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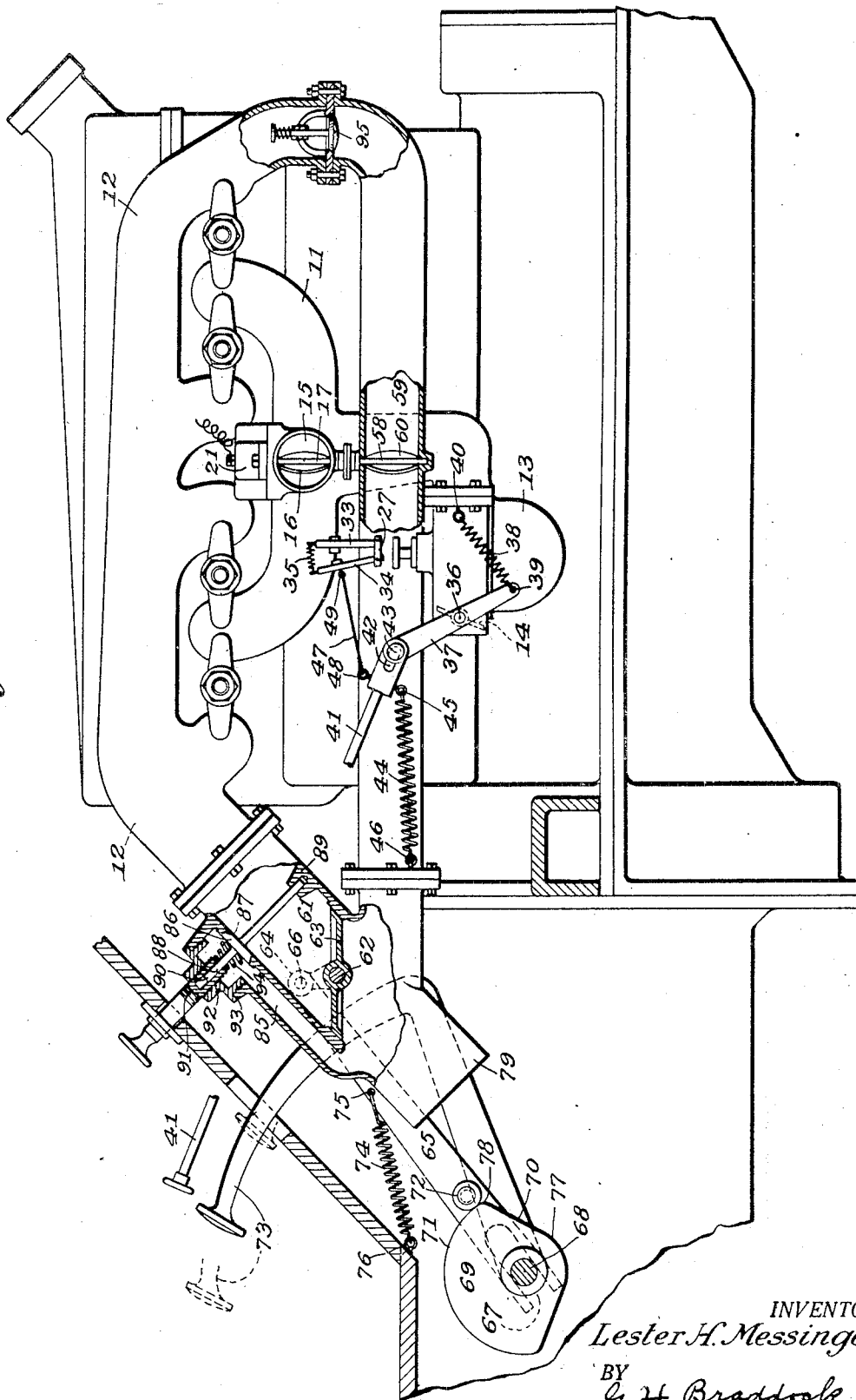
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1,890,790

