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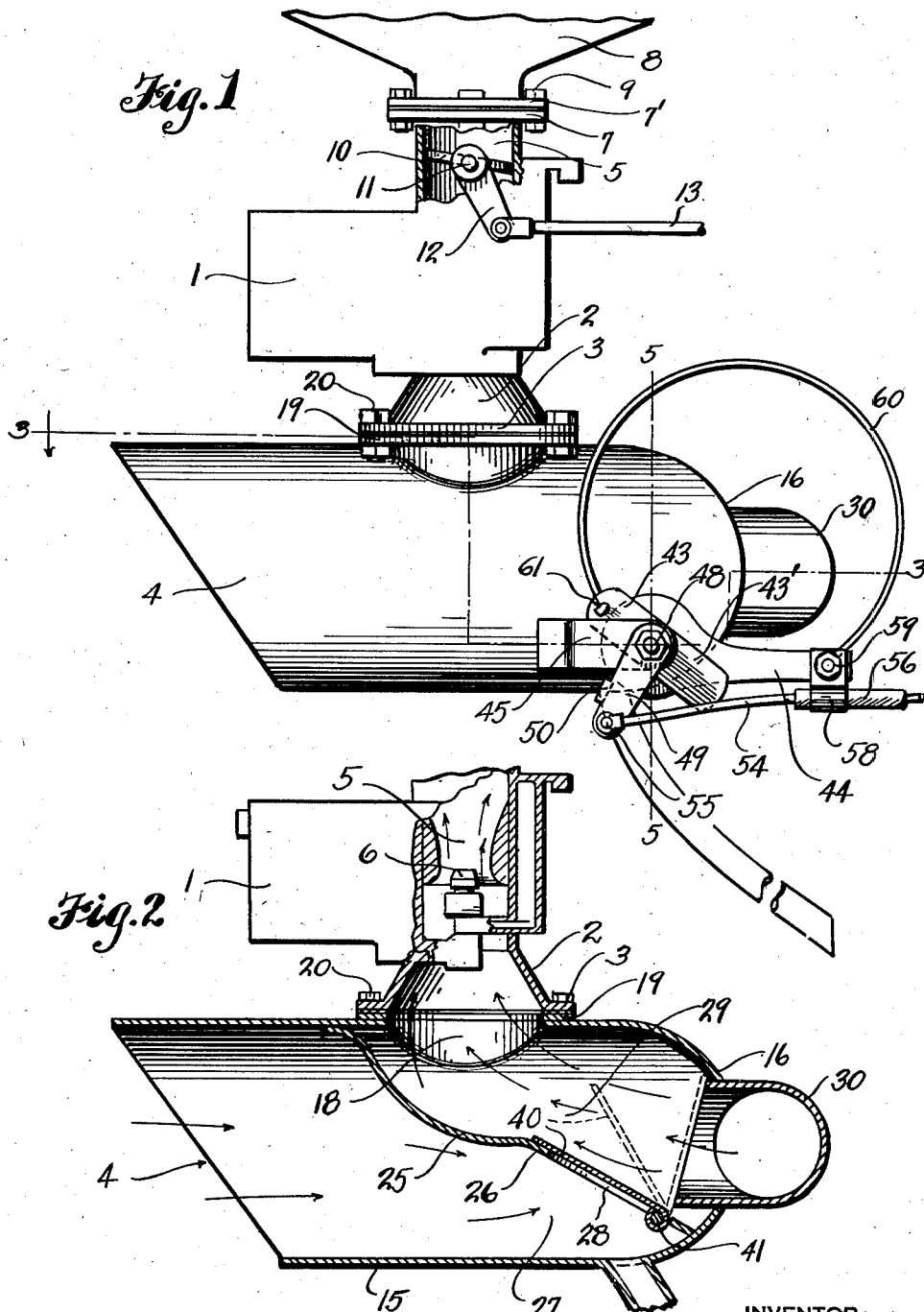
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2,388,028

AIR SCOOP FOR AIRPLANE ENGINES.

