Aug. 4, 1953 A. F. BRAUN 2,647,502

COMPOUND CARBURETION SYSTEM

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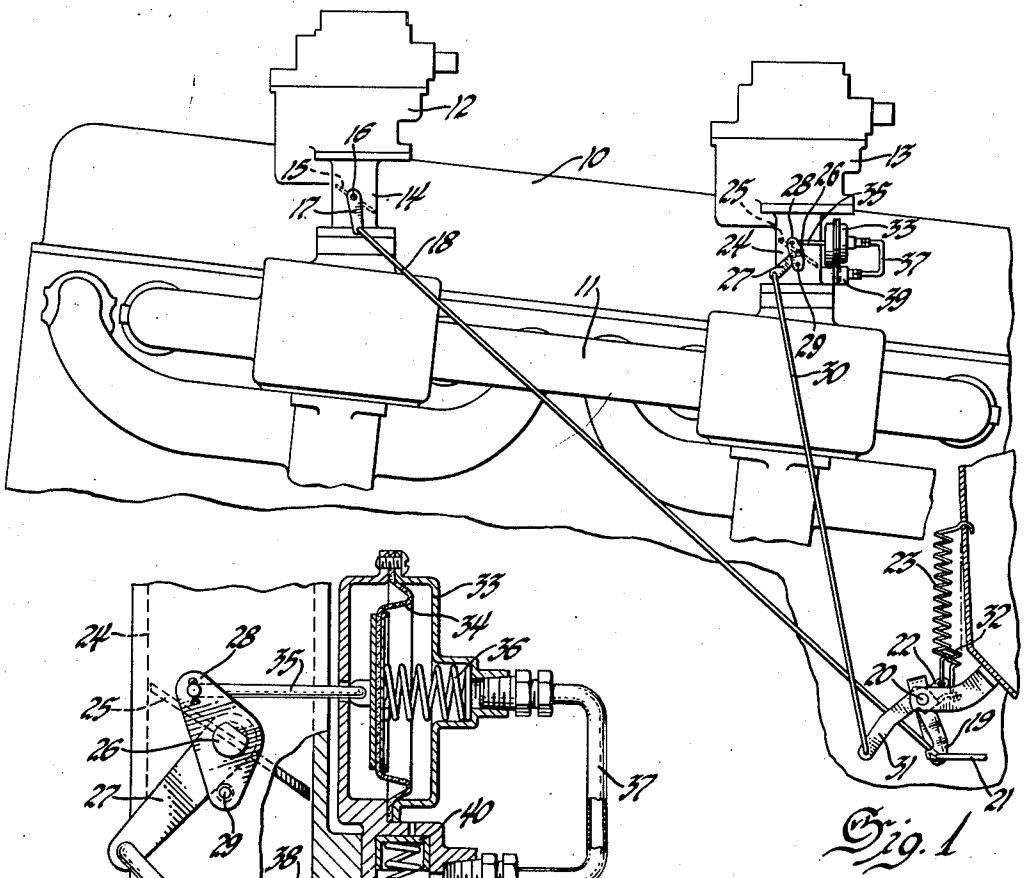


