Oct. 9, 1956

M. L. SMITLEY ET AL

2,766,024

TWO-STAGE CARBURETOR

Filed Jan. 8, 1953

3 Sheets-Sheet 1

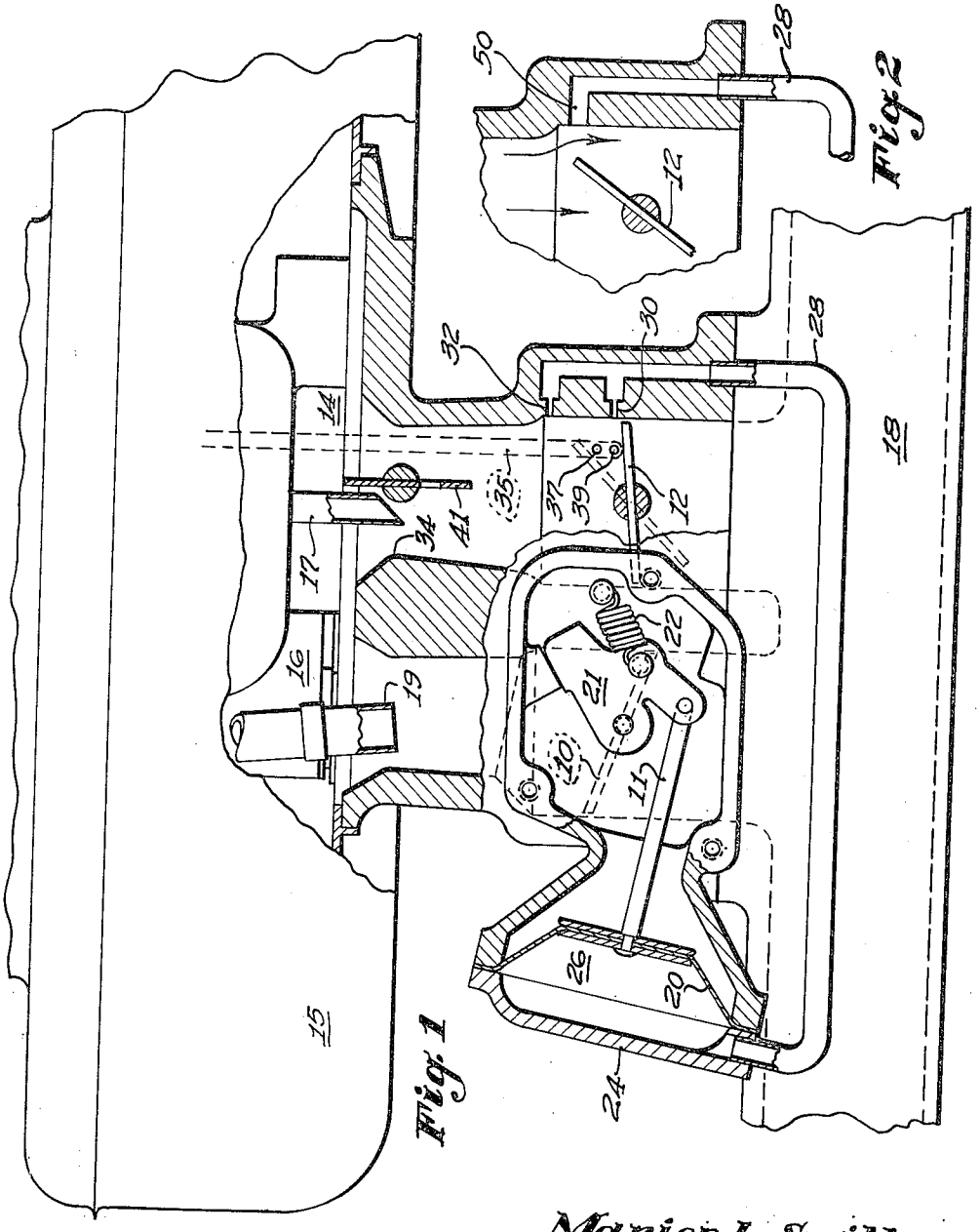


Fig. 1

Fig. 2

Marion L. Smitley
Melvin F. Sterner
INVENTOR.