BRAKING ATTACHMENT FOR INTERNAL COMBUSTION ENGINES

Original Filed April 15, 1926 3 Sheets-Sheet 1

Fig. 1



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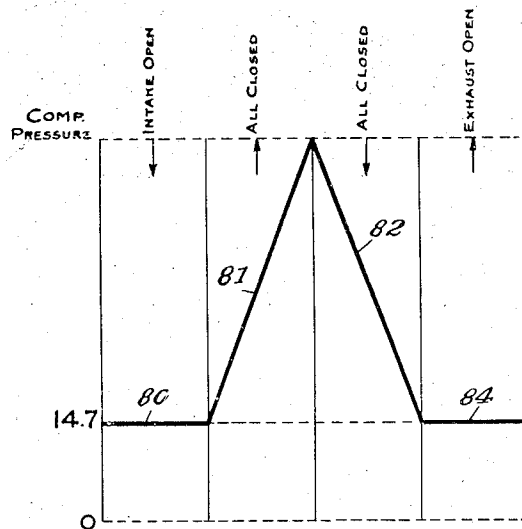
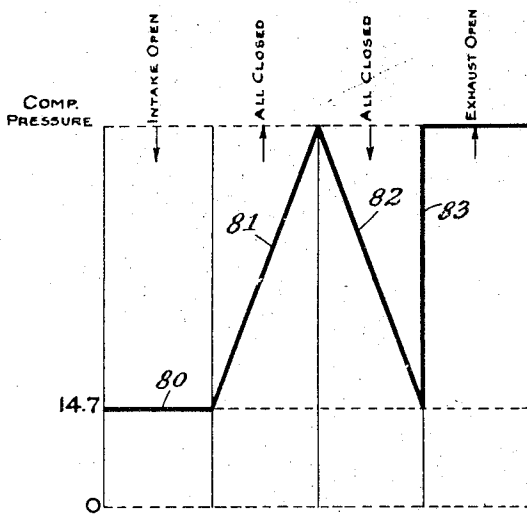
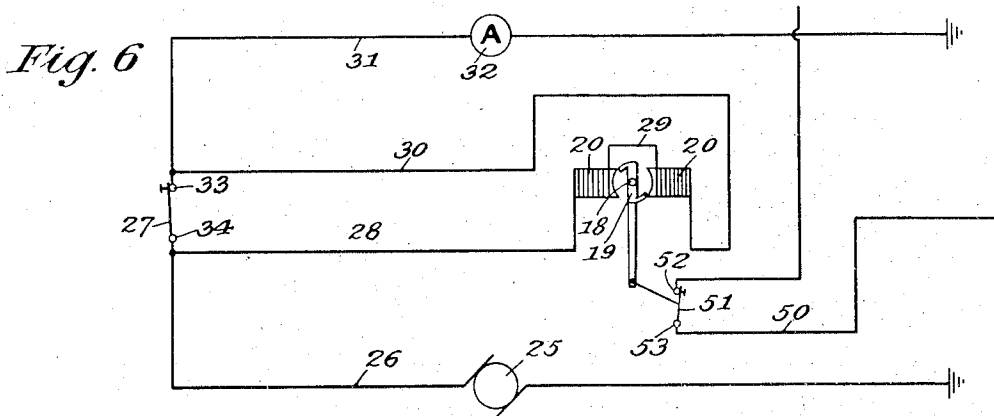
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BRAKING ATTACHMENT FOR INTERNAL COMBUSTION ENGINES

Application filed April 15, 1926, Serial No. 102,346. Renewed January 13, 1932.

This invention relates to a braking attachment for internal combustion engines, and has more particular reference to a braking attachment for the engines of automotive vehicles.

The broad object of the invention is to provide an attachment for internal combustion engines adapted to the purpose of closing the exhaust line at times when it is desired to build up pressure in the engine cylinders adapted to retard the upward or return advancement of the pistons, whereby to produce a braking action against said pistons.

