is closed as by a welch plug 87. The hole 85 is angled downward from the outside of the head to the boost venturi 81. A hole 89 is drilled up from the bottom of the head to an intersection with angled hole 85. A hole 91 of smaller diameter than hole 89 is drilled to extend up from angled hole 85 coaxial with hole 89, and to an intersection with a horizontally extending hole 93 drilled in head 77 adjacent its upper end (see FIG. 11).

A fuel tube 95 has its upper end pressed in hole 89 and extends down into the well 59. An idle fuel tube 97 of smaller diameter than tube 95 has its upper end pressed into hole 91 and extends down within the tube 95. Idle tube 97 has a restricted lower end 99 which extends down below the lower end of tube 95. A nozzle tube 101 is pressed in the angled hole 85, extending from hole 89 through the arm 79 into the venturi 81. The space 103 between tubes 95 and 97 and the nozzle tube 101 provides a high speed fuel passage from the well 59 to the boost venturi 81.

Idle orifice tube 97 is part of a low speed circuit for delivering fuel at low speed operation to idle port 105 (see FIG. 7) in the primary barrel. This low speed circuit includes holes 91 and 93 in the nozzle head 77. Head 77 has a vertical hole 107 (see FIG. 11) extending up from its bottom with a restricted air bleed hole 109 through the upper end of the head. Hole 93 has a restricted economizer passage 111 extending from its inner end into the vertical hole 107. An air metering plug 113 is pressed in the outer end of hole 93. Air from the air horn 45 passes through and is metered by plug 113 into the hole or passage 93. Air bleeds into the vertical hole 107 from the air horn through bleed hole 109 to lean the mixture delivered through the economizer 111. The vertical hole 107 is aligned with a hole 115 (see FIG. 12) extending down from shoulder 57 which constitutes part of a passage 117 for flow of fuel-air mixture from hole 107 to the idle port 105. Passage 117 is formed by a horizontal hole 119 drilled at an angle through side wall 9 to an intersection with hole 115, and a vertical hole 121 drilled down through side wall 9 to an intersection with a horizontal hole 123 which is drilled to provide the idle port 105. The upper end of vertical hole 121 above horizontal hole 119 is plugged as indicated at 125. The outer end of idle port hole 123 is plugged as indicated at 127. The outer end of horizontal hole 119 is plugged as indicated at 128 in FIG. 12. The vertical hole 121 extends down past idle port hole 123 to an intersection with an idle adjusting screw port hole 129. An idle adjusting screw 131 having a fuel needle end 133 is threaded in hole 129. A coil compression spring 135 surrounds screw 131, reacting from the side wall 9 against the head 137 of the screw 131.

Head 77 has a second vertical hole 139 (see FIG. 10) in the upper end of which is pressed a nozzle bleed tube 141 having a restricted upper end 143. The bottom of the head is formed with a slot 145 connecting the lower end of the vertical hole 139 and the hole 89 for communication between the hole 139 and the well 59. Fuel tube 95 has a hole 147 adjacent its upper end directed toward the slot 145. This allows air to bleed into the space 103 between tubes 95 and 97.

Each of the primary barrels 35 and 37 has a primary throttle valve 149 (see FIGS. 5 and 7) at its lower end, the two primary throttle valves being fixed on a primary throttle shaft 151 journalled in the throttle body section. Each primary throttle bore is designated 153. Each throttle valve, when at dead idle, is fully seated around its perimeter on the bore, and is grooved on the bottom as indicated at 155 on the side toward the idle port 105 to provide a restricted opening from the idle port into the throttle bore when the throttle valve is fully seated. The main body casting 1 is formed with a by-pass designated in its entirety by the reference character 157 (see FIGS. 4 and 6) for by-passing air for idling from the upper end of the primary section 31 to the primary throttle bores 153 below the primary throttle valves 149. As shown, this idle air by-pass 157 is common to the two primary barrels, being constituted by a vertical hole 159 extending downward in the portion 161 of casting 1 between the primary barrels 35 and 37 to an intersection with a horizontal hole 163 extending inward from side wall 9 of the casting, and a vertical hole 165 extending up from the bottom of the casting 1 to hole 163 and offset outward from the hole 159. An idle air adjusting screw 167 is threaded in the horizontal hole 163. This screw has an unthreaded inner end portion 169 which traverses the upper end of the hole **165**, and is adapted to be threaded in or out to vary the size of the opening from hole **163** into hole **165**. A coil compression spring **171** surrounds screw **167**, reacting from side wall **9** against the head **173** of the screw.