BY Stanley M. Udale

ATTORNEY

Oct. 9, 1956

M. L. SMITLEY ET AL

2,766,024

TWO-STAGE CARBURETOR

Filed Jan. 8, 1953

3 Sheets-Sheet 2

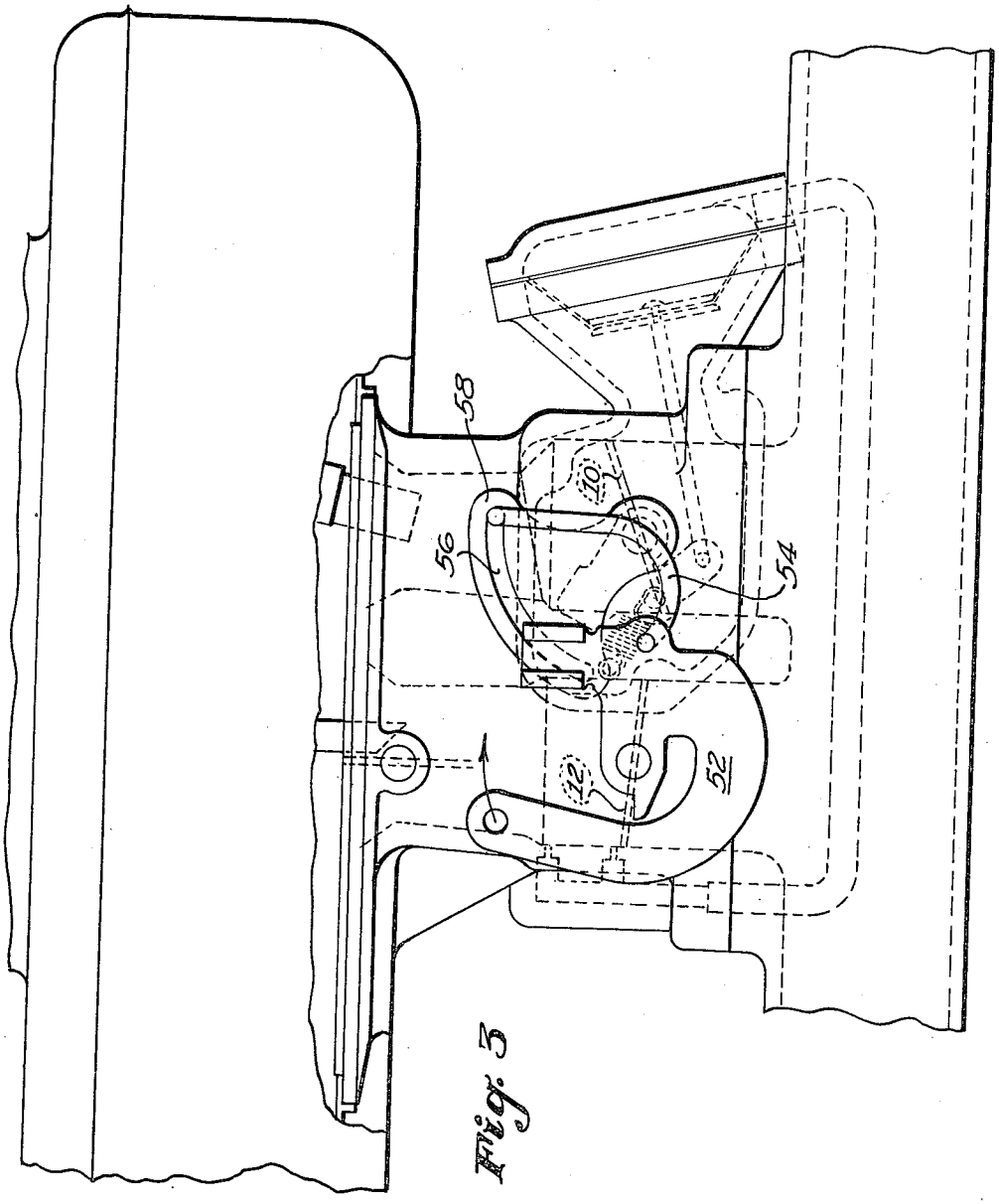


Fig. 3

Marion L. Smitley
Melvin H. Sterner
INVENTOR.