It is a practice of automotive vehicle operators at the present time to keep the right foot either upon the ordinary brake or throttle and to not use the clutch except when coming to a complete stop, simply releasing the throttle (thus allowing the engine to be driven by the automotive vehicle) acting as a fairly good brake, and the careful driver is apt to use this method in slowing down for street intersections, down grades, etc., in order to save his brake bands.

A more specific object of the invention is to provide an attachment for an explosive engine of an automotive vehicle adapted to the purpose of closing the exhaust line at times when the throttle is retarded and the engine is being driven by the automotive vehicle, to thus build up pressure in the exhaust line adapted to be communicated to the engine cylinders to retard the upward or return advancement of the pistons when it is desired to produce a braking action against said pistons in addition to the ordinary braking action with throttle retarded and exhaust gas outlet open.

In my application for patent Serial No. 102,347 filed April 15, 1926, I have disclosed an attachment for an automotive vehicle engine adapted to provide the cylinders with air at atmospheric pressure at times when the vehicle is propelling the engine and the throttle is in its idling position, in order that explosive mixture cannot enter the cylinders when said vehicle is driving the engine, and that the air at atmospheric pressure will provide pressure in the cylinders preventing

the drawing of lubricating oil into the combustion chambers.

A further specific object of the present invention is to provide an attachment for an internal combustion engine of an automotive vehicle which will include means for supplying the cylinders with fluid at atmospheric pressure when the throttle is in its idling position and the vehicle is propelling the engine, and mechanism for closing the exhaust line at times when fluid at atmospheric pressure is being supplied said cylinders (with throttle retarded and vehicle propelling engine) and it is desired to build up pressure in the exhaust line adapted to be communicated to the engine cylinders to retard the upward or return advancement of the pistons on their exhaust strokes to produce a braking action against said pistons in addition to the ordinary braking action with throttle retarded and exhaust gas outlet open.

A further specific object is to provide an attachment for an internal combustion engine of an automotive vehicle which will include means for supplying the cylinders with air at atmospheric pressure in such manner that explosive mixture cannot enter when the throttle is in its idling position and the vehicle is propelling the engine, and mechanism for closing the exhaust line at times when air at atmospheric pressure is being supplied said cylinders (with throttle retarded and vehicle propelling engine) and it is desired to build up pressure in the exhaust line adapted to be communicated to the engine cylinders to retard the upward or return advancement of the pistons on their exhaust strokes to produce a braking action against said pistons in addition to the ordinary braking action with throttle retarded and exhaust gas outlet open.

A further specific object is to provide means in the improvement for regulating the pressure which can be produced in the exhaust manifold, to thus control the magnitude of the braking action.

A further specific object is to provide an interconnection between said means for supplying the cylinders with air at atmospheric pressure and said mechanism for closing the

exhaust line adapted to make certain that when said means is inoperative the exhaust line will be open, in order that no pressure can be built up in the exhaust manifold when the cylinders are receiving explosive mixture, and hence, there can be no explosions in said exhaust manifold.

A further specific object is to provide a braking attachment as stated, which will include novel and improved features and characteristics of construction designed to render the attachment efficient and capable in the performance of its intended functions.

With the above objects in view, as well as others which will appear as the specification proceeds, the invention comprises the construction, arrangement, and combination of parts as now to be fully described and as hereinafter to be specifically claimed, it being understood that the disclosure herein is merely illustrative and intended in no way in a limiting sense, changes in details of construction and arrangement of parts being permissible so long as within the spirit of the invention and the scope of the appended claims.