Horizontal holes **175** (see FIG. 12) are drilled approximately at right angles to the horizontal holes **119** intersecting the latter and extending to the vertical hole **159** which constitutes the upper part of the idle air by-pass **157** upstream from (above) the idle air adjusting screw **167**. These holes **175** thus serve to interconnect the two idle mixture passages **117** and the idle air by-pass **157**, with the connection to passages **117** at points downstream (below) economizers **111** and air bleeds **109** therefor, and with the connection to by-pass **157** at a point upstream from (above) the idle air adjusting screw **167**. Pressed in each of the holes **175**, and located between the vertical holes **121** and **159**, is a restriction jet **177**. The outer end of each hole **175** is plugged as indicated at **179**.

In the primary air inlet portion **31***a* of the air horn **45** is a choke valve **181** fixed on choke shaft **183**. The carburetor has the usual accelerator pump such as indicated at **185** in FIG. 9 for supplying fuel to the primary barrels in response to opening of the primary throttles via a pump discharge jet cluster indicated at **187** in FIGS. 4–6. Vents such as indicated at **189** are provided for venting the float bowls to the interior of the air horn **45**.

At the upper end of each secondary barrel **39** and **41** is a venturi cluster **193** having a fuel nozzle **195** supplied with fuel from the respective float bowl via a passage part of which is indicated at **197** in FIG. 7. Each secondary barrel has a secondary throttle valve **199** at its lower end, the two secondary throttle valves being fixed on secondary throttle shaft **201** journalled in the throttle body section **3**. Each secondary barrel also has a velocity valve **203** therein, the two velocity valves being fixed on shaft **205** which carries weights such as indicated at **207** (FIGS. 6 and 8) for biasing the velocity valves closed.

It will be understood that at dead idle, the primary throttle valves **149** are fully seated in the primary throttle bores **153**. As to each of the primary barrels **35** and **37**, fuel for idling is supplied from well **59**, metered through the idle orifice tube **97**, and thence passes through holes **91** and **93**, economizer passage **111**, idle mixture passage **117** and thence through idle port **105** and port **129**. Air entering hole **93** through the metering plug **113** initiates atomization of the fuel, and the flow of the air/fuel mixture is accelerated in passing through the economizer **111**. Air entering hole **107** through the bleed hole **109** leans the mixture and accelerates its delivery to the idle port **105**. The holes **175** constitute metering passages interconnecting the upper part (the inlet side) of the idle air by-pass **157** to the two idle mixture passages **117** for the two primary barrels **35** and **37**, and act to supply air from the by-pass **157** to the idle mixture passages **117**. This air constitutes a further part of the air for the idle mixture, additive to the air supplied through metering plug **113** and bleed hole **109**. All this air constitutes part of the air required for idling the engine. Additional air for idling passes directly through the idle air by-pass **157**. Some further air for idling may be supplied by leakage of air such as may occur past the primary and secondary throttle valves, around the throttle shafts, etc.

The amount of air bled through metering passages **175** into the idle mixture passages **117** is dependent upon the rate of flow of air through the idle air by-pass **157**. The rate of flow through the latter is dependent upon the setting of the idle air adjusting screw **167**. With increased flow of air through by-pass **157**, the pressure at the ends of passages **175** toward the by-pass **157** decreases. Thus, with increased flow of air through by-pass **157**, bleeding of air through passages **175** into the idle mixture passages **117** decreases, and the mixture supplied through passages **117** richens up to compensate for increased air flow through by-pass **157** (which would otherwise lean the mixture supplied to the engine).