BY Stanley M. Udale

ATTORNEY

Oct. 9, 1956

M. L. SMITLEY ET AL

2,766,024

TWO-STAGE CARBURETOR

Filed Jan. 8, 1953

3 Sheets-Sheet 3

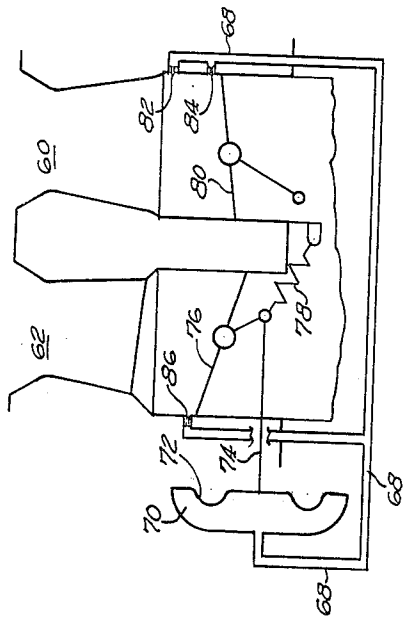


Fig. 5

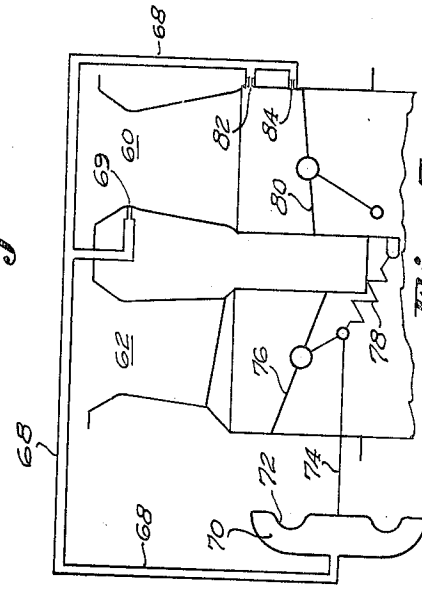


Fig. 7

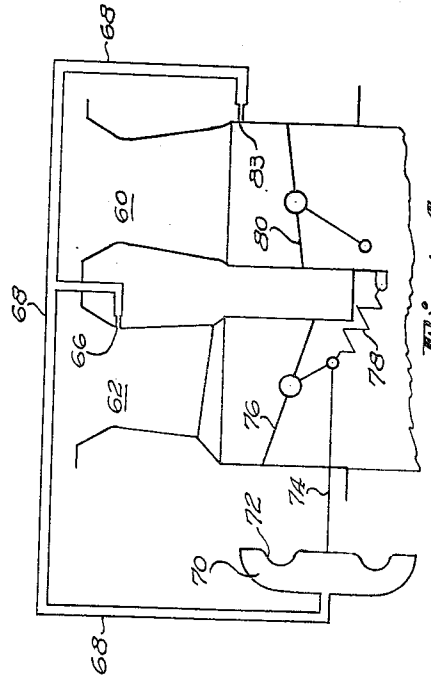


Fig. 4

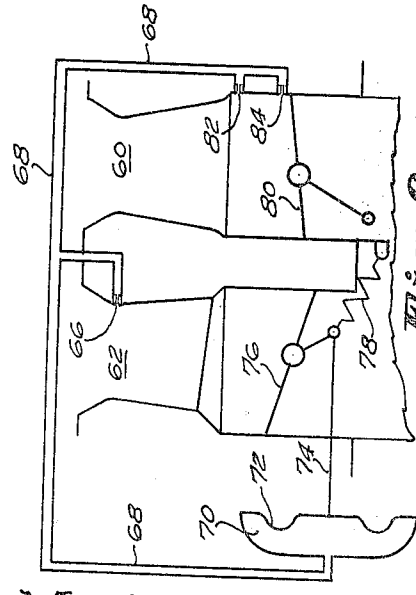


Fig. 6

Marion L. Smitley
Melvin F. Sterner

INVENTOR.