In the accompanying drawings forming a part of this specification:

Fig. 1 is a side elevational view, partly in section, disclosing the improvement as applied to an automotive vehicle and engine;

Fig. 2 is a fragmentary sectional view of a cylinder, an exhaust manifold, and an intake manifold of the engine of the vehicle, detailing parts of the improvement, the interconnected valves being disclosed positioned as when the auxiliary air inlet is open and an outlet of the exhaust manifold is closed;

Fig. 3 is a view corresponding with the disclosure of Fig. 2, but with the interconnected valves reversed; that is to say, the interconnected valves are positioned as when the auxiliary air inlet is closed and said mentioned outlet of the exhaust manifold is open;

Fig. 4 is a plan view of parts of the improvement;

Fig. 5 is a sectional view as on line 5—5 in Fig. 4, the parts above the magnet housing being not sectioned;

Fig. 6 is a diagrammatic view disclosing a wiring system to be utilized in connection with the improvement;

Fig. 7 is a diagrammatic view illustrating the manner in which the improvement functions to increase pressure in engine cylinders and thus create braking action; and

Fig. 8 is a diagrammatic view illustrating the pressures in an ordinary automotive vehicle engine of commerce.

With respect to the drawings, 10 represents the cylinders of an internal combustion engine of a character ordinarily applied to automotive vehicle use, 11 the intake manifold, 12 the exhaust manifold, 13 the carburetor, and 14 the throttle valve.

Numerals 15 denotes an auxiliary air inlet

adapted to communicate with the intake manifold, which is, preferably, spaced from the carburetor a sufficient distance to preclude the possibility of drawing gaseous fuel into the cylinders when the auxiliary inlet is open to take in atmospheric air.

The auxiliary air inlet 15 is normally closed by a butterfly valve 16 in said inlet, 17 indicating a shaft rotatably mounted in said auxiliary air inlet 15 and upon which the butterfly valve is fixed. See Figs. 2, 3 and 5.

An extension 18 of the shaft 17 fixedly carries an armature 19 of a magnet 20 in a housing 21 of ordinary or preferred structure. A lever 22 also fixed upon the extension 18 has secured to it one end of a coil spring 23 the other end of the spring being secured to the magnet housing 21 as at 24.

It is the service of the coil spring 23 to hold the lever 22 toward the left in Fig. 4 of the drawings to keep the butterfly valve 16 in position to close the auxiliary air inlet, and it is the service of the magnet, when energized to a sufficient extent, to act upon the armature 19 to rotate the shaft 17 to the open position of the butterfly valve 16, against the action of the spring 23 and to maintain said valve open.

The magnet 20 can be energized only when the throttle valve 14 is retarded, and said magnet is adapted to have sufficient power to actuate the armature 19 against the action of the coil spring 23 only when a throttled down engine is being driven by a force other than explosions in its cylinders, as when a vehicle is driving a throttled down engine.

Referring more particularly to Fig. 6, I have there disclosed a wiring system to be utilized in connection with the improvement. In said figure, 25 is a generator, 26 is a lead wire from said generator to the movable contact of a switch 27, 28 is a lead wire from said switch 27 to the magnet 20, 29 is a wire connecting the poles of said magnet, 30 is a lead wire from the magnet to the fixed contact of the switch 27, and 31 is a lead wire from said switch 27 to the ammeter 32. Clearly, with the switch 27 open, a current will flow through the magnet, via the leads described, from generator to ammeter, to energize the magnet, but by closing the switch 27, the circuit will be shunted, and the magnet will lose its energy.

Referring more particularly to Fig. 1, the switch 27 there shown is suitably mounted upon the vehicle and consists of a fixed contact 33 and a pivoted contact 34, a coil spring 35 normally urging said contacts toward each other to close the switch. 36 is a shaft of the carburetor upon which the throttle valve 14 is fixed, and 37 is a throttle valve actuating lever fixed upon said shaft 36, a coil spring 38 secured at one of its ends 39 to the lever 37 and at its other end 40 to a part of the car-