Accordingly, adjustment of the idle air adjusting screw **167** within relatively wide limits has no effect on the idle mixture ratio, since backing off the screw **167** results in reducing the bleeding of air through passages **175** and advancing the screw **167** results in increasing the bleeding of air through passages **175**. Consequently, once the idle fuel adjusting needles **133** have been set to obtain the proper idle mixture for any given idle speed of the engine, it is possible to change the speed over a relatively wide range simply by adjusting the idle air adjusting screw **167**, without any necessity for resetting the idle fuel adjusting needles. Moreover, adjustment of the idle air adjusting screw **167** even over a relatively wide range (four to five turns of the screw with the construction as herein illustrated) has little effect to change the mixture ratio supplied by the idle system at off idle and early part-throttle. Thus, the passages **175** provide such compensation as to maintain the mixture ratio at the desired value throughout the entire idle delivery (including off idle and early part-throttle), and eliminate the leaning effect on the mixture which would be present in a system without such passages in the off idle and early part-throttle range.

Fixed on the left end of the primary throttle shaft **151** are inner and outer primary throttle arms **209** and **211**. The outer primary throttle arm carries a fast idle adjusting screw **213** engageable with a fast idle cam **215** pivoted at **217** on the left side of the float bowl section **5** of the carburetor. The fast idle cam **215** is overbalanced so as to be gravity-biased to tend to rotate in clockwise direction as viewed in FIG. 13 from an initial fast idle position (cold engine) to a normal warm engine idle position. The cam **215** has a starting step **219** opposed to and engageable by the screw **213** when the cam is in fast idle position for blocking the primary throttle valves **149** open a predetermined amount to determine a fast idle position of the primary throttle valves, intermediate steps **221** successively opposed to and engageable by the screw upon rotation of the cam for blocking the primary throttle valves open lesser amounts, and a normal idle step **223** which is opposed to the screw **213** when the cam is fully backed off permitting the primary throttle valves to assume their normal warm engine idle position.

The position of the fast idle cam **215** is controlled by means responsive to engine temperature including a thermostatic coil **225** contained in a coil housing **227** shown as mounted on the right side of the carburetor. The coil **225** is a spiral coil having its center secured to a shaft **229** journalled in the housing **227**. A sleeve **231** surrounds one end of the shaft **229**, being free on the shaft and rotatable relative to the shaft, and projects out through the left side of the housing **227**. A crank arm **233** extends radially from the sleeve **231** within the housing **227**. At the outer end of the arm **233** is a crank pin **235** which is engageable by a hook formation **237** at the outer end of the thermostatic coil **225**. The latter is coiled in such a way that, with shaft **229** stationary, it acts mechanically as a spring tending to rotate crank arm **233** and the sleeve **231** counter-clockwise as viewed from the left side of the carburetor and acts thermostatically upon increase in temperature of air within the housing in such manner as to relax and back the hook formation **237** in the direction away from the pin **235** to reduce the spring force acting on the pin **235** and the arm **233**. A shaft **239** extends across the front of the carburetor, having its right end fixed in the sleeve **231**, and being journalled in lugs **241** on the front of the carburetor. At its right end, shaft **239** carries a crank arm **243**. A link **245** connects this crank arm **243** to the fast idle cam **215**. The arrangement is such that when the thermostatic coil **225** is cold (corresponding to the cold engine condition), the spring force of the coil acts to hold the fast idle cam 215 in its fast idle position against the gravity bias tending to make the cam back off (swing clockwise) from its fast idle position. As the thermostatic coil 225 warms up (corresponding to warming up of the engine), the coil relaxes and permits the fast idle cam to back off from its fast idle position, whenever the primary throttle arm 211 is swung clockwise as viewed in FIG. 13 to disengage the screw 213 from the cam. When the engine has fully warmed up, the coil 225 is heated to the point where it relaxes sufficiently to allow the fast idle cam 215 to back off completely to its normal warm engine idle position.

