

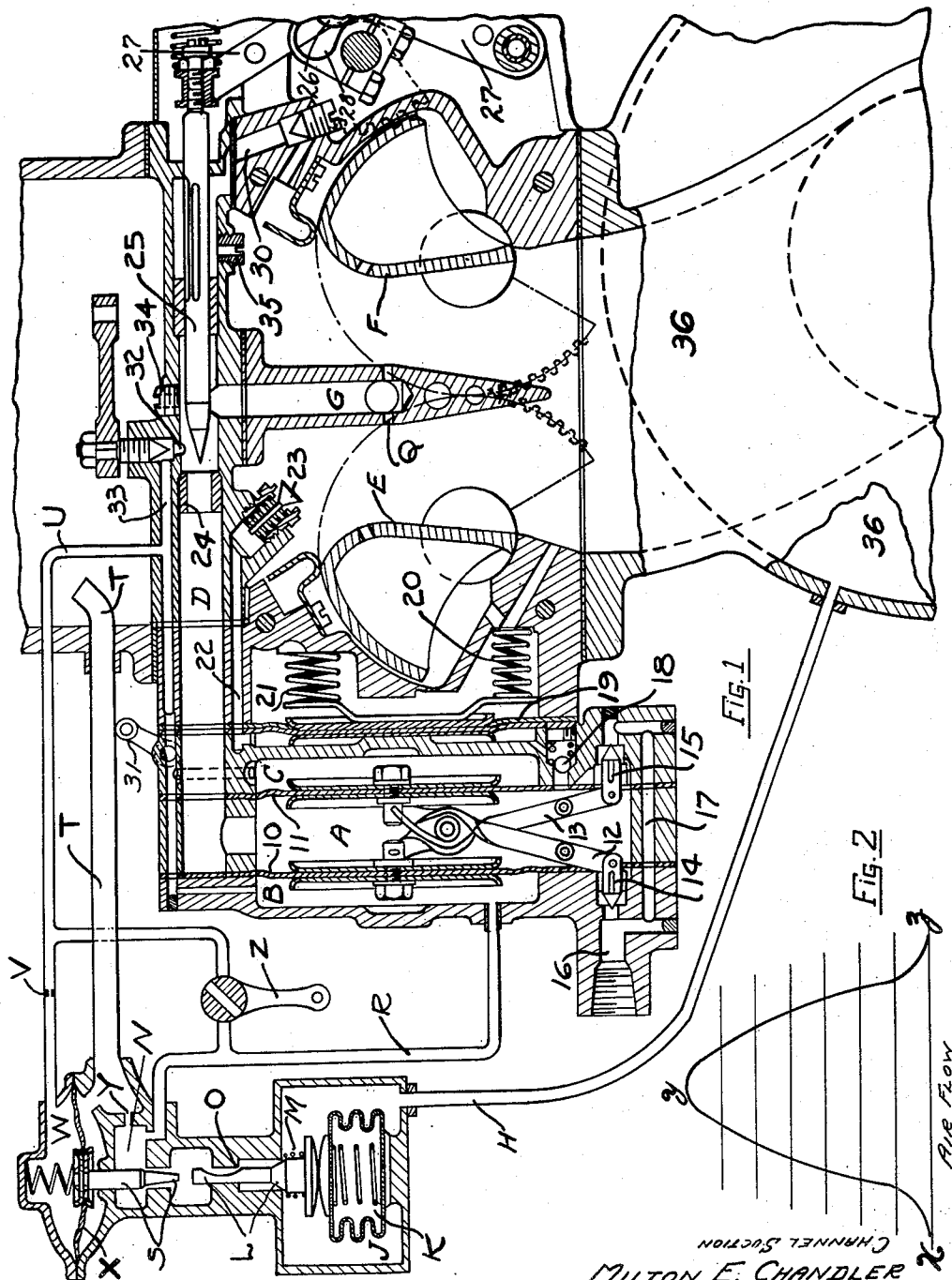
Jan. 7, 1941.