Fig. 1

Fig. 2

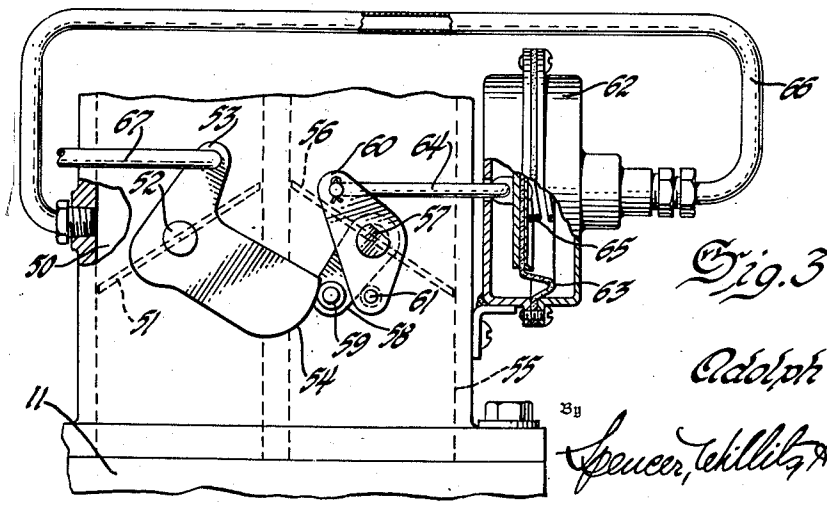


Fig. 3

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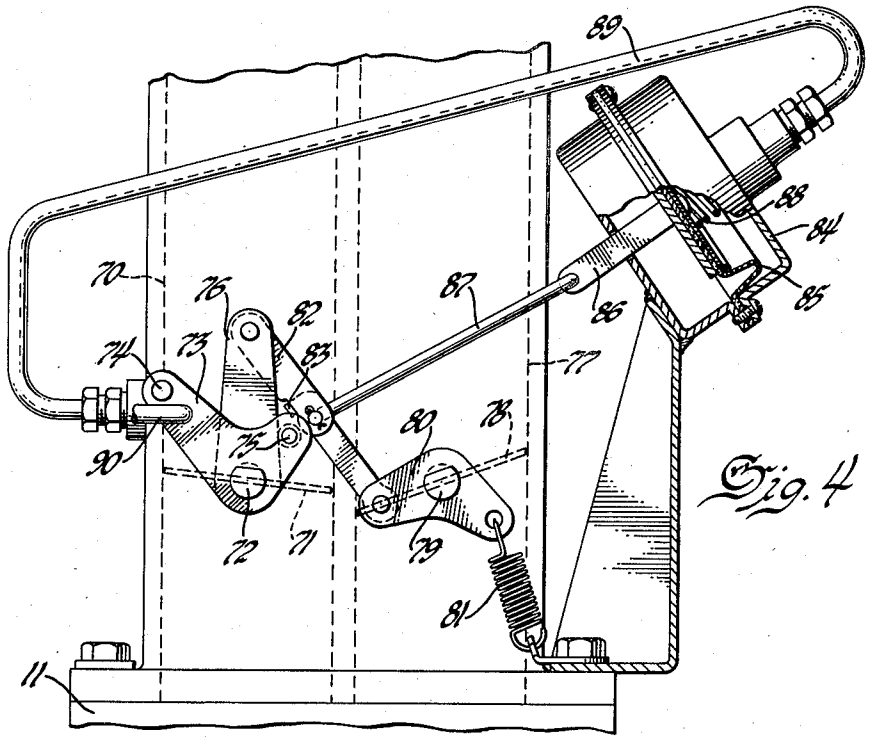


Fig. 4

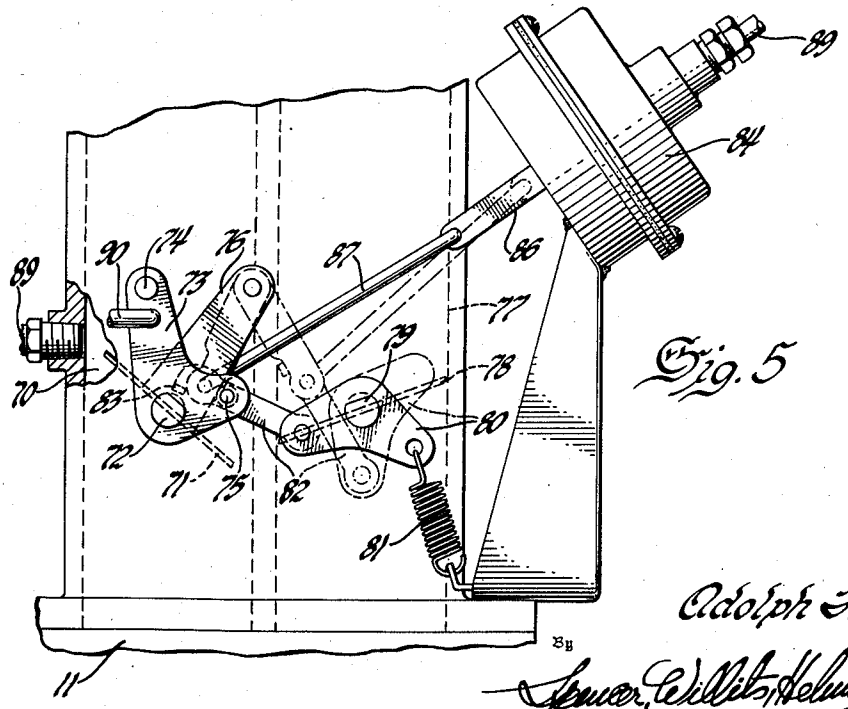


Fig. 5

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COMPOUND CARBURETION SYSTEM

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This invention relates to compound carburetion systems for internal combustion engines, i. e., carburetion systems which include a plurality of carburetors which communicate with the same cylinder or cylinders of the engine and are so controlled that when the engine is operating at lower speeds combustible mixture is supplied to the cylinder or cylinders by only one of the carburetors and when the engine is operating at higher speeds combustible mixture is supplied to the cylinder or cylinders by a plurality of the carburetors.