The fast idle cam 215 is provided with an elongate arcuate slot 247 on an arc centered in the axis of the fast idle cam. Received in this slot 247 is a pin 249 formed at the lower end of a rod 251, the upper end of which extends slidably through a guide 253 swivelled at 255 at the end of a crank arm 257 fixed on the left end of the choke shaft 183. The rod 251 is threaded at its upper end, and has a nut 259 threaded thereon. A coil compression spring 261 surrounds the rod between the nut 259 and the corresponding end of the swivelled guide 253. When the choke valve 181 is closed, and the thermostatic coil is cold, the parts occupy the position shown in FIG. 13 wherein the pin 249 at the lower end of the rod 251 is at the forward end X of the slot 247 in the fast idle cam 215. Spring 261 reacts from the guide 253 against the nut 259 at the upper end of the rod 251 to add some spring force to the gravity bias tending to make the fast idle cam back off, and holds the rod in the position shown. When the thermostatic coil 225 warms up, and the primary throttle arm 211 is swung clockwise, the fast idle cam 215 may swing clockwise even though the choke valve 181 should remain closed, by reason of the lost-motion connection established between the cam 215 and the choke valve 181 by the pin 249 and the slot 247.

The choke valve 181 is adapted to swing between the closed position in which it is illustrated in FIG. 13 and a fully open position in which it is vertical. It is mounted off center on the choke shaft 183 in such manner as to be unbalanced to tend to swing open. It therefore tends to swing open in response to velocity of air flowing down through the carburetor and differential in air pressure above and below it. The position of the choke valve 181 is also controlled by means responsive to intake manifold vacuum (which indicates the load on the engine). This means comprises a choke cylinder 263 formed on the air horn 45. A piston 265 is slidable in this cylinder and connected to the choke valve 181 by a link 267. The inner end of the cylinder 263 is open to the interior of the air horn 45 and the outer end of the cylinder is closed. A vacuum passage 269 extends from within the cylinder 263 adjacent its outer end to one of the primary mixture conduits or barrels below to the primary throttle valve therein so that the piston 265 is subject at its outer end to intake manifold vacuum. The vacuum tends to cause the piston 265 to move outward in the cylinder 263 and open the choke valve 181. The cylinder 263 has longitudinal slots such as indicated at 271 extending part way along the cylinder wall for by-passing air around the piston 265 when the piston has been moved outward far enough to uncover the inner ends of the slots. Thus, full manifold vacuum is applied to the piston 265 until the piston has pulled the choke valve open part way, after which air is by-passed around the piston to decrease the vacuum (increase the pressure) in the outer end of the cylinder.

The shaft 229 extends out of the thermostatic coil housing 227 to the right, and has a crank arm 273 fixed on its outer end. A link 275 connects this crank arm 273 to a crank arm 277, fixed on the right end of the primary throttle shaft 151. This linkage is such that when the primary throttle shaft 151 is turned clockwise as viewed in FIG. 13 to open the primary throttle valves 149 for acceleration (counterclockwise as viewed in FIG. 14), shaft 229 is rotated to rotate the thermostatic coil 225 bodily in such direction as to rotate crank arm 233 and shaft 239 to drag the link 245 toward the left as viewed in FIG. 13 and swing the fast idle cam 215 counterclockwise. The cam 215 thereupon acts to pull down the rod 251 and swing the choke valve 181 toward closed position, thereby to accomplish enrichment upon acceleration of the mixture of air and fuel being delivered by the primary barrels 35 and 37.

As appears in FIGS. 4 and 14, the primary throttle shaft 151 has an inner arm 279, a dog 281, and an outer arm 283 at its right end. The inner arm 279 and the dog 281 are rotatable relative to the shaft 151 and to one another. The outer arm 283 is fixed to the shaft 151. The dog 281 has a first lateral lug 285 engageable with the outer arm 283 and a second lateral lug 287 engageable with the inner arm 279. A coil spring 289 biases the dog 281 to rotate in the direction for engagement of its lug 285 with the outer arm 283. A link 291 connects the inner arm 279 and an arm 293 fixed on the right end of the secondary throttle shaft 201. A coil spring 295 is provided for biasing the secondary throttle valves 199 closed. When the primary throttle valves 149 are opened, the outer arm 283 rotates counterclockwise as viewed in FIG. 14 along with the primary throttle shaft 151. Dog 281 having lugs 285 and 287 thereon follows the arm 283 around under the bias of spring 289. When the primary throttle valves 149 have been opened a predetermined amount (50°, for example), lug 287 comes into engagement with the inner arm 279 and rotates it counterclockwise. This results in opening of the secondary throttle valves 199. The secondary throttle linkage is so proportioned that the secondary throttle valves arrive at their wide open position at the same time as the primary throttle valves. A shoe 297 on arm 293 is engageable with a shoe 299 on arm 283 to preclude opening of the secondary throttle valves until the primary throttle valves have been opened approximately the stated predetermined amount.