BY Stanley M. Udale

ATTORNEY

United States Patent Office

2,766,024

Patented Oct. 9, 1956

2,766,024

TWO-STAGE CARBURETOR

Marion L. Smitley, Huntington Woods, and Melvin F. Sterner, Royal Oak, Mich., assignors to Holley Carburetor Company, Detroit, Mich., a corporation of Michigan

Application January 8, 1953, Serial No. 330,328

1 Claim. (Cl. 261—23)

In the operation of large 200 horsepower automotive engines, two carburetors in parallel are used and the primary carburetor is opened first by the first throttle and the secondary throttle of the secondary carburetor is opened later by the first throttle. With automatic transmission, a mechanical connection between first and second throttle has proven entirely satisfactory. With the ordinary synchromesh transmission, a mechanical linkage has been found to be unsatisfactory.

The object of this invention is to provide an automatic control of the secondary carburetor in a two-stage carburetor when used with an ordinary synchromesh transmission.

If the throttle of the secondary carburetor is mechanically opened, there is the possibility that with both throttles wide open at low engine speed, poor distribution will result when the ordinary synchromesh transmission is used.

To delay the opening at first, and to later regulate the rate of opening by the road load, is the object of this invention. If manifold suction is applied to keep the throttle of the secondary carburetor closed, and if the suction just downstream of the lip of the first throttle (where suction is much greater than manifold suction) is applied to a diaphragm chamber to open the secondary throttle, then at low load—e. g.—when accelerating on a level boulevard—the second throttle is all set to open long before the first throttle is wide open. As the first throttle is opened, the suction at a first restriction near the upstream lip of the first throttle remains relatively high and unregulated, and would open the second throttle much too soon. To regulate this suction below the lip of the first throttle as it opens, a second air bleed upstream of the first is used. This air bleed is derived from a second hole which is provided upstream of the first hole into a passage leading to a diaphragm chamber. This second hole bleeds air from the main air passage from a point (about ½" above the first hole) and thus, reduces the suction at the lip right after the initial throttle opening. Later on, as the throttle continues to open, the suction at the second opening increases and when half open equals and exceeds the suction at the first opening. Meanwhile, the manifold suction decreases so that the second throttle can follow and anticipate the motion of the first throttle and open after first throttle is half open. The second throttle is thus opened wide before the first throttle is wide open.

Figure 1 shows the preferred form of my invention.

Figure 2 shows an alternative construction.

Figure 3 shows the back view of Figure 2.

Figures 4, 5, 6 and 7 show alternative constructions.

In Figure 1:

12 is the first throttle of the primary carburetor **14**.

10 is the second throttle of the secondary carburetor **16**.

Throttle **10** is unequally divided so that the suction in inlet manifold **18** holds throttle **10** shut when the engine is idling (both throttles shut).

20 is the diaphragm, the motion of which opens throttle **10** through linkage **11**.

30 is the restricted orifice near the upstream lip of throttle **12**.

32 is the second restricted orifice near **30**.

22 is the spring which assists in keeping the throttle **10** closed.

24 is the casing which forms with the diaphragm **20** a vacuum chamber **26**.

28 is the vacuum pipe leading from chamber **26** to the openings **30** and **32**.

35 is the low speed tube of carburetor **14**.

37 and **39** are the two low speed outlets from **35**.

41 is the choke tube located in **34** which is the air entrance **34** of carburetor **14**.

Openings **32** and **30** are just upstream of the lip of the throttle **12** so that as the throttle **12** is opened, the suction in chamber **26** rises. **32** is in line with the throttle **12** when throttle **12** is half open.

The dimensions that have been found satisfactory for one installation (for ½ of a 200 horsepower engine):

Unbalance of throttle **10**=0.055 in 1.3125" diameter
Dimension of **30**=0.046"
Dimension of **32**=0.051"
Distance **30**—**32**=½"
Diameter of diaphragm **20**=1⅞"
Leverage of spring **22**=5/16" to ½"
Minimum effort of spring **22**=12 ozs.
Maximum effort of spring **22**=24 ozs.