Filed March 14, 1942

2 Sheets-Sheet 1



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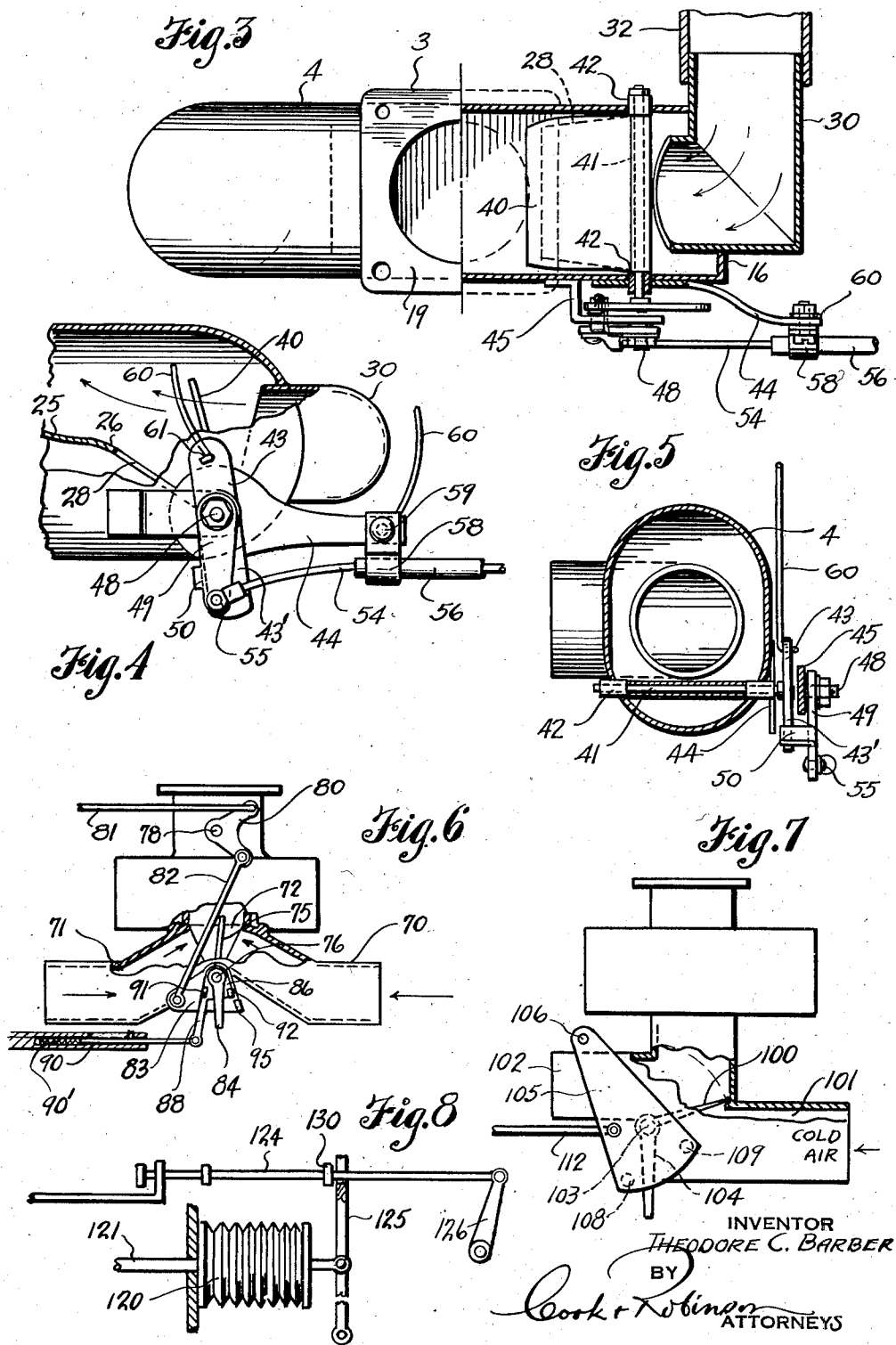
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UNITED STATES PATENT OFFICE

2,388,028

AIR SCOOP FOR AIRPLANE ENGINES

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2 Claims. (Cl. 261-14)

This invention relates to airplane engine accessories, and has reference more particularly to improvements in devices as now quite generally used with the carburetors of airplane engines, for the controlled admittance of heated air to the air intake horn of the carburetor.