A secondary lockout lever 301 is pivoted at 217 along with the fast idle cam 215, being rotatable relative to the cam. This lockout lever is gravity-biased toward latching engagement with a lug 303 on the secondary throttle shaft 201 to lock the secondary throttle valves 199 closed, and is engageable by a lug 305 on the fast idle cam 215 to be released (swung out of latching engagement with lug 303) when the fast idle cam backs off to its normal idle position. A lug 307 on the inner throttle arm 209 is engageable with the cam to swing it to open the choke valve 181 for unloading purposes.

The heads 77 of the primary nozzle bodies 75 extend upward above the level of the top of the float bowl section 5 into idle air bleed supply chambers 309 formed in the float bowl cover or air horn section 43. Each chamber 309 is sealed off from the primary air inlet 31*a*, section 43 including partitions 311 which seal against the nozzle bodies 75 for this purpose. Section 43 is formed with a bottom recess 313 which curves around the front thereof and connects the two chambers 309, this recess being closed at the bottom by a flange 315 formed on the float bowl section 5. This recess in conjunction with the two chambers 309 constitutes a duct for supplying preheated air to the idle air bleeds 109, 113 and 143. Air is supplied to the recess or duct 313 from the primary air inlet 31*a* upstream of the choke valve 181 via passages such as indicated at 317 provided in the float bowl cover or air horn section 43. Air flowing through the duct 313 to the idle air bleed supply chambers 309 is adapted to be heated by a heat-exchange tube 319 which extends through the duct 313 and one end of which is supplied with air heated by the engine via a heat tube 321 from a heat pocket 323 on the exhaust manifold of the engine (see FIG. 2), and the other end of which is connected as indicated at 325 to the thermostatic coil housing 227. A passage 327 connects housing 227 to the intake manifold so that when the engine is in operation air is drawn from pocket **323** through **321**, **319**, **325** and the housing **227**.

The arrangement is such that air heated by the engine is adapted to flow from the heat pocket **323** through the duct constituted by tube **321**, heat-exchange tube **319** and connection **325** to the thermostatic coil housing **227**. As this air flows through the heat-exchange tube **319** (which is in heat-exchange relation to a portion of duct **313**), it gives up some heat to the air surrounding the heat-exchange tube in the duct **313**. Thus, the air supplied to the idle air bleeds is preheated in the duct **313** more quickly to bring it up to its stabilized operating temperature for smoother engine operation during the warm-up period and to reduce the tendency toward icing of the idle air bleeds and the idle port. Also the air flowing through the heat-exchange tube **319** downstream to the thermostatic coil housing **227** is cooled. This cooling is a reflection of icing conditions (i.e., the colder the ambient temperature, the more the air flowing to the thermostatic coil housing will be cooled), and this tends to retard the relaxation of the thermostatic coil to tend to hold the engine on fast idle for a longer period when such conditions are present.

Operation is as follows:

When the engine is cold, the thermostatic coil **225**, acting as a spring, holds the fast idle cam **215** in its fast idle position. The fast idle cam **215** acts through the rod **251** and the spring **261** to hold the choke valve **181** closed. With the choke valve closed, the choke piston **265** is positioned at the inner end of the choke cylinder **263**. When the engine is cranked to start it, the resultant low pressure pulsations caused in the intake manifold of the engine are transferred to the outer end of the choke cylinder via passage **269** and to the underside of the choke valve. This causes the choke valve to open and close with each intake stroke, the opening of the choke valve being permitted by the yielding of the spring **261**, even though the fast idle cam remains in the fast idle position and even though rod **251** is thereby held from moving upward. In this respect, it will be observed that when the primary throttle shaft **151** is turned to open the primary throttle valves **149** to supply fuel for starting the engine, link **275** acts to rotate the coil **225** in such direction that the coil acts to apply additional spring force tending to hold the fast idle cam **215** in the fast idle position and tending to hold the rod **251** in its FIG. 13 position. Despite this holding of the fast idle cam in its fast idle position, spring **261** yields to allow the fluttering of the choke valve on the cranking of the engine. Once the engine has started, the intake manifold vacuum increases, and choke piston **265** moves the choke valve **181** open to the position determined by the arrangement of the slots **271** in the choke cylinder **263**.