In Figure 2:

An unrestricted opening **50** leading to the pipe **28** is located so that when the throttle of the primary carburetor has moved 50° from its idle position of 5°; that is, when the throttle stands at 55° from the horizontal, the suction in **50** is at a maximum. The difficulty is that this location varies from 40° to 70° and a new location involves an expensive delay in changing the tool set up. With two restrictions, the diameters of these can be changed quickly and the equivalent of changing the location of opening **50** is cheaply made.

In Figure 3:

52 is the throttle lever for throttle **12** carrying **54** which is a bent link which engages a slot **56** in the throttle lever **58** for the throttle **10**.

In Figure 4:

In this figure, the mechanical control shown in Figure 3 is omitted for the sake of clarity; and,

60 is the #1 venturi of the primary carburetor.

62 is the #2 venturi of the secondary carburetor.

66 is a restriction in the walls of the throat of #2 venturi **62**.

68 is the pipe common to both restrictions **66** and **83**.

83 is a restriction in the outlet from the primary carburetor located so as to become effective when #1 throttle **80** is opened to 55°.

70 is a chamber with a diaphragm **72**.

74 is a link leading to the #2 throttle **76** of the secondary carburetor **62** which throttle **76** is slightly offset so as to be held closed by suction to keep the secondary carburetor out of action until actually needed.

78 is a tension spring which is connected to link **74** and assists the suction offset of throttle **76** in holding the secondary carburetor out of action until it is really needed after #1 throttle **80** has been opened wide.

In Figure 5:

Here again, **60**, **62**, **76**, **74**, **78**, **80**, **70**, **72**, **68** have the same function as the corresponding parts in Fig. 4. Here the #1 throttle **80** has an important part to play. Restrictions **82** and **84** are successively brought into operation as the throttle **80** is opened and the suction existing downstream of the upstream lip of butterfly throttle **80** is transmitted through pipe **68** to act on diaphragm **72**.

When this suction overcomes the spring **78** and the off-

set of #2 throttle **76**, then this #2 throttle **76** opens a third restriction **86** which is subjected to the suction downstream of the upstream lip of #2 throttle **76**. This suction blends with suction generated by #1 throttle at restrictions **82** and **84**. The cumulative effect through these three restrictions **82**, **84** and **86** is such as to open the #2 throttle **76** at least as much as #1 throttle **80** has been opened. The linkage shown in Fig. 3 limits this opening to an amount equal to the opening of #1 throttle **80** so that the two throttles open in step with each other.

In Figure 6:

Here the parts **60**, **62**, **66**, **68**, **76**, **78**, **74**, **70** and **80** have the same function as the corresponding parts shown and described in Fig. 4 and restrictions **82** and **84** have the same functions as the parts so numbered in Fig. 5.

Figure 6 differs from Figure 4 in that restriction **83** of Figure 4 is replaced by two restrictions **82** and **84**.

In Figure 7:

Here the parts **60**, **62**, **68**, **70**, **72**, **74**, **76**, **78**, **80**, **82** and **84** have the same function as corresponding parts in Figures 5 and 6. A restriction **69** in the walls of the throat **60** of the primary carburetor is connected into the pipe **68**.

OPERATION

Figure 1

The operation of the two carburetors **14** and **16** is similar except that primary carburetor **14** has a low speed tube **35** and choke **41** with the usual two speed fuel outlets **39** and **37**. The choke valve **41** also acts as a nozzle, but this feature is no part of this invention which is restricted to the control of the second throttle by the first throttle.

Assume that the engine is running under closed throttle. The manifold suction holds throttle **10** closed due to its offset. The 12 ounce pull of spring **22** at 5/16" radius holds throttle **10** shut. Then as the throttle **12** is opened, first the restriction **32**, and later the restriction **30**, comes under the influence of the air flowing past the inclined butterfly throttle at the speed of sound around the tip of the upstream lip of throttle **12**. This very high suction is great enough to overcome both the pull of spring **22** and the action of the lower manifold suction in **18** on the offset throttle **10**. Valve **10** is thus opened shortly after the throttle **12** has reached the position of approximately halfopen, provided that the road load permits the engine to accelerate normally. Any abnormal condition; e. g.—head wind or steep grade—will permit throttle **12** to pass the half-way point and to permit the unbalanced throttle to remain closed (held by spring **22**) so as to avoid wide open throttle low engine speed operation with both throttles wide open.