M. E. CHANDLER

2,228,000

AIRPLANE CARBURETOR

Filed May 2, 1938



CHANNEL SECTION

MILTON E. CHANDLER
INVENTOR

Harley M. Udall
ATTORNEY

UNITED STATES PATENT OFFICE

2,228,000

AIRPLANE CARBURETOR

Milton E. Chandler, Detroit, Mich., assignor, by
mesne assignments, to Chandler-Evans Cor-
poration, Meriden, Conn., a corporation of Dela-
ware

Application May 2, 1938, Serial No. 205,542

9 Claims. (Cl. 261—51)

The object of this invention is to automati-
cally control the mixture ratio of a carburetor,
of the variable Venturi type, having a pressure
reducing valve for the fuel supply operated by a
diaphragm and in which the carburetor is con-
nected to a supercharger. The two variables re-
lied upon to control the mixture ratio are the
supercharger pressure and the suction in the
throat of the variable venturi. These two vari-
ables are arranged to control the pressure of the
fuel at its point of discharge past its regulating
orifice. The invention disclosed herein includes
features of improvement upon the carburetor de-
scribed and claimed in the co-pending applica-
tion of Milton J. Kittler, Serial No. 107,386, filed
October 24, 1936, entitled Airplane carburetor.

In a carburetor of this type the problem is
complicated by the fact that due to the location
of the fuel outlets in the throat of the variable
venturi and to a throttle controlled air bleed, the
channel suction at first increases as the throttles
are opened and then (from one-half throttle on),
this suction decreases as the throttles approach
the wide open position.

By channel suction is meant the depression in
the fuel passage leading from the point where
the fuel is controlled by the needle at the fuel
orifice to the fuel outlet in the throat of the
variable venturi. It follows that the problem of
obtaining automatic control of the mixture in-
volves these two variables.

In the drawing:

Figure 1 shows diagrammatically the applica-
tion of the novel control to a variable Venturi
carburetor connected to a supercharger.

Figure 2 shows the approximate relationship
between the channel suction and the air flow
which corresponds approximately to throttle po-
sition.

The carburetor, as shown, has a diaphragm
fuel chamber A located between two flexible dia-
phragms 10 and 11, which diaphragms also form
the walls of two air chambers B and C. Dia-
phragm linkage 12, 13 connects the diaphragms
10, 11 to the needle valves 14, 15. A fuel en-
trance 16 is connected to a fuel pump (not shown)
which supplies fuel under substantially constant
pressure to a passage 17 which delivers fuel to
the needle 15. The passage 16 delivers fuel di-
rectly to the needle valve 14. The areas of the
seats of these needle valves 14, 15, are so small,
and the diaphragms 10 and 11 are so large that
any slight variation in the pressure at 16 has no
appreciable effect on the head of fuel in the
chamber A.

The fuel leaves the diaphragm chamber A and
passes along a horizontal passage D to a restric-
tion 24 controlled by a movable needle valve 25.
This needle valve is moved by the lever 27, the
movement of which is determined by a roller
26 which engages with the box cam 28. This box
cam 28 is moved in unison with two throttles E
and F. Gears are indicated showing that the
throttles E and F and the needle valve 25 will
move together, so that when the box cam 28 is
moved, the throttles E and F are also moved and
at the same time that the needle valve 25 is
moved.

The fuel flows past the needle valve 25 into
the fuel passage or channel G and delivers fuel
into the throat of the variable venturi through
the outlets Q. The suction in the passage G is
referred to in this specification as the channel
suction. This channel suction is communicated
through an opening 32 and through a horizontal
passage 33 with the air chambers B and C. Air
is admitted around the needle valve 25 through
a vent in a plug 34 and also through two passages
30, 35. The air admitted through 30, 35 is con-
trolled by longitudinal grooves in the needle
valve 25.

When the throttles E and F are closed and the
needle 25 moves to the left so as to approach the
restriction 24, there are flutes in needle valve 25
which admit air from the two passages 30, 35, into
the channel G and thereby reduce the channel
suction, as shown in Fig. 2. x indicates the idle
suction, y the suction with the throttle approxi-
mately half open and z the wide open suction.
The value corresponding to x in Figure 2 is low
because the three vents 30, 34, and 35 are in full
operation when the throttle is closed.

