Oct. 7, 1930. G. S. C. HUFFAM ET AL 1,777,971

AUTOMATIC BRAKING AIR ADMISSION VALVE FOR AUTOMOBILE ENGINES

Filed Dec. 6, 1926 2 Sheets-Sheet 1

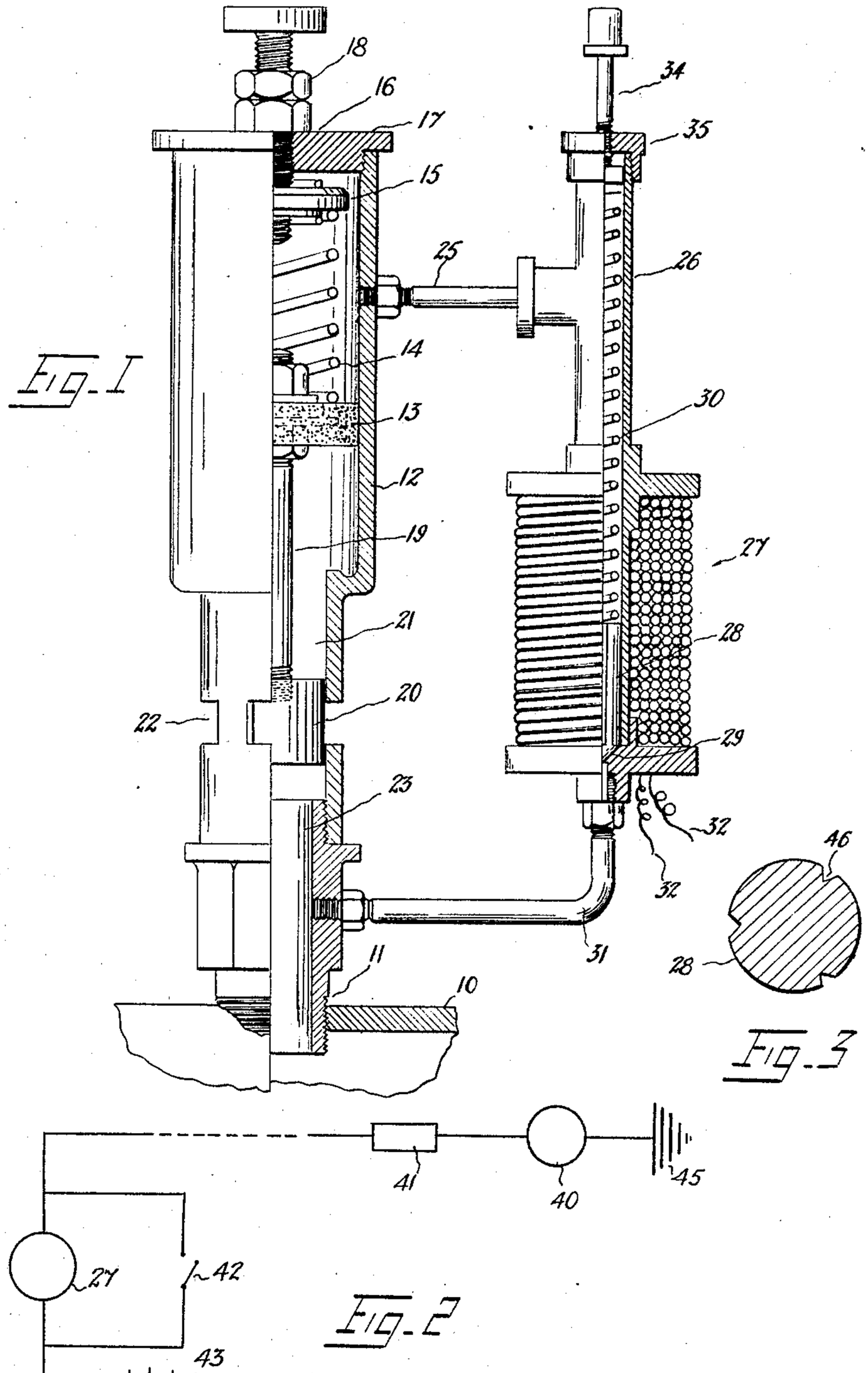

Fig. 1

Fig. 3

Fig. 2

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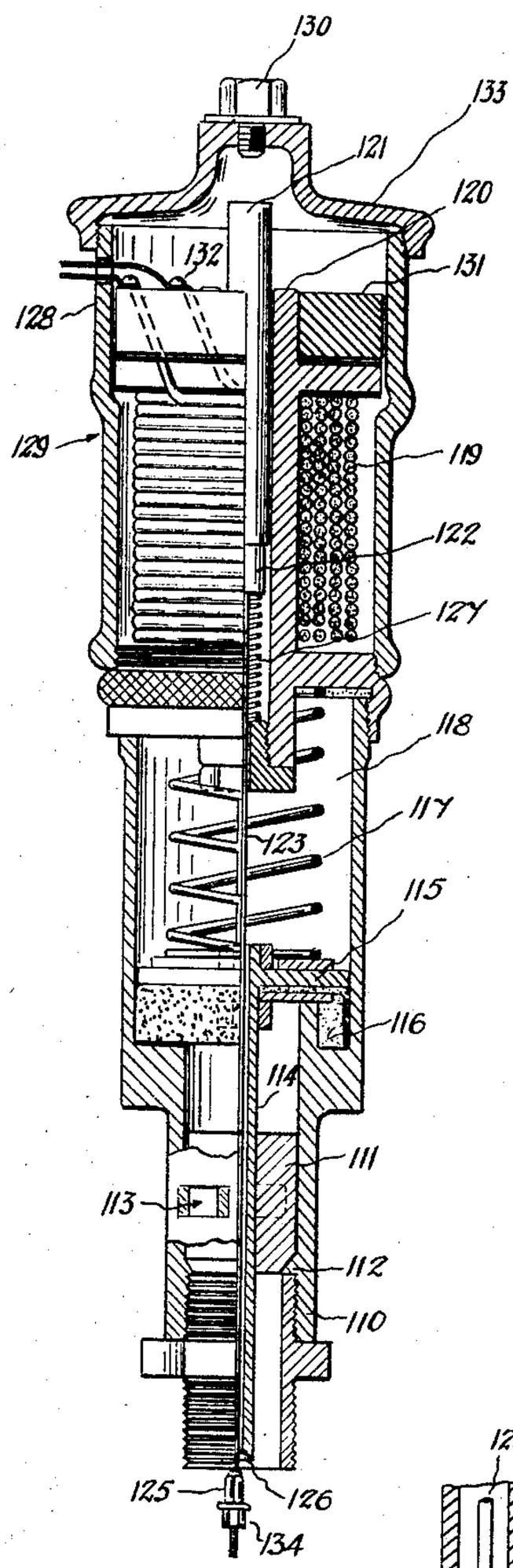

Fig. 4

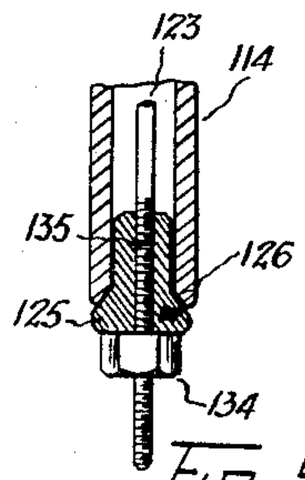

Fig. 5

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UNITED STATES PATENT OFFICE

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AUTOMATIC BRAKING-AIR-ADMISSION VALVE FOR AUTOMOBILE ENGINES

Application filed December 6, 1926, Serial No. 152,996, and in Australia December 8, 1925.

This invention consists in an attachment for automobile engines and it has been devised with the object of providing effective means for admitting braking air into the engine manifold under coasting conditions, that is to say when the throttle valve is closed and the car is running by gravity on a descending grade with the engine in gear. The desirable condition which is sought to be attained is the automatic shut down of the braking air admission valve at all times whilst the throttle is open either at idling or running, and its automatic opening under coasting conditions.

Under idling conditions the vacuum depression in the manifold of an internal combustion engine is somewhat less than the vacuum depression in the manifold under coasting conditions, but it is in excess of the manifold depression under running conditions. This is explained by the fact that the vacuum depression resulting from the piston movements is broken in some measure proportionately to the degree of throttle opening. As the throttle is opened only very little under idling conditions the depression is reduced by only a small degree, but as under running conditions the throttle is open in a substantial measure, the vacuum depression is further reduced. The margin of difference between the vacuum depression under idling conditions and under some running conditions, is, however, small and cannot always be depended upon for controlling a valve. The invention, therefore, includes accessory means for ensuring certainty in the opening and closing movements of an air valve fitted to admit air to the manifold so that it will operate to close the air admission port absolutely whilst the engine is idling and to open it positively when the engine is turning over at a fast rate and the throttle is closed. This governing means is also fitted with a cut-out which functions to ensure the holding closed of the air valve under running conditions thus to enable the driver of a car to ensure that free air will not pass into the manifold except under coasting conditions. In this specification the term "coasting", which is ordinarily used to indicate running on a down grade with the gear in neutral, is used to refer to the running of a car on a down grade with the gear in and the throttle shut, so that the engine load is utilized for its braking effect to retard the car's movement.