The invention resides in improvements in the compound carburetion system disclosed in my United States Patent No. 2,434,192, dated January 6, 1948, by which the secondary carburetor or carburetors are brought into operation with the minimum departure from the desired rate of acceleration of the speed of the engine, which minimize the discrepancies between the volumes of combustible mixture supplied to the several cylinders of a multi-cylinder engine, and which minimize the height of and render the carbureting apparatus more compact.

For a better understanding of the objects and nature of this invention, reference is made to the following specification and the accompanying drawing, wherein embodiments of the invention are described and illustrated.

In the accompanying drawing:

Figure 1 is a fragmentary side elevation of a multi-cylinder internal combustion engine equipped with carbureting apparatus in which my invention is embodied.

Figure 2 is an enlarged side elevation, with parts broken away and in section, of the secondary carburetor of the carbureting apparatus shown in Figure 1.

Figure 3 is a side elevation, with parts broken away and in section, of another embodiment of my invention.

Figures 4 and 5 are side elevations, with parts broken away and in section, of a third embodiment of my invention.

In the drawing, the reference character 10 indicates a multi-cylinder internal combustion engine with an intake manifold 11 which communicates with a plurality of the cylinders of the engine. On the intake manifold, forward of its midpoint, there is disposed a primary carburetor 12 and, to the rear of its midpoint, a secondary carburetor 13. The primary carburetor may be of the conventional type with a mixture passage 14 in which there is disposed a butterfly throttle valve 15 mounted on a shaft 16 to which

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there is fixed an arm 17. The arm 17 is connected by a link 18 to a lever 19 mounted so that it may rock on a shaft 20 and to which there is also connected a link 21 through which the lever 19 may be rocked by the accelerator pedal of the vehicle. To an arm 22 on the lever 19 there is connected a spring 23 which biases the throttle valve 15 to its closed position.

The secondary carburetor 13 includes a mixture passage 24 in which there is disposed a butterfly throttle valve 25 which is mounted on a shaft 26. On the shaft 26 there is mounted so that it may rock an arm 27. To the shaft 26 there is fixed a double-armed lever 28 with a pin 29 on one of its arms in the path of the arm 27 when the latter is moved in the direction to close the throttle valve 25. The arm 27 is connected by a link 30 to a lever 31 which is mounted so that it may rock on the shaft 20 in the path of the lever 19 when the latter is rocked to open the throttle valve 15. The lever 31 is biased by a spring 32 in the direction to move the arm 27 on the shaft of the throttle valve 25 of the secondary carburetor in the direction to close the throttle valve.

On the secondary carburetor 13 there is mounted a pressure responsive device which consists of an enclosure 33 with a flexible wall 34 which is connected by a link 35 to the arm of the lever 28 which does not carry the pin 29 and is biased by a spring 36 in the direction to close the throttle valve. The interior of the enclosure 33 is connected to the mixture passage of the secondary carburetor on the engine side of the throttle valve by a duct which includes a tube 37 and a bore 38 with a valve housing 39 interposed between them. In the valve housing 39, there is disposed a piston valve 40 which is biased by a spring 41 to a position in which the tube 37 communicates with the bore 38 through the valve housing 39 but is movable by suction in the manifold 11 to a position in which it interrupts communication between the bore and the tube.

The lever 19, of course, does not come into contact with the lever 31 until the throttle valve 15 of the primary carburetor has been opened to a pre-selected extent, e. g., about one half. Consequently, until the throttle valve of the primary carburetor has been opened to this extent the throttle valve 25 of the secondary carburetor is held closed by the spring 32.