buretor normally urging the throttle valve to its retarded position. 41 is a throttle actuating rod suitably mounted upon the vehicle and having an elongated slot 42 in its lower end which pivotally and slidably receives a pin 43 upon the upper end of the lever 37. A coil spring 44 fixed to the rod 41 as at 45 and to a part of the engine as at 46, normally urges the rod 41 rearwardly to hold the lower end of the slot 42 in engagement with the pin 43. A cable or rod 47, secured at one of its ends 48 to the throttle actuating rod and at its other end 49 to the pivoted contact 34, serves to normally hold the pivoted contact 34 out of engagement with the fixed contact 33, the spring 44 being stronger than the spring 35. Preferably, the spring 44 urging the throttle actuating rod to position the pin 43 in the lower part of the elongated slot 42 is considerably stronger than the spring 38 urging the throttle valve closed, in order that considerable pressure will be necessary to move the throttle actuating rod ahead to allow the switch 27 to be closed by the spring 35 and that switch will not be liable to become accidentally closed, say, for example, by the weight of the foot, when this is not intended.

It will be clear that the magnet 20 will be in the circuit having the generator and the ammeter at all times when the throttle actuating rod is retarded as in Fig. 1 to open the switch 27, and that when the throttle is so retarded, the auxiliary air inlet of the attachment will be open provided the magnet is energized to an extent sufficient to overcome the action of the coil spring 23. Clearly, the magnet can have sufficient power to overcome the spring 23 under any desired and predetermined condition. For example, the magnet can be stronger than the spring 23 so long as the engine speed is at or above a predetermined speed, and said spring 23 can act when the engine speed is below said predetermined speed. This certain speed would ordinarily be that speed just above the speed at which the engine would normally operate with throttle retarded, so that when this speed of engine is reached and the throttle is retarded, as when a vehicle is driving the engine, the auxiliary air inlet is open, but at all other times it is closed.

It is desirable that when the throttle actuating rod (positioned as in Fig. 1) is advanced, the movable contact 34 engages the fixed contact 33 to shunt the circuit away from the magnet before the throttle valve 14 starts to open, to thus insure a feed of gaseous fuel at the commencement of opening of said throttle valve, as will be understood. This is the purpose of the elongated slot 42.

It is preferable that the ignition circuit be open at all times when the auxiliary air inlet is open. In Fig. 6 the ignition circuit is denoted 50, and includes a switch 51 adapted

to be actuated when the butterfly valve 16 is actuated. In Figs. 4 and 5 the manner of actuation of the switch 51 is clearly disclosed. 52 is a fixed contact of said switch 51 upon the housing of the magnet 20, and 53 is a movable contact thereof pivoted upon said housing at 54. 55 is a connecting rod secured at 56 to the movable contact 53 and at 57 to the lever 22. When the valve 16 is closed, the contacts 52 and 53 are engaged, but the instant the lever 22 moves with the valve 16 as it commences to open, the contacts 52 and 53 are moved apart to break the ignition circuit.

It will be evident that when the throttle is retarded and a vehicle is driving the engine, the auxiliary air inlet 15 will be open so that no gaseous fuel can be drawn via the carburetor, and so that air approximately at atmospheric pressure will be freely supplied to the cylinders.

Mechanism, now to be described, is provided for closing the exhaust line at times when air at atmospheric pressure is being supplied the cylinders, with throttle retarded and a vehicle propelling the engine, and it is desired to build up pressure in the exhaust line, which pressure is adapted to be communicated to the engine cylinders to retard the upward or return advancement of the pistons on their exhaust strokes to produce a braking action against said pistons in addition to the ordinary braking action against said pistons produced when the throttle is retarded and the exhaust gas outlet is open.

Numeral 58 denotes an extension of the shaft 17 opposite the armature 19, said extension 58 being rotatably mounted in a passage 59 leading from the exhaust manifold 12 and having fixed thereon a butterfly valve 60 set with respect to the butterfly valve 16 in such manner as to open said passage 59 when the auxiliary air inlet is closed, and to close said passage 59 when said air inlet is open. See Figs. 1, 2, 3 and 5.