In the accompanying drawing:—

Fig. 1 is a half sectional elevation of the attachment;

Fig. 2 is a circuit diagram;

Fig. 3 is a transverse section through the electromagnet armature.

It is usually desirable to house the solenoid in the same casing as the air valve, and the piston. An arrangement in which this is done is shown in Figs. 4 and 5.

Fig. 4 is a half sectional elevation; and

Fig. 5 is a fragmentary enlarged section of the auxiliary valve in the foot of the fitting shown in Fig. 4.

10 is the induction manifold. The nipple end 11 of the attachment in which the invention consists is screwed into the manifold 10 at any convenient position therein intermediate the carburetter head and the engine valves. 12 is a cylinder, 13 a bucket piston working in the cylinder 12, 14 a loading spring acting upon the piston to force it downward, 15 a cap abutment for the top end of the spring 14, 16 an adjusting screw working through a tapped hole in the cover 17 of the cylinder 12, and 18 a lock nut. 19 is a piston rod and 20 a piston valve fixed on the bottom end of the rod 19 and working in a tubular throat 21 concentric with the cylinder 12. 22 are lateral ports through the side of the tubular throat 21. When the valve 20 is lifted air may pass through the ports 20 and thence through the tubular centre portion 23 of the nipple 11 into the manifold 10.

The cylinder 12 is connected above the top stroke position of the piston 13 through a pipe 25 with the closed tubular head 26 on the frame of a solenoid 27. The armature 28 (see Fig. 3) is slidable vertically through the core of the solenoid and its bottom end is coned to act as a valve which bears on a seating 29. A helical spring 30 in compression holds the armature valve 28 down

on the seating 29. The seating port is connected to the manifold by a small pipe 31. As shown, this pipe is led into the nipple 11, this being a convenient and compact arrangement. 32 and 33 are the terminal connections of the solenoid winding. 34 is a screw working in a tapped hole in the cap 35 of the tubular head 26; it serves for adjusting the tension load on the spring 30.

The diagram, Fig. 2 describes the circuiting arrangement, assuming that the equipment of the car is of the six volt and single contact ("earth return") type. 40 is the generator, 41 the generator cut-out, 27 the solenoid, 42 a short circuiting switch around the solenoid winding, 43 is the battery, and 44—45 are earth or frame connections. The armature 28 is grooved or fluted as shown at 46, Fig. 3 to allow air to pass from the seating 29 upwardly through the head 26 and pipe 25 to and from the top end of the cylinder 12.

The operation is as follows:—

The short circuiting switch 42 being open, the solenoid windings 27 are in series with the circuit of the generator 40. Under idling conditions, the generator, depending upon its adjustment, delivers little or no current to the circuit. Consequently the solenoid is not energized and the armature valve 28 is held down in the seating 29 and the valve 20 is forced down by the spring 14, closing the ports 22 and preventing ingress of atmospheric air through those ports to the manifold 10. Under coasting conditions the generator delivers current, usually at about 10 amps. rate into the line; this current flowing through the solenoid coils 27 energizes the solenoid so that its armature 28 is lifted against the compression of the spring 30. The depression in the manifold thus acting through the pipe circuit 31 and 25 and the core and head portion of the solenoid frame produces an equal depression above the piston 13. The piston 13 is thus caused to rise, compressing the spring 14. In its rising movement it lifts the piston valve 20 and opens the ports 22, thus admitting air through the ports 22 and the nipple 23 to the manifold. So long as under running conditions the vacuum depression is not sufficient to lift the piston 13 against the load of the spring 14, the valve 20 remains closed. If, however, due to any cause during running conditions the vacuum depression becomes sufficiently high to lift the piston 13, the driver may cut-out the solenoid 27 by closing the switch 42, thus ensuring that the valve 28 will remain closed on the seat 29 and so prevent establishment of a vacuous condition in the upper end of the cylinder 12, whereby the piston 13 would be lifted and the valve 20 opened. The driver is thus enabled to ensure that the attachment will not function to admit air to the manifold under running conditions and at the same time it is ensured automatically that air may be admitted for braking purposes under coasting conditions and that air will not be admitted to the manifold under idling conditions.