It will here be explained, as matter pertinent to a better understanding of the present invention, that for various reasons quite well known to those familiar with the art to which this invention applies, it is desirable that provision be made for supplying heated air to the air intake port or air horn that supplies air to the engine's carburetor. Also, as is well known, it is desirable to control, or determine a proportionate admittance of the hot air in accordance with certain conditions, involving relative humidity or temperature or both of these, since the exclusive use of outside, or cold air might cause ice to form in the carburetor throat with detrimental or destructive results. Such formation of ice can be avoided, or in case it has formed, it can be melted away by the admittance of hot air into the air stream flowing to the carburetor's air horn.

Furthermore, it will be here mentioned, but without setting forth the reasons, that it is extremely desirable to admit warm air to the carburetor whenever the carburetor throttle valve is closed, and the engine is idling; for example, such as is the usual case when gliding to a landing or when practising stalls, spins, and the like.

Furthermore, it has been disclosed that many engine stalls leading to accidents, have resulted merely because, when gliding to a landing, the pilot did not open the valve to admit hot air to the carburetor with the closing of the throttle valve of the carburetor.

In those devices sometimes referred to as air scoop, now in general use as a means to facilitate the supplying of atmospheric air to the carburetor, a hot air connection is provided therewith and the admittance of heated air therefrom to the air stream supplying the carburetor is determined and controlled by the setting of a butterfly valve in the scoop. This valve is adjustable to definite opposite limits to admit either all cold air, or all hot air to the carburetor, or it may be set and held at various positions that are intermediate those limits for the admittance of a mixture of various proportioned amounts of hot and cold air. It is to be explained, however, that in all present-day devices, or scoops, to my knowledge, these adjustments of the air flow control valve must be manually accomplished, and therefore the human element enters the operation. It

is due to this human element that so many avoidable accidents have resulted. Such, for example, the forgetting by the pilot to open the hot air valve to the carburetor at the time the throttle valve was closed with the resultant stalling of the engine.

In view of the foregoing, it has been the principal object of his invention to improve air scoop devices by the provision of means for the automatic actuation of the hot air control valve in the hot air connection, whereby it will be caused to open automatically for the admittance of hot air to the carburetor incident to every closing of the carburetor throttle valve, and which will move toward its closed position to cut off the hot air flow in accordance with the extent of vacuum or suction created with the opening of the throttle valve and the flow of cold or outside air to the carburetor.

It is also an object of this invention to provide a manually controlled means for limiting the closing action of the hot air valve at any definite position, but without interference with the provision for its automatic movement to full open position, to close off the admittance of cold or outside air and to supply only hot air to the carburetor.

More specifically stated, the principal object of this invention is to improve upon devices now generally in use for control and delivery of hot air to the carburetors of airplane engines by the provision of means for effecting an automatic control of the hot air valve, insofar as it concerns the opening movement of the valve to admit hot air with the closing of the carburetor throttle valve, and an additional means for manually setting the valve for controlling and determining the inflow of cold and hot air in proportionate amounts when such is desired.

Still further objects of the invention are to be found in the details of construction of the air scoop, in its preferred form as well as in its various modifications, as will hereinafter be fully explained.

In accomplishing these and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is a side view of an air scoop, embodying improvements in accordance with the present invention, and showing the device as applied to the carburetor of an airplane engine and connected with the hot air supply tube.

Fig. 2 is a vertical section, taken longitudinally of the air scoop at its axial center.

Fig. 3 is a horizontal section taken substantially on the line 3—3 in Fig. 1.

Fig. 4 is a detail illustrating use of the manually operable means for limiting the closing action of the hot air control valve.

Fig. 5 is a cross section on line 5—5 in Fig. 1.

Figs. 6, 7 and 8 are views diagrammatically illustrating alternative means for automatic control of the hot air delivery to the carburetor.

Referring more in detail to the drawings—First, describing the improved construction and application of the air scoop illustrated in Figs. 1 to 5:

1 designates a typical form of, or any suitable carburetor, adapted to be used in connection with an airplane engine for supplying fuel charges thereto. This carburetor has a downwardly opening air horn 2, flanged about its lower end as at 3, for the attachment thereto of the air scoop of the present invention which is designated in its entirety by reference numeral 4.