However, after the throttle valve of the primary carburetor has been opened to the pre-selected extent, further movement of the ac-

celerator pedal in the direction to open the throttle valve of the primary carburetor will bring the lever 19 into contact with the lever 31 and, thereafter, move the latter with the former. This movement of the lever 31 will, through the link 30, move the arm 27 on the shaft of the throttle valve of the secondary carburetor out of contact with the pin 29 on the double-armed lever 28. The piston valve 40 is moved by the suction in the intake manifold 11 to a position in which it interrupts communication between the bore 38 and the tube 37 only when the suction attains the high values it attains when the throttle valves are closed or nearly closed and serves to eliminate the tendency which the suction acting through the diaphragm 34 would otherwise have to open the throttle valve of the secondary carburetor under this condition. Consequently, when the throttle valve of the primary carburetor has been opened sufficiently to move the arm 27 out of contact with the pin 29 the suction in the intake manifold will be applied to the diaphragm 34 and if the suction is sufficiently high will open the throttle valve of the secondary carburetor to the limit permitted by the arm 27. Therefore, after the throttle valve of the primary carburetor has been opened sufficiently to move the arm 27 out of contact with the pin 29 the position of the throttle valve of the secondary carburetor will depend upon the value of the suction in the intake manifold as well as upon the position of the throttle valve of the primary carburetor as is desirable in the interest of satisfactory operation of the engine under different loads. The movement of the arm 27 is so correlated with the movement of the throttle valve of the primary carburetor that the former reaches the position in which it permits the throttle valve of the secondary carburetor to be opened wide when the latter reaches its wide open position.

In the modification of the invention shown in Figure 3 of the drawing, the primary and secondary carburetors are juxtaposed and made in a single unit which is mounted on the intake manifold 11 of the engine midway between its ends. In the mixture passage 50 of the primary carburetor there is disposed a butterfly throttle valve 51 which is mounted on a shaft 52 to which is fixed an arm 53 which is connected by a link 67 to the accelerator pedal of the vehicle and on which is formed a cam 54.

In the mixture passage 55 of the secondary carburetor, there is disposed a butterfly throttle valve 56 which is mounted on a shaft 57. To the shaft 57 there is fixed an arm 58 with a pin 59 on it in the path of the cam 54 on the arm 53 when the latter is moved in the direction to close the throttle valve 51. On the shaft 57 there is mounted, so that it may rock, a double-armed lever 60 with a pin 61 on one of its arms in the path of the arm 58 when it is moved in the direction to close the throttle valve 56.

On the secondary carburetor, there is mounted a pressure responsive device which consists of an enclosure 62 with a flexible wall 63 which is connected by a link 64 to the arm of the lever 60 which does not carry the pin 61 and is biased by a spring 65 in the direction to close the throttle valve 56. The interior of the enclosure 62 is connected by a tube 66 to the mixture passage 50 of the primary carburetor on the atmospheric side of the throttle valve 51.

The cam 54 on the arm 53 on the shaft 52 of the throttle valve 51 of the primary carburetor is so shaped that it holds the throttle valve 56 of the secondary carburetor closed until the throttle valve of the primary carburetor has been opened to a pre-selected extent, e. g., about one-half, and, thereafter, permits the throttle valve of the secondary carburetor to open gradually as the throttle valve of the primary carburetor is opened and to be opened wide when the throttle valve of the primary carburetor reaches its wide open position. The connection of the tube 66 to the mixture passage of the primary carburetor on the atmospheric rather than the engine side of the throttle valve 51 obviates a valve like the valve 40 in the embodiment of the invention shown in Figures 1 and 2 in the duct which connects the interior of the enclosure 62 to the mixture passage. The embodiment of the invention shown in Figure 3 operates similarly to the embodiment shown in Figures 1 and 2 and it is thought that its operation will be understood without further explanation.

In the modification of the invention shown in Figures 4 and 5 of the drawing, as in the modification in Figure 3, the primary and secondary carburetors are juxtaposed and made in the same unit which is mounted on the intake manifold 11 of the engine midway between its ends.

In the mixture passage 70 of the primary carburetor, there is disposed a butterfly throttle valve 71 which is mounted on a shaft 72. To the shaft 72 there is fixed a double-armed lever 73 with pins 74 and 75 on its arms which is connected to the accelerator pedal of the vehicle by a link 90. On the lever 73 between and in the paths of the pins 74 and 75, there is mounted so that it may rock on the shaft 72 an arm 76.

In the mixture passage 77 of the secondary carburetor, there is disposed a butterfly throttle valve 78 which is mounted on a shaft 79 to which there is fixed a double-armed lever 80. To one arm of the lever 80, there is connected a spring 81 which biases the throttle valve toward its closed position. The other arm of the lever 80 is connected by a toggle 82 to the arm 76 which is mounted so that it may rock on the shaft 72 on which the throttle valve of the primary carburetor is mounted. An ear 83 on one of the links which constitute the toggle 82 prevents the toggle moving over center upwardly.