The foot of the casing at 110 is screwed externally so that it may be fitted into a tapped hole in the inlet manifold. As shown, an adapter nipple is fitted into the bottom end of the casing. The air valve 111 is provided with a ring seating 112 in the casing 110, and the casing 110 is laterally ported as shown at 113 above the seating 112. The valve 111 is a free fit in the lower part of the casing which is bored cylindrically, the fit being made free in order to minimize risk of sticking of the valve due to interference by dust. When the valve is lifted automatically, air is drawn in through the ports 113 and passes under the valve 111 through the seating 112 and through the nipple adjuster into the manifold.

The valve 111 is fixed on a tubular rod 114 on the top end of which a piston 115 is formed or fitted. This piston is preferably provided with a leather bucket packing 116 but it might be made as a close fitted metal piston with labyrinthine rings, or it may be otherwise packed. A helical spring 117 in compression is contained in the cylinder 118 in which the piston 115 works. This spring bears down on the piston, forcing the tubular rod 114 downward and holding the valve 111 on its seating 112. 119 is the winding of a solenoid, and 120 is the solenoid spool which may be of brass or like non-magnetic metal. Within the spool 120 the soft iron armature 121 is freely movable. The bottom end of this armature sits on a cap 122 from which depends a light rod 123 which passes downwardly through the tubular rod 114 and is fitted on the lower end of it with an auxiliary valve 125. The valve 125 seats on a face 126 formed on the bottom end of the tubular rod 114. The valve 125 is positioned on the stem rod 123 by screwing at 135 and locking it by means of a lock nut 134, facility for neat adjustment being thus offered. Below the cap 122 is fitted a helical spring 127 in compression. This spring supports the cap 122, forcing up the stem rod 123 and holding the auxiliary valve 125 shut. The body portion of the valve 125 is fluted in order that air may freely pass it when its head is moved off its seating 126. The spring 127 is tensioned to hold the valve 125 closed, notwithstanding that the atmospheric depression in the inlet manifold tends to pull it open. The solenoid is relied on to apply movement to the valve 125 to open it, and the spring 127 is relied on to close the valve 125 automatically and to hold it closed.

The terminals of the winding 125 are

brought out through the upper section 128 of the casing 129. These wires are connected in series into the circuit of the car generator. The generator current consequently traverses the coil 119 and when a current of sufficient value passes, the armature 121 is pulled downward, compressing the spring 127, forcing down the cap 122 and the stem rod 123, and thus opening the valve 125. 130 is a check pin which limits the upward movement of the armature 121. As shown in Fig. 4, the spring 127 is partially compressed and the valve 125 is open. 131 is a block of insulating material adapted to carry the line terminals 132 which are screwed into it. The casing is conveniently made in three portions, namely, the lower portion containing the valve casing and the air cylinder, the mid ring portion which includes the solenoid spool, and the top portion 129 which encloses the solenoid and carries the cap 133.

The operation is as follows:—

Under idling conditions the output of current by the generator is very small or the generator circuit is entirely broken at the automatic cut-out; consequently the flux of current through the solenoid coils 119 is insufficient to energize the solenoid so as to move the armature 121. The armature 121 is therefore at top position, the spring 127 is extended, and the valve 125 is closed on its seat. The vacuum depression in the manifold tends to hold the valve 111 closed on its seat 112, and free air does not therefore enter the manifold. When the car is running under load at a speed exceeding about 10 miles per hour, the generator, according to the adjustment of its brushes or other controls, delivers current at a rate which is sufficient to energize the solenoid and cause it to force down the armature 121 and thus open the valve 125, provided that the tension of the spring 127 is sufficiently relaxed to permit it to be compressed by the armature action. The spring 127 is tensioned to hold the valve 125 closed when the current at a low rate only is passing through the solenoid windings and it is not stiff enough to resist the armature pressure upon it under ordinary running conditions when the generator is delivering current at a normal rate.