The air horn 2 of the carburetor supplies air to the air passage 5 therein which contains the fuel atomizing nozzle 6, located therein within the usual Venturi passage, as noted in Fig. 2. At the upper end of the passage 5, the carburetor body is formed with an encircling flange 7 to facilitate its attachment to the complementary flange 7' of the engine's fuel intake manifold, which in Fig. 1, has been designated by reference numeral 8. Bolts 9, through the flanges, secure the carburetor and scoop in place. Also, there is located in the air passage of the carburetor, above the Venturi passage and nozzle, a throttle valve 10, which is supported by a pivot shaft 11 extended to the outside of the carburetor and there equipped with a lever arm 12 to which an actuating rod 13 is attached; it being understood that the rod 13 extends to or is connected with means accessible to the airplane pilot for the control of the valve to regulate the speed of the engine to which fuel is supplied.

The air scoop 4, as here shown, comprises a horizontally disposed tubular body portion 15, which, as noted in Fig. 2, is open at its forward end to permit a direct inflow of outside air and is closed at its rearward end by a wall 16; it being understood that in the flight of an airplane, the scoop is directed forwardly. In the top wall of the scoop, approximately midway between its front and rearward ends, is an opening 18 about which a flange plate 19 is welded or otherwise secured to the scoop body. This flange has an opening therethrough that registers with the lower end opening of the horn 2, and the flange 19 is fitted to the base flange 3 of the air horn and the two are securely joined together by bolts 20.

Disposed within the air scoop is a partition wall 25. This wall joins with the top wall of the scoop, as shown best in Fig. 2, just forwardly of the opening 18, and curves downwardly and rearwardly therefrom and is joined with the opposite side walls, and terminates at its lower, rearward edge, in a horizontal flange 26 that is transverse of the scoop passage, approximately vertically aligned with the rearward limit of the opening 18, and about halfway between the top and bottom walls of the scoop. Thus, below the partition wall 25 there is a passage 27 for inflowing cold air or what may be referred to as outside air, leading to an opening 28 into a forwardly directed passage 29 above the partition wall.

The passage 29, as observed in Fig. 2, communicates at its forward end directly to the air horn 2 through the opening 18, and at its rear end, it has direct communication with the open end of a hot air supply tube 30.

As observed in Fig. 3, the hot air supply tube 30 enters through the rear wall 16 of the air scoop and as it leaves the scoop, is formed with a lateral bend to which a hot air supply tube or duct 32 is connected.

It will here be explained that hot air, or heated air, may conveniently be supplied by utilizing the engine's heat, and can be drawn to the air scoop through the duct 32. One means for storage of hot air would be provided by formation of an enclosing chamber or housing about the exhaust manifold of the engine. However, heated air might be supplied in any other suitable manner.

The admittance of hot air to the carburetor, or the admittance of cold air thereto, or the admission of a mixture of cold and hot air in various proportionate amounts, is governed by the disposition of a butterfly valve 40 that is located within the air scoop. This butterfly valve comprises a flat metal plate that is fixed across its lower edge to a rotatably mounted cross shaft 41 extended through the opposite side walls of the scoop near the bottom wall, and just forward of the hot air inlet. The valve rod 41 is mounted by and is revoluble in bearings 42—42, which are set in the side walls of the scoop, as best illustrated in Figs. 3 and 5, and at one end, just outside of the scoop wall, this shaft is equipped with an actuating cross arm comprising the oppositely directed upper and lower end portions 43 and 43'.

It will here be explained that the valve plate 40, as mounted by the cross shaft 41, is adapted to swing to a position against the flange 26, thus to close off inflow of cold air to the carburetor, but to completely open the hot air passage. Also, it may be swung to its opposite limit, flatly against the end of the hot air pipe 30, as seen in dotted lines in Fig. 2, to close off the hot air and completely open the cold air passage. At intermediate positions, this valve 40 will admit proportioned amounts of cold and hot air as determined by its particular setting.

By reference more particularly to Fig. 3, it will be observed that a bracket 44 is fixed to the side wall of the air scoop and extended rearwardly and outwardly therefrom to a position approximately even with the rear end of the scoop. Another bracket 45 is fixed to the side wall of the scoop forwardly of the shaft 41, and this extends directly outward from the scoop, then is turned rearwardly, and at a point axially aligned with the shaft 41, it is equipped with an outwardly directed pivot stud 48. Pivotaly mounted to swing on the stud 48 is a downwardly directed lever arm 49. This lever arm is movable independently of the cross head, comprising the arms 43 and 43', fixed to shaft 41. However, it is formed near its lower end with an inwardly turned wing or lug 50, shown best in Fig. 5, which is adapted to be engaged with the forward edge of the arm 43' to serve as a limiting stop for the forward swinging action of the latter, thus to hold the valve 40 against closing beyond a predetermined extent, toward the hot air inlet.