On the secondary carburetor, there is mounted a presssure responsive device which consists of an enclosure 84 with a flexible wall 85 which is connected to the toggle 82 by a rod 86 and a link 87 with a right-angularly disposed end portion which forms the pintle which connects the links which constitute the toggle. A spring 88 biases the diaphragm 85 in the direction to break the toggle 82 downwardly. The interior of the enclosure 84 is connected by a tube 89 to the mixture passage 70 of the primary carburetor on the atmospheric side of the throttle valve.

When an engine equipped with the embodiment of the invention shown in Figures 4 and 5 is not operating, the parts of the carbureting apparatus occupy the positions in which they are shown in Figure 4. The throttle valve of the primary carburetor is held closed by the usual spring which also, through the intermediaries of the pin 75 and the toggle 82 adds its force to that exerted by the spring 81 to hold the throttle valve of the secondary carburetor closed.

During the initial opening movement of the throttle valve 71 of the primary carburetor, the suction in the intake manifold 11 applied to the diaphragm 85 is insufficient to counteract the spring 88 and, therefore, as shown in solid lines

in Figure 5, the spring breaks the toggle 82 downwardly and the throttle valve 78 of the secondary carburetor remains closed. However, as the throttle valve of the primary carburetor is opened farther the suction of the intake manifold which is applied to the diaphragm 85 increases and counteracts the spring 88 and moves the pintle of the toggle in the direction to straighten the toggle as shown in dash-and-dot lines in Figure 5. When the throttle valve of the primary carburetor has been opened to a pre-selected extent which varies with the load on the engine, e. g., about one-half when the engine is operating under normal load, the pin 74 on the lever 73 will contact the arm 76. Thereafter, either a further increase in the suction of the intake manifold which is applied to the diaphragm 85 or further opening movement of the throttle valve of the primary carburetor will result in opening movement of the throttle valve of the secondary carburetor. The parts are preferably so correlated that when the engine is operating under normal load the throttle valve of the secondary carburetor will be opened wide when the throttle valve of the primary carburetor reaches its wide open position.

By the provision of the secondary carburetors and the correlation of the movement of their throttle valves with the movement of the throttle valves of the primary carburetors in the manners which have been illustrated and described, my invention insures satisfactory operation of the engine at relatively low speeds without sacrificing anything in the matter of operation of the engine at higher speeds. The throttle valves of the secondary as well as the primary carburetors are preferably balanced so that, per se, they are unaffected by the suction in the intake manifold. The provision of the throttle valves of this type in the secondary carburetors actuated by pressure responsive devices tends to bring the secondary carburetors into operation with the minimum departure from the desired rate of acceleration of the speed of the engine and the provision in the secondary carburetors of throttle valves of this type whose opening movement is limited in accordance with the position of the throttle valves of the primary carburetors obviates manually operated throttle valves in the secondary carburetors and thus minimizes the height of and renders the carburetors more compact. Disposition of the carburetors midway between ends of the manifold as in the embodiments of the invention shown in Figures 3, 4 and 5 minimizes the discrepancies between the volumes of combustible mixture supplied to the several cylinders of the engine.

I claim:

1. In an internal combustion engine which includes a cylinder, a primary carburetor through which a combustible mixture may be supplied to the cylinder, a throttle valve in the primary carburetor, means through which the throttle valve of the primary carburetor may be opened, a secondary carburetor through which a combustible mixture may be supplied to the cylinder, a throttle valve in the secondary carburetor, means through which the throttle valve of the secondary carburetor may be opened, a member of variable effective length which is interposed between the first specified means and the second specified means and abuts against the first specified means after the throttle valve of the primary carburetor has been partly opened, and a pressure responsive device to which the suction of the engine is communicated for increasing the effective length of the member and opening the throttle valve of the secondary carburetor after the throttle valve of the primary carburetor has been partly opened.