Numeral 61 indicates a second passage from said exhaust manifold 12, and 62 represents a shaft rotatably mounted in the passage 61 and having fixed thereon a butterfly valve 63 adapted to be actuated to close said passage 61. 64 is an arm upon the shaft 62 to which a link 65 is pivoted as at 66. The lower end of the link 65 has a longitudinal slot 67 receiving a service brake shaft 68 which fixedly carries a cam 69 including a forward, cam surface 70 merging in circumferential surface 71. A roller 72 upon the link 65 and above the longitudinal slot 67 is adapted to ride upon the cam surface 70 and the circumferential surface 71, while the link 65 is adapted to move longitudinally from and toward the service brake shaft 68, said shaft, naturally, riding in the slot 67. 73 is the usual service brake lever fixed upon the shaft 68.

A coil spring 74 fixed upon the link 65 as

at 75 and upon a fixed part as at 76 normally holds said link in its lowest position, with the butterfly valve 63 in open position and the roller 72 resting upon the lower portion 5 77 of the cam surface 70, while ordinary actuation of the service brake lever 73 is adapted to rotate the cam 69 to cause the roller 72 to ride up the cam surface 70 to thus close the valve 63 when at the upper end 78 of said 10 surface, as disclosed in Fig. 1. Thereafter, the service brake lever 73 can be further depressed to complete the service braking, the links 65 then remaining stationary while the circumferential surface 71 rides beneath the 15 roller 72, as will be understood. Means (not shown) can return the service brake lever 73 to its normal position. The passages 59 and 61 lead to a common outlet 79.

So long as the auxiliary air inlet 15 is 20 closed and explosive mixture is being fed to the cylinders, no real braking action upon the part of the engine is required, and it is desirable that the exhaust line be open in order that there will not be explosions in the 25 exhaust manifold. In the present improvement the butterfly valve 60 will be in position to open the exhaust line so long as the auxiliary air inlet is closed. However, all of the braking action possible on the part of the 30 engine is desirable when the throttle is retarded and the vehicle is driving the engine. At this time, and at this time only, the auxiliary air inlet 15 will be open to feed air at atmospheric pressure to the cylinders, and 35 the valve 60 will be in the closed position of the passage 59. Then, when the service brake lever 73 is actuated to close the valve 63 during the commencement of its movement and the passage 61 is closed, the exhaust line will 40 be shut off. Naturally, the exhaust gases and air driven from the cylinders will quickly build up pressure in the exhaust gas manifold adapted to communicate with the cylinders during the exhaust strokes of the pistons 45 to retard their return or upward movement. Clearly, there can be no explosions in the closed exhaust manifold, because during the interval of building up pressure in said manifold, only atmospheric air, and no gaseous 50 fuel, is being supplied to the cylinders. As soon as either condition (throttle retarded, or vehicle driving engine) terminates, the valve 16 closes the inlet 15 and the valve 60 opens the passage 59, and immediately the 55 braking action caused by pressure in the exhaust line terminates. It will be seen that the present improvement is adapted to assist the braking action until a vehicle has slowed down to that speed just above which it is 60 driving the engine.

The diagram in Fig. 7 will make clear the manner in which the present improvement communicates pressure from the exhaust line to a cylinder to resist the exhaust stroke of 65 the piston. At 80 is represented air at at-

mospheric pressure taken into a cylinder upon the intake or suction stroke. At 81 is denoted the mounting pressure reached upon the compression stroke. At 82 is indicated the decreasing pressure in the cylinder upon 70 the power stroke. And at 83 is represented the pressure communicated to the cylinder upon opening the exhaust valve with the exhaust line closed. In Fig. 8 I have disclosed a diagram of pressure in the cylinder of an 75 internal combustion engine with exhaust line open. Numerals 80, 81, and 82 represent the same pressures as in Fig. 7, while 84 indicates atmospheric pressure in the exhaust manifold. 80