As the engine warms up, and the thermostatic coil **225** in the housing **227** is warmed up by air heated by the engine flowing from the heat pocket on the exhaust manifold through the heat-exchange tube **319** to the housing **227**, the coil **225** relaxes. Assuming that the primary throttle valves **149** have been closed and the engine thereby idling with screw **213** on primary throttle arm **211** engaging the starting step **219** on the fast idle cam **215**, the next time the primary throttle valves are opened with resultant disengagement of the screw from the cam, the cam backs off (rotates clockwise) from its FIG. 13 fast idle position. This permits rod **251** to move upward to allow further opening of the choke valve. The linkage between the fast idle cam and the choke valve is so proportioned that the choke valve is permitted fully to open shortly after the starting of the engine before the fast idle cam backs off completely to its normal idle position. When the choke valve has fully opened, the fast idle cam may back off farther to complete its movement to normal idle position by reason of the lost motion between the cam and the rod **251** afforded by the pin and slot connection **249**, **247** between the rod and the cam. When the cam backs off completely to normal idle position, it actuates the secondary lockout lever **301** to release the secondary throttle valves **199**.

Assuming that during the warm-up period the fast idle cam **215** is in some intermediate position and the choke valve **181** is open, and further assuming that the engine is idling (primary throttle valves **149** closed), when the primary throttle shaft **151** is turned to open the primary throttle valves **149** for acceleration, link **275** acts to rotate the thermostatic coil **225** bodily in the direction to swing the fast idle cam toward its fast idle position. The fast idle cam thereupon acts to pull down the rod **251** and swing the choke valve **181** back toward its closed position to supply an enriched accelerating mixture to the intake manifold.

As previously pointed out, the air supplied to idle air bleeds **109**, **113**, **143** is preheated in the duct **313** by the heat-exchange tube **319** to bring this air up to its stabilized operating temperature more quickly for smoother engine operation during the warm-up period and to tend to prevent icing of the idle air bleeds and the idle port. Also, since some of the heat in the air flowing to the thermostatic coil housing **227** is given up to preheat the air for the idle air bleeds, the coil relaxes at a slower rate. Thus, the control reflects the presence of icing conditions to extend the warm-up period, the operation of the fast idle cam **215** being modified so that it does not reach its normal idle position until after warm-up is completed.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a carburetor for an internal combustion engine, said carburetor having an idle system including an idle air bleed passage, said carburetor further having a thermostatic control, and means for conducting heat from the engine to said control, said conducting means being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and reducing the amount of heat conducted to said thermostatic control.

2. In a carburetor for an internal combustion engine, said carburetor having a choke valve and an idle system including an idle air bleed passage, said carburetor further having a thermostatic control for the choke valve, and means for conducting heat from the engine to said control, said conducting means being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and reducing the amount of heat conducted to said thermostatic control.

3. In a carburetor for an internal combustion engine, said carburetor having a fast idle cam and an idle system including an idle air bleed passage, said carburetor further having a thermostatic control for the fast idle cam, and means for conducting heat from the engine to said control, said conducting means being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and reducing the amount of heat conducted to said thermostatic control.

4. In a carburetor for an internal combustion engine, said carburetor having a choke valve, a fast idle cam and an idle system including an idle air bleed passage, said carburetor further having a thermostatic control for the choke valve and fast idle cam, and means for conducting heat from the engine to said control, said conducting means being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and

reducing the amount of heat conducted to said thermostatic control.