2. In an internal combustion engine which includes a cylinder, a primary carburetor through which a combustible mixture may be supplied to the cylinder, a throttle valve in the primary carburetor, means through which the throttle valve of the primary carburetor may be opened, a secondary carburetor through which a combustible mixture may be supplied to the cylinder, a throttle valve in the secondary carburetor, means through which the throttle valve of the secondary carburetor may be opened, a toggle which is interposed between the first-specified means and the second-specified means and abuts against the first-specified means after the throttle valve of the primary carburetor has been partly opened, and a pressure responsive device to which the suction of the engine on the atmospheric side of the throttle valve of the primary carburetor is communicated connected to the toggle to straighten it and open the throttle valve of the secondary carburetor after the throttle valve of the primary carburetor has been partly opened.

3. A charge forming device comprising primary and secondary carburetors having passages therein for supplying combustible mixtures to the cylinders of an internal combustion engine, primary and secondary throttles in said passages to control the supply of said mixtures to said cylinders, means for opening said primary throttle to a position within a variable range of positions the limits of which are controlled by the operation of the engine, means actuated by the pressure difference between the atmosphere and a passage leading to one of said throttles for determining the limits to said range of positions under various conditions of operation of said engine, means for holding said secondary throttle in closed position during the operation of said primary throttle in said range of positions, and means operable by the movement of said primary throttle beyond said range of positions for opening said secondary throttle.

4. A charge forming device comprising primary and secondary carburetors having passages therein for supplying combustible mixtures to the cylinders of an internal combustion engine, primary and secondary throttles in said passages to control the supply of said mixtures to said cylinders, means for opening said primary throttle to a position within a variable range of positions the limits of which are controlled by the operation of the engine, means actuated by the pressure differences between the atmosphere and a passage leading to said primary throttle for determining the limits to said range of positions under various conditions of operation of said engine, means for holding said secondary throttle in closed position during the operation of said primary throttle in said range of positions, and means operable by the movement of said primary throttle beyond said range of positions for opening said secondary throttle.

5. A charge forming device comprising primary and secondary carburetors having passages therein for supplying combustible mixtures to the cylinders of an internal combustion engine, primary and secondary throttles in said passages to control the supply of said mixtures to said cylinders, means for opening said primary throttle to a position within a variable range of posi-

tions the limits of which are controlled by the operation of the engine, means actuated by the pressure difference between the atmosphere and a passage leading to one of said throttles for determining the limits to said range of positions under various conditions of operation of said engine, means for holding said secondary throttle in closed position during the operation of said primary throttle in said range of positions, means operable by the movement of said primary throttle beyond said range of positions for opening said secondary throttle, and means for closing said secondary throttle in response to a decrease in pressure in said passage leading to said one of said throttles below the limit required to open said secondary throttle in response to said movement of said primary throttle.

6. A charge forming device comprising primary and secondary carburetors having passages therein for supplying combustible mixtures to the cylinders of an internal combustion engine, primary and secondary throttles in said passages to control the supply of said mixtures to said cylinders, a lever having spaced abutment means thereon and rigidly secured to said primary throttle for opening and closing said primary throttle, an arm movable about the axis of said primary throttle and between said abutment means, a lever secured to said secondary throttle for opening and closing said secondary throttle, resilient means associated with said secondary throttle and tending to retain said secondary throttle in closed position, means connecting the end of said arm with said secondary throttle lever for opening said secondary throttle in response to engagement between said arm and one of said stops and during the opening movement of said primary throttle, and means associated with said connecting means and operative in response to the flow of fluid in one of said passages leading to said throttles for determining the position at which said abutment engages said arm.

7. A charge forming device comprising primary and secondary carburetors having passages therein for supplying combustible mixtures to the cylinders of an internal combustion engine, primary and secondary throttles in said passages to control the supply of said mixtures in said cylinders, means for opening said primary throttle to a position within a range of positions for said primary throttle, means for holding said secondary throttle in closed position during the operation of said primary throttle in said range of positions, means operable by movement of said primary throttle beyond said range of positions for opening and closing said secondary throttle, and means operable in response to the flow of fluid in one of said passages to said throttles for controlling said last mentioned means.

8. A charge forming device comprising primary and secondary carburetors having passages therein for supplying combustible mixtures to the cylinders of an internal combustion engine, primary and secondary throttles in said passages to control the supply of said mixtures to said cylinders, means for opening said primary throttle to a position within a range of positions for said primary throttle, means for holding said secondary throttle in closed position during the operation of said primary throttle in said range of positions, means operable by movement of said primary throttle beyond said range of positions for opening and closing said secondary throttle, and means responsive to the difference in pressure between the atmosphere and said passage leading to said primary throttle for controlling said opening and closing movements of said secondary throttle by said last mentioned means.

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