In order that the carburetor should respond
when the throttles are suddenly opened, an ac-
celerating pump is provided comprising the check
valve 18, the diaphragm 19, the fuel passage 22,
the fuel outlet 23, and the springs 20 and 21.
This particular detail is no part of the present
invention and is merely shown so that the com-
plete carburetor may be indicated.

Briefly, the pressure on the back of the dia-
phragm 19 is that of the mixture outlet from
the carburetor. Hence, when the throttles are
opened quickly, and the mixture outlet vacuum
is destroyed, the diaphragm 19 moves to the left,
the check valve 18 moves to the left, and fuel
which is accumulated behind the diaphragm 19
is discharged through the pressure exerted by the
springs 20, 21 through the passage 22 and out
through the nozzle 23. The carburetor there-

upon delivers a rich mixture to the supercharger 36.

All that has thus far been described is the carburetor proper and the invention here disclosed relates to the control means.

Discussing in detail this invention, a pipe H communicates the pressure generated by a supercharger 36 to a chamber J which contains a flexible bellows K from which the air has been exhausted. This bellows may be supported by an internal spring and may also have inherent elasticity. This bellows engages with a valve L which is held in contact with the bellows by a spring M. This valve L controls a restricted passage O so that the compressed mixture admitted through the passage H can flow past the valve L into a chamber a variable amount determined by the absolute pressure of the mixture in H. This compressed gas flows past a needle valve S which is controlled by a diaphragm X which, in its turn, is controlled by the pressure in the chamber W. This chamber W is connected through a passage U in which there is a restriction V with the channel suction, that is to say, with the passage 33. The lower side of the diaphragm X is subjected to the pressure in the air entrance through the passage T generally referred to as "scoop pressure," because of the air scoops which are used on airplane carburetors to take advantage of the air velocity of the airplane. In order to disconnect the chambers B and C from the passage 33, a valve 31 is provided.

The compressed mixture that flowed by the restriction O, valve L and also by the tapered needle S flows into a chamber N which is connected through a restriction Y with the pipe T. The pressure in N is thus a function of both the pressure in the supercharger and of the scoop pressure in T. As the throttles open the channel suction increases, the valve S rises and thus increases relatively the amount of compressed gas that flows from the pipe H past the restriction O, the tapered needle S into the chamber N, and thus increases the flow through R into the chambers B and C, and thus raises the pressure in the chambers B and C. The pressure in these two chambers is balanced against the pressure in the chamber A which determines the pressure on the fuel orifice 24 and thus determines the rate of fuel flow past the needle 25.

When the throttles are open wide, the channel suction once more falls as shown in Figure 2. When this happens a decrease in channel suction causes a decrease in the pressure in the pipe U which is reflected by the movement of the needle valve S which restricts the flow of the compressed gases through the pipe H which restricts the flow through the passage R allowing the pressure in the chambers B and C to fall, which allows the pressure in the chamber A to fall, and thus decreases the head of fuel on the orifice 24. Of course, the needle valve 25 is now withdrawn, as shown in the drawing and hence the orifice 24 is now wide open. The fuel then flows through the passage 24 under the influence of the depression at the point Q which is then the major factor in determining fuel flow. By suitably forming the contour of the valve L and the tapered needle S it is possible to arrange so that the mixture ratio remains within the desired limits.

In an emergency when it is desired to reduce the fuel flow for any reason the valve Z is provided. When this valve is in the wide open position, pressure in B and C from the pipe R is de-

stroyed because the pipe U is in free communication with the pipe R.

The purpose of the restriction V in the pipe U is to eliminate flutter of the diaphragm X in the chamber W.

The reason so little pressure is applied at wide open throttle to the chambers B and C from the pipe H through the described mechanism is because when the throttle is open the air flow is at its maximum, and the fuel flow through G should chiefly respond to and be controlled by the air flow through the variable Venturi shaped throttles E and F. The suction that corresponds to this maximum air flow is of the order of one or two inches of mercury. Under such conditions the relative effect of a small increment of pressure in the chambers B and C is high. At half throttle, on the other hand, the channel suction is at its maximum and the pressure head across the orifice 24 is high, as the flutes in the needle valve 25 restrict the effects of the vents 30, 35 when the throttle is half opened. It follows from this that a considerable increment of pressure in the chambers B and C is needed at one half throttle to make any appreciable difference in the flow of fuel through the orifice 24.