Upon the opening of the valve 125 the cylinder 118 is connected to the manifold through the tubular rod 114 and a condition of partial vacuum is established in the cylinder 118. The atmospheric pressure acting below the piston 115 then tends to force that piston upward and thereby lift the valve 111 so as to open the ports 113 and allow atmospheric air to pass under the valve 111 past the seat 112 into the manifold, but the piston 115 in rising must compress the loading spring 117. The tension of that spring is adjusted so that it resists compression corresponding to the degree of vacuum in the cylinder 118 under driving conditions. When the carburetter throttle is open more or less the atmospheric depression in the manifold is correspondingly reduced. The atmospheric depression in the cylinder 118 will therefore vary according to the degree of throttle opening. With a wide open throttle a low degree of vacuum only will exist in the cylinder 118, but if the throttle be fully closed whilst the car is in motion, the gear being left engaged, maximum atmospheric depression will exist in the manifold and in the cylinder 118, and this depression will be enough to compress the spring 117 and allow the piston 115 to rise. Consequently, given a proper adjustment of the tension of the spring 117, the piston 115 will be raised by pneumatic action only under coasting conditions and will not be raised under running conditions. The valve 111 will therefore be opened only under coasting conditions, and only under these conditions will free air be admitted via the ports 113 into the manifold.

To provide, however, against weakening of the spring 117 and to ensure that the air valve 111 cannot open under load running conditions, the line terminals of the solenoid may be short circuited by a hand switch placed conveniently for operation by the driver. With the solenoid coil thus short circuited the armature 121 will not be moved and the valve 111 will then remain held on its seat by the pressure of the spring 117 acting above the piston 115 and also by the atmospheric load above it which tends to bear it down on the seat 112.

An arrangement is thus provided whereby the supply of air for braking purposes can be controlled entirely automatically with a check against accidental operation. The engine will not get air under idling conditions or whilst running under load with the throttle partially or fully opened, but it will get a full supply of braking air into the manifold if the car be running in gear at any ordinary driving rate with the carburetter throttle closed.

What we claim as our invention and desire to secure by Letters Patent is:—

1. An attachment for automatically supplying free air to automobile engines under coasting conditions, comprising a casing adapted to be connected into the engine manifold, a cylinder in said casing, a spring loaded piston in said cylinder, a normally closed air admission valve operated by said piston, a check valve controlling a passage from the manifold to the interior of the cylinder, electromagnetic means for opening said check valve to procure evacuation of air from the cylinder to the manifold and so permit the piston and the air admission valve to be

lifted by atmospheric pressure when the depression in the manifold is in excess of that produced by operation of the engine running idle or running under load.

2. An attachment for automatically admitting free air to automobile engines under coasting conditions, including a piston, an air admission valve operated thereby, a check valve controlling a passage from the manifold to the cylinder in which the piston works, electromagnetic means for opening said check valve to evacuate air from the cylinder to open the air valve, said means adapted to be included in a circuit in which the strength of the current varies with the engine speed.

3. An attachment according to claim 1 characterized in that the air admission valve is fully closed when the engine is running idle or running under load and is automatically opened by pneumatic action to admit free air to the manifold only under coasting conditions.

4. An attachment according to claim 1 in which the check valve in the cylinder manifold connection is normally closed, and is opened only when the magnetic flux from the electromagnet is in excess of a predetermined measure.

5. An attachment for automatically supplying free air to automobile engines, comprising a tubular casing adapted to be connected into the manifold at one point only, a cylinder in said casing, an air admission valve, a piston for operating said valve, a passage through the stem of the piston connecting the cylinder with the manifold, a check valve normally closing said passage, electromagnetic means for opening said check valve to evacuate air from the cylinder to allow the piston to be lifted by atmospheric pressure beneath it and thereby open the air admission valve.

6. An attachment according to claim 1, wherein the air valve is automatically opened only when the magnetic flux from the electromagnet is in excess of a predetermined measure and the depression in the manifold is in excess of that produced by the operation of the engine running idle or running under load.

7. An air admission attachment comprising a casing containing a tier of three chambers, a valve seat and a valve co-acting therewith in the bottom chamber, a spring loaded piston in the intermediate chamber connected by a tubular rod to said valve, and a solenoid coil in the top chamber, an auxiliary valve co-acting with a valve face formed on the bottom end of said tubular rod, and having a stem extending up through said tubular rod into the top chamber, a spring supporting said auxiliary valve on its seat, and an armature within the solenoid arranged to force said auxiliary valve open when the solenoid is energized.

In testimony whereof we affix our signatures.

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