A flexible control wire 54 is operatively attached to the lower end of the arm 49, as seen at 55 in Fig. 1, and this wire extends slidably through a guide tube 56 to a position adjacent the

pilot, where it may be equipped with any suitable means for making and retaining its adjustment.

As observed in Figs. 3 and 4, the tube 56 is held at one end in a clamp 58 that is secured by a bolt 59 to the rear end of the bracket 44. It will also be observed that a spring wire 60 is formed in a circularly curved loop and attached at its ends, under expanding tension, to the bolt 59 and to the upper end of the lever arm 43, as at 61, thus to at all times urge the arm 43 forwardly, and thus yieldingly urge the valve plate 40 toward a position closed over the cold air inlet 26, thereby to close off cold air flow to the carburetor.

It is to be here explained, however, that the tension of the spring 60 is so predetermined that when the throttle valve of the carburetor is opened, the suction that is created by the operation of the engine and transmitted to the air horn of the carburetor augmented by air pressure directed into the open end of the housing 4, will operate to move the valve 40 to an open position for the admittance of cold air. The tension of the spring may be so determined that, if desired, the valve 40 will open at a predetermined opened position of the throttle valve, but in accordance with the objects of this invention, the spring should at all times be sufficiently strong to close the valve 40 against inflow of cold air, and to provide a full open passage of flow of hot air to the carburetor whenever the throttle valve is completely closed.

In the event that it should for any reason be desired to limit the closing of the valve 40 toward the hot air inlet thus to admit a certain proportionate amount of hot air with the cold air, as is quite commonly done, this is accomplished by the manual adjustment of the lever arm 49 through the pull wire 54 by the pilot. For example, the rearward adjustment of the lever 49 from its forward limit at which it is shown in Fig. 1, to that of Fig. 4, limits the closing of the valve 40 toward the hot air inlet at the dotted line position indicated in Fig. 4; this being by reason of the fact that the inwardly directed wing 50 on the arm 49 then operates as a limiting stop against which the forward edge of the arm 43' engages to determine the extent of closing of the valve 40 toward the hot air inlet. It will be understood also that the proportionate amounts of incoming hot air and cold air may be regulated as desired, through the manual control of lever 49, which establishes the closing of valve 40 toward the hot air inlet. However, should the operator, at any time, completely close the throttle valve 10, the valve 40 will automatically move to a position for closing off the inflow of cold air and provide full opening for the delivery of hot air to the carburetor because the stop 50 is effective only in one direction of movement of valve 40.

In Fig. 6, I have shown an alternative construction, in which the automatic valve action is incorporated. In this view, the carburetor is indicated as being equipped with a cold air inlet 70 which might correspond to that of the air scoop, and a hot air passage 71 converging and opening to a common opening 72 which supplies air to the carburetor. Pivotaly mounted at the junction of the cold and hot air passages 70 and 71, is a butterfly valve 75, supported by a shaft 76. The butterfly valve, as supported, may swing to opposite limits to completely close off the hot air or cold air respectively, as delivered through the ducts 70 and 71 to opening 72. The throttle valve mounting shaft 78 of the carburetor is equipped with a bell

crank lever 80, to one arm of which an actuating rod 81 is connected. The other arm of this bell crank is connected by a rod 82 with a triangular bell crank plate 83 which has free pivotal mounting about the shaft 76 or a pivot coaxial thereof. Thus, with the actuation of the throttle valve, the plate 83 is rocked accordingly.