Attention is drawn to the fact that the valve L when it first moves in response to an increment of pressure in the supercharger opens the path through the restriction O and that when the compression rises still farther the opening is restricted.

The feature which I desire to cover by Letters Patent is the regulation of pressure in the fuel supply chamber by the channel suction and by the supercharger pressure acting simultaneously; in other words, by maintaining a pressure on the fuel intermediate the channel suction and the supercharger pressure to obtain the most desirable mixture ratio.

What I claim is:

1. Fuel supply means for a throttle controlled carburetor having an air entrance and a mixture outlet connected to a supercharger comprising, a source of fuel supply under pressure, pressure reducing means therefor, automatic means responsive to the absolute pressure at the discharge side of the supercharger for controlling the pressure reducing means, and automatic means responsive to the drop in pressure from the air entrance to the mixture outlet created by the throttle for controlling the pressure reducing means whereby the pressure on the fuel at the low pressure side of the pressure reducing means is responsive to the drop in pressure due to the throttle and also to the absolute pressure created by the supercharger.

2. Fuel supply means for an airplane engine having an air entrance and a mixture chamber of the variable Venturi type connected to a supercharger comprising, a source of fuel under substantially constant pressure, a fuel supply chamber connected thereto, means for reducing the pressure therein comprising a fuel supply chamber having a flexible wall, an air chamber associated with said flexible wall, fuel control mechanism connected to said flexible wall, means for admitting the atmospheric pressure existing in said air entrance to said air chamber, means for admitting compressed mixture from said supercharger to said air chamber, and means responsive to both the absolute pressure of mixture from said supercharger and to the drop in pressure in said mixing chamber below the pressure in the air entrance for jointly controlling the

admission of compressed mixture to said air chamber for the purpose described.

3. Fuel supply means for an airplane having an air entrance, a mixture chamber of the variable Venturi type, throttle means therefor forming a variable venturi, a fuel channel discharging into the throat of said venturi, a needle valve controlling said fuel supply adapted to be connected to and operated by said throttles, said fuel channel connecting the point of fuel supply to the throat of the venturi, means for admitting the atmospheric pressure of said air entrance to said channel, valve means for controlling the admission of said air, said valve being connected to said throttles, a mixture outlet, a supercharger connected thereto, a source of fuel supply under substantially constant pressure, a fuel supply chamber connected thereto, means for reducing the pressure in said fuel supply chamber, said pressure reducing means including a flexible wall for said fuel supply chamber, an air chamber associated with said flexible wall, fuel supply control mechanism connected to said flexible wall, means for admitting atmospheric pressure to said air chamber, means for admitting compressed mixture from said supercharger to said air chamber, and means responsive to and operated by both the absolute pressure of the mixture from said supercharger and the suction in said fuel channel for controlling the admission of compressed mixture to said air chamber.

4. In a carburetor having an air entrance, a throttle valve therein, a mixture outlet, a supercharger connected thereto, a fuel supply chamber having a restricted outlet, a fuel channel connected thereto and discharging into said mixture outlet, an air chamber, a flexible diaphragm forming a partition between the two chambers, a passage connecting the air chamber with the fuel channel, means for modifying the vacuum in the air chamber comprising a passage connected to the air entrance and to the air chamber, a passage connecting the supercharger with the passage connected to the air entrance, two restrictions in series in the last said passage, valve means in one restriction responsive to the supercharger pressure adapted to vary the restriction, and valve means in the other restriction responsive to the channel suction adapted to open the restriction when the channel suction is high.

5. A carburetor as described in claim 3 in which a needle valve is provided controlled by the movement of the throttle and adapted to regulate the area of the restricted outlet from the fuel supply chamber, and an air vent is provided leading to said fuel channel, and valve means also controlled by the movement of the throttle are provided to restrict the area of the air vent as the throttle is opened.