5. In a carburetor for an internal combustion engine, said carburetor having an idle system including an idle air bleed passage, said carburetor further having a thermostatic control, and a duct for conducting air heated by the engine to said control, said duct being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and reducing the amount of heat conducted to said thermostatic control.

6. In a carburetor for an internal combustion engine, said carburetor having a choke valve and an idle system including an idle air bleed passage, said carburetor further having a thermostatic control for the choke valve, and a duct for conducting air heated by the engine to said control, said duct being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and reducing the amount of heat conducted to said thermostatic control.

7. In a carburetor for an internal combustion engine, said carburetor having a fast idle cam and an idle system including an idle air bleed passage, said carburetor further having a thermostatic control for the fast idle cam, and a duct for conducting air heated by the engine to said control, said duct being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and reducing the amount of heat conducted to said thermostatic control.

8. In a carburetor for an internal combustion engine, said carburetor having a choke valve, a fast idle cam and an idle system including an idle air bleed passage, said carburetor further having a thermostatic control for the choke valve and fast idle cam, and a duct for conducting air heated by the engine to said control, said duct being in heat-exchange relation with said idle air bleed passage for preheating the idle bleed air and reducing the amount of heat conducted to said thermostatic control.

9. In a carburetor for an internal combustion engine, said carburetor having a mixture conduit, a throttle valve and a choke valve for said mixture conduit, a choke control comprising a housing and a thermostatic element in the housing, and an idle system including an idle air bleed, means providing a duct for conducting air heated by the engine to said housing, and means providing a duct for conducting air from upstream of the choke valve to said idle air bleed, portions of said ducts being in heat-exchange relation for preheating the air conducted to the idle air bleed, said housing being downstream from said portions of said ducts.

10. In a carburetor for an internal combustion engine, said carburetor having two primary mixture conduits and two secondary mixture conduits, primary throttle valves for the primary conduits, a choke valve for the primary conduits, secondary throttle valves for the secondary conduits, an idle system for each primary conduit, each idle system including an idle air bleed, each bleed opening into an idle bleed air duct supplied with air from upstream of the choke valve, a choke control comprising a housing and a thermostatic element in the housing, and means providing a duct for conducting air heated by the engine to said housing and including a heat-exchange tube



extending through said idle bleed air duct, said housing being downstream from said heat-exchange tube.

11. In a carburetor for an internal combustion engine, said carburetor having a mixture conduit, a throttle valve and a choke valve for said mixture conduit, means responsive to engine temperature for controlling the position of the throttle valve at idle and for controlling the position of the choke valve, said control means being adapted to establish a fast idle position of the throttle valve when the engine is cold and a normal idle position of the throttle valve when the engine is warmed up, said control means being adapted to hold the choke valve closed when the engine is cold and to allow the choke valve fully to open before the engine is warmed up, said control means including a housing and a thermostatic element in said housing, said carburetor having an idle system including an idle air bleed, means providing a duct for conducting air from upstream of said choke valve to said bleed, and means providing a duct for conducting air heated by the engine to said housing, portions of said ducts being in heat-exchange relation for preheating the air conducted to said bleed, said housing being downstream from said portions of said ducts whereby the temperature of the air conducted to said housing is reduced by the heat exchange for modifying the action of said control means.

12. In a carburetor for an internal combustion engine, said carburetor having a primary and a secondary mixture conduit, a primary throttle valve and a choke valve for the primary conduit, a secondary throttle valve for the secondary conduit, means for locking the secondary throttle valve closed, means responsive to engine temperature for releasing said locking means when the engine has warmed up, and means controlled by said temperature-responsive means adapted to hold the choke valve closed when the engine is cold and adapted to permit full opening of the choke valve before the engine has warmed up and before release of said locking means, said temperature-responsive means including a housing and a thermostatic element in the housing, said carburetor having idle systems for the primary conduits including idle air bleeds, means providing a duct for conducting air from upstream of said choke valve to said bleeds, and means providing a duct for conducting air heated by the engine to said housing, portions of said ducts being in heat-exchange relation for preheating the air conducted to said bleeds, said housing being downstream from said portions of said ducts whereby the temperature of the air conducted to said housing is modified by the heat exchange for modifying the action of said temperature-responsive means.


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