Fixed to the shaft 76 of the butterfly valve 75 is a downwardly depending control lever arm 84, and pivoted on an axis coaxial of shaft 76 is a second triangular plate 86 having a downwardly extended actuating arm 88 to which a rod 90 from the dash board is extended for its control. On the plate 86 at opposite sides of the arm 84, are lugs 91 and 92, and also on the plate 83 at the side opposite the connection of rod 82, is a lug 95. By means here shown, the operator may, through the pull rod 90, effect a manual setting of the plate 86 whereby, through one or the other of the lugs 91 and 92, a setting of the butterfly valve may be accomplished with reference to the extent of opening of the hot air inlet, and through the connection 82 and bell crank 80 with the throttle valve, insure the automatic opening of the hot air passage and complete closing of the cold air passage whenever the throttle valve is moved to its closed position; it being understood that, with this setting of the throttle valve, the lug 95 engages lever 84 to actuate valve 75. However, in order to eliminate any possibility of interference in this operation that might result from a certain setting of the plate 86 and lug 91, the rod 90 includes a telescoping assembly held yieldingly in extension by an inserted spring 90'.

In Fig. 7, I have illustrated another arrangement wherein a butterfly valve 100 is arranged at the junction of a cold air duct 101, and a hot air duct 102 opening to the carburetor, and may be moved to position to close off the flow of air from either one to the carburetor. This valve 100 is mounted by a revoluble supporting rod 103 to which a lever arm 104 is attached. A triangular plate 105 is disposed adjacent the arm 104 and has a pivotal support at its upper corner, as at 106. The lower swinging end of the plate extends to opposite sides of the arm 104 and has spaced lugs 108 and 109 at its corners and located to engage opposite sides of the lever arm. A dash connection 112, which may be a wire or rod, is attached to the plate. Thus the operator, by moving the plate, may positively move the butterfly valve to desired positions of adjustment, yet with plate 105 at a neutral position, the valve 100 will have a free floating action that will allow it to close the cold air inlet due to gravity whenever the suction is nullified by reason of closing the throttle valve of the carburetor.

In Fig. 8 is still another modification, wherein a flexible bellows 120 is connected by a tube 121 with the suction manifold of the engine, thus to cause the bellows to expand or contract in accordance with the degree of suction. The bellows has connection with a pivoted lever 125 to cause the lever to move in accordance with the bellows action. Also, there is a rod 124 connected with the hot air control valve lever 126. The rod 124 may be manually shifted endwise to open or close this hot air valve. Also, the lever 125 is arranged to engage a stop 130 on the rod to automatically open the hot air valve incident to the contraction of the bellows that is incident to increased suction due to complete closing of the throttle valve.

With the air scoop constructed and applied as shown in Figs. 1 to 5, it is quite apparent that

the hot air control valve may be manually manipulated, as has previously been done, but will automatically adjust itself to close off cold air and open the hot air duct with the closing of the throttle valve.

In view of the modifications shown, it is quite apparent that I do not wish to be limited in my claims to details, but intend that the claims shall be given an interpretation that is commensurate with the invention disclosed.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is:

1. An air scoop of the character described, comprising a housing having an open end pointed in the direction of flight for forced inflow of atmospheric air and having a partition wall therein setting off a suction chamber; said partition wall having an opening therein for the direct and forced inflow of atmospheric air incident to flight, and said suction chamber having a protected inlet for connection with a source of supply of heated air, and having an outlet adapted for connection with the air suction passage of a carburetor; a shaft rotatably mounted in the chamber, a valve member fixed on the shaft to swing between opposite limits at which, respectively, it overlies the partition opening to resist pressure of and inflow of atmospheric air in flight, and the heated air inlet, a spring member acting on the shaft to yieldingly urge the valve member toward its position for closing the open-

ing against the inflow of atmospheric air, and a movable stop member adapted to be manually adjusted to different positions for determining the extent of movement of the valve member toward closing off the entrance of heated air to the chamber.

2. An air scoop of the character described, comprising a housing open at its forward end for the forcible inflow of atmospheric air in flight and having a partition wall therein setting off a suction chamber; said partition wall having an opening therein for the direct inflow of atmospheric air, and said suction chamber having an inlet for connection with a source of supply of heated air, and having an outlet adapted for connection with the air suction passage of a carburetor; a shaft rotatably mounted in the chamber, a valve member fixed on the shaft to swing between opposite limits at which, respectively, it overlies the partition opening, and the heated air inlet, a lever arm on the shaft, a spring mounted on the housing and acting on the arm to urge the valve toward position closed against admission of atmospheric air, a second lever arm mounted to swing on an axis coaxial of the valve shaft, and having a stop projecting into the path of travel of the first lever, and means for manually adjusting the second mentioned lever to determine the extent of travel of the valve toward the heated air inlet.

THEODORE C. BARBER.