6. In a carburetor having an air entrance, a throttle valve therein, a mixture outlet, a supercharger connected thereto, a fuel supply chamber having a restricted outlet, a fuel channel connected thereto and discharging into said mixture outlet, an air chamber, a flexible diaphragm forming a partition between the two chambers, a passage connecting the air chamber with the fuel channel, means for modifying the vacuum in the air chamber comprising a passage connected to the air entrance and to the air chamber, a passage connecting the supercharger with the passage connected to the air entrance, two restrictions in series in said passage, an obstruction in one restriction adapted to first open and then close the restriction, means responsive to

the supercharger pressure adapted to move said obstruction, and valve means in the other restriction responsive to the channel suction adapted to open the restriction when the channel suction exceeds a predetermined minimum value.

7. In a carburetion apparatus, means providing an air intake passage to an engine, means providing a pressure source of fuel, means including a flexible diaphragm providing a fuel chamber, said chamber being at one side of said diaphragm and having a fuel inlet and a fuel outlet, a valve for controlling said fuel inlet, means associating said diaphragm and valve whereby movements of said diaphragm will control the inlet of fuel into said fuel chamber, means for subjecting the other side of said diaphragm to the pressure in the air intake passage to produce a force normally reacting against said diaphragm tending to open said valve and to maintain a positive pressure in said fuel chamber, a supercharger having its intake side connected with the intake passage leading to the engine and a connection from its discharge side to the other side of said diaphragm for producing an additional force acting on said diaphragm in the same direction as the first said force producing means upon the attainment of a predetermined pressure in the supercharger discharge thereby to increase the positive pressure in the fuel chamber and to increase the fuel flow from said fuel outlet, a venturi in said intake passage between said supercharger and the entrance to said passage, and automatic valve means for modifying the force produced by said supercharger in accordance with pressure conditions at the throat of said venturi.

8. In a carburetion apparatus, means providing an air supply passage, means for providing a pressure supply of fuel, means including a flexible diaphragm providing a fuel chamber, said chamber being at one side of said diaphragm and having an inlet and an outlet for fuel, a valve for controlling said fuel inlet, means associating said diaphragm and valve whereby movements of said diaphragm will control the inlet of fuel into said chamber, means for subjecting the other side of said diaphragm to the pressure in the air-intake passage to produce a force normally reacting in one direction against said diaphragm tending to open said valve and to maintain a positive pressure on the fuel in said fuel chamber, a supercharger, means for impressing upon said diaphragm the additional force of the supercharger discharge pressure acting in the same direction as the first said force producing means for increasing the positive pressure in said fuel chamber as the air flow through said passage increases whereby to increase the fuel flow through said fuel outlet, means in the path of air flow through said passage for creating a pressure difference between different portions of said passage, and valve means responsive to the pressure difference created by said means in the air flow path for modifying the effect of said additional force impressing means upon said diaphragm.

9. In a carburetion apparatus, means providing an air supply passage, means for providing a pressure supply of fuel, means including a flexible diaphragm providing a fuel chamber, said chamber being at one side of said diaphragm and having an inlet and an outlet for fuel, a valve for controlling said fuel inlet, means associating said diaphragm and valve whereby movements of said diaphragm will control the inlet of fuel into said chamber, means for subjecting the other side of

said diaphragm to the pressure in the air intake passage to produce a force normally reacting in one direction against said diaphragm tending to open said valve and to maintain a positive pressure on the fuel in said fuel chamber, a super-
5 charger, means for impressing upon said other side of said diaphragm the additional force of a predetermined supercharger discharge pressure acting in the same direction as the first said
10 force producing means for increasing the positive pressure in said fuel chamber as the air flow through said passage increases whereby to in-

crease the fuel flow through said fuel outlet, a Venturi device in said air supply passage between the air entrance to the passage and said supercharger for producing a low pressure in predetermined ratio to the rate of flow of air through
5 said passage, and valve means responsive to the pressure conditions created by said Venturi device for decreasing and increasing the effect of said additional force impressing means in predetermined ratio to the density of the air flowing
10 through said passage.

MILTON E. CHANDLER.