Figure 2

The operation of Figure 2 is the exact equivalent of the operation of Figure 1 except that the operation of determining the exact location of opening **50** is very difficult. In both cases, it should be noted that on the level road when the driver has opened the throttle from 5° idle position to 55°, the second throttle is opened wide. Maximum speed is thus obtained. On approaching a hill, the car slows down and the driver opens the primary throttle **12** wide. The second throttle **10** remains closed and the hill is climbed on the primary carburetor functioning alone. On reaching level ground or descending a hill, the closing of the first throttle at firsts opens, and later causes the secondary throttle to close, as the lip of the throttle moves clock-wise and first raises, and then lowers, the suction at the two orifices **30** and **32**. The suction in pipe **28** is intermediate the two suctions in **32** and **30**.

Figure 3

In Figure 3, when the throttle **12** is closed, link **54** engages the upper end of slot **56** and holds throttle **10** closed. When throttle **12** is wide open, throttle **10** may still be closed; but, it could be wide open. When throttle **12** is half-open, throttle **10** may still be closed; but, it could be half-open.

Figure 4

Here the primary (#1) throttle **80** opens until at 55° (approximately) when the suction downstream of the upstream lip creates enough suction in chamber **70** to start #2 throttle **76** to move so as to open; and as **76** opens, suction in the secondary venturis **62** and restriction **66** also increases, so that throttle **76** continues to open as #1 throttle **80** is opened provided the load is low enough to permit this operation.

Figure 5

After the throttle **80** brings the first restriction **84** under the influence of the throttle, then the restriction **82** is brought under the influence of throttle **80**. Throttle **76** thereupon begins to open when restriction **86** is subjected to suction downstream of upstream lip of throttle **76**. #2 throttle **76** is then opened wide at light loads and high engine speeds.

Figure 6

Here again the operation is assisted, as in Figure 4, by the suction in the #2 venturi **62** which increases as #2 throttle **76** continues to open so that when #1 throttle is wide open, #2 throttle **76** is also wide open due to the influence of venturi suction in the #2 carburetor **62** acting in conjunction with the restriction **66** leading to the chamber **70**.

Figure 7

Here the suction created in the primary carburetor (transmitted through the primary venturi **60** at restriction **69**) assists the suction on downstream side of #1 throttle **80** acting through restrictions **82** and **84** to keep the #2 throttle **76** open so as to keep in step with the opening of the #1 throttle **80** which is usually operated by hand.

What we claim is:

In a two-stage carburetor for an internal combustion engine having a manually operated primary carburetor in parallel with a secondary carburetor which is opened automatically, both carburetors having an air entrance, a mixture outlet and a butterfly throttle in each outlet, a restricted opening in the wall of the mixture outlet of the primary carburetor located so as to be transferred from the atmospheric side to the engine suction side of the said butterfly throttle in said primary carburetor the moment it moves away from its idle position in the wall of the first mixture outlet and a second restriction adjacent the first restriction and located so as to be subjected to the engine suction when the first throttle is approximately one-half open, a diaphragm, a chamber associated therewith, linkage connecting the diaphragm with said throttle of said secondary carburetor, yieldable means holding said second throttle closed, a passage from said two restrictions to said diaphragm chamber and whereby the resultant suctions from the said two restrictions opens the throttle of said secondary carburetor, the suction existing at each restriction modifying the suction existing at the other restriction and in which there is a venturi in the air entrance to the primary carburetor, a third restricted opening, said opening being located in the wall of the throat thereof, a connection between said opening and said passage connecting the other two restrictions, the butterfly throttle of said secondary carburetor being unbalanced so that the engine suction opposes the opening movement of said secondary throttle.

References Cited in the file of this patent

UNITED STATES PATENTS

2,193,533	Kishline et al.	Mar. 12, 1940
2,323,222	Holley et al.	June 29, 1943
2,390,019	Winkler et al.	Nov. 27, 1945
2,609,187	Scott	Sept. 2, 1952
2,609,806	Winkler	Sept. 9, 1952