The pressure built up in the exhaust line can be any pressure which may be suitable or preferred under a particular set of conditions. A device for controlling this pressure 85 may be constructed as disclosed in Fig. 1. In said figure, 85 is a by-pass from the passage 61 to the outlet 79 and around the butterfly valve 63, and 86 is a valve normally covering an opening 87 between said passage 61 and said by-pass. A stem 88 having said 90 valve 86 is slidably mounted in a protuberance 89 within the passage 61 and at its other end 90 in an adjusting screw 91 itself threaded into a fitting 92 screwed into the by-pass as at 93. A coil spring 94 upon the stem 88 95 and between the valve 86 and the adjusting screw serves to hold said valve 86 seated. Clearly, the pressure with which the valve 86 engages its seat to cut off communication between the passage 61 and the by-pass 100 is regulated by the adjustment screw and determines the pressure of air and exhaust gases which can exist in the exhaust manifold.

At the right in Fig. 1 I have disclosed a 105 valve 95 in the passage 59 adapted to the purpose of offering a small amount of resistance to exhaust gases, so that, normally, when the passages 59 and 61 are both open, all exhaust gases will have a tendency to 110 pass out via the passage 61. The passage 61 is of greater diameter than the passage 59 to offer less interference to the passage of the gases. It is desirable to keep the butterfly valve 60 in the passage 59 as free as possible 115 of carbon deposits which may have a tendency to interfere with the easy operation of said valve 60, and hence, the valve 16 upon the same shaft.

What I claim is:

1. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, a throttle, throttle actuating means, air inlet means in said intake manifold, means 125 holding said air inlet means in closed position, means for moving said air inlet means to open position, said last mentioned means 130

being operative only when said throttle actuating means is in the idling position of said throttle and the engine speed is above a predetermined speed, and mechanism for closing said exhaust line only when said throttle actuating means is in the idling position of said throttle and the engine speed is above said predetermined speed to build up pressure in said cylinder adapted to retard the advancement of said piston, whereby to produce a braking action against said piston.

2. In an internal combustion engine, a carburetor, a throttle therefor, a cylinder, a piston in said cylinder, a driving connection between said piston and a vehicle, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, means for retarding said throttle to idling position whereby said vehicle can propel said piston, mechanism for closing said exhaust line only when said throttle is in idling position and said vehicle is propelling said piston to build up pressure in said cylinder adapted to retard the advancement of said piston, said mechanism including a brake lever, and means whereby said brake lever can be depressed to cause a friction brake to function in ordinary manner while said exhaust line is closed.

3. In an internal combustion engine, a carburetor, a throttle therefor, a cylinder, a piston in said cylinder, a driving connection between said piston and a vehicle having said engine, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, means for retarding said throttle to idling position whereby said piston can be propelled by said vehicle, mechanism for closing said exhaust line only when said throttle is in idling position and said piston is being propelled by said vehicle to build up pressure in said cylinder adapted to retard the advancement of said piston during its exhaust strokes, said mechanism including a brake lever functioning during the first stages of its depression, and means whereby said brake lever can be further depressed while said exhaust line is closed to cause a friction brake to function in ordinary manner.

4. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, throttle actuating means, air inlet means in said intake manifold, means holding said air inlet means in closed position, means operative when said throttle actuating means is in its retarded position and the engine speed is above a predetermined speed adapted to open said air inlet means and to hold it open until

the engine speed has fallen to said predetermined speed, and mechanism for closing said exhaust line when said air inlet means is open to build up pressure in said cylinder adapted to retard the advancement of said piston upon its exhaust strokes, whereby to produce a braking action against said piston.

5. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, throttle actuating means, air inlet means in said intake manifold, means holding said air inlet means in closed position, means operative when said throttle actuating means is in its retarded position and the engine is being operated by a force other than explosive mixture in said cylinder and at a speed above a predetermined speed adapted to open said air inlet means, and mechanism for closing said exhaust line when said air inlet means is open to build up pressure in said cylinder adapted to retard the advancement of said piston during its exhaust strokes, whereby to produce a braking action against said piston.

6. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, throttle actuating means, air inlet means in said intake manifold, means holding said air inlet means in closed position, means operative when said throttle actuating means is in its retarded position and the engine is being operated by a force other than explosive mixture in said cylinder and at a speed above a predetermined speed adapted to open said air inlet means and to hold it open until the engine speed has fallen below said predetermined speed to be driven by explosive mixture in said cylinder, and mechanism for closing said exhaust line when said air inlet means is open to build up pressure in said exhaust line adapted to be communicated to said cylinder to retard the advancement of said piston during its exhaust strokes, whereby to produce a braking action against said piston.

7. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, a throttle, throttle actuating means, an air inlet in said intake manifold, valve means for said air inlet, means holding said valve means to close said air inlet, means operative only when said throttle actuating means is in the idling position of said throttle and the engine is being operated by a force other than that of the explosion of the mixture in said cylinder

der to open said air inlet, whereby air at atmospheric pressure free of explosive mixture can enter said cylinder, and mechanism for closing said exhaust line when atmospheric air is entering said cylinder to cause built up pressure to exist in said exhaust line adapted to be communicated to said cylinder to retard the advancement of said piston during its exhaust strokes.

8. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, a throttle, throttle actuating means, an air inlet in said intake manifold, valve means for said air inlet, means holding said valve means to close said air inlet, mechanism responsive to the speed of the engine to open said air valve when the speed exceeds a predetermined speed, means operated by the throttle actuating means to interrupt the operation of said mechanism when said throttle is open wider than the idling position, and mechanism for closing said exhaust line when said air inlet is open to build up pressure in said exhaust line adapted to be communicated to said cylinder to retard the advancement of said piston during each of its exhaust strokes.

9. In combination, a vehicle, and an internal combustion engine including a carburetor, a cylinder, a piston in said cylinder, a driving connection between said piston and said vehicle, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, a throttle, throttle actuating means, an air inlet in said intake manifold, valve means for said air inlet, means holding said valve means to close said air inlet, mechanism responsive to the speed of the engine to open said air valve when the speed exceeds a predetermined value while said throttle actuating means is in the idling position of said throttle and said vehicle is propelling said piston, means operated by the throttle actuating means to interrupt the operation of said mechanism when said throttle is open wider than the idling position, and mechanism for closing said exhaust line when said air inlet is open to build up pressure in said exhaust line adapted to be communicated to said cylinder to retard the advancement of said piston during each of its exhaust strokes, whereby to produce a braking action against said piston.

10. In combination, a vehicle, and an internal combustion engine including a carburetor, a cylinder, a piston in said cylinder, a driving connection between said piston and said vehicle, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, a throttle, throttle actuating means, an

air inlet in said intake manifold, valve means for said air inlet, means holding said valve means to close said air inlet, means operative only when said throttle actuating means is in the idling position of said throttle and said vehicle is propelling said piston to open said air inlet, mechanism for closing said exhaust line when air is entering said cylinder to cause built up pressure to exist in said exhaust line, said mechanism including a brake lever functioning during the initial stage of its depression, and means whereby said brake lever can be further depressed to cause a friction brake to function in ordinary manner while said exhaust line is closed.

11. The combination as specified in claim 8, and means for regulating the pressure which can be produced in said exhaust line.

12. The combination as specified in claim 8, and means for controlling the amount of pressure which can be built up in said cylinder.

13. The combination as specified in claim 8, and mechanism interconnecting said air inlet valve means and said mechanism for closing said exhaust line adapted to insure that when said valve means closes said air inlet, said exhaust line will be open.

14. In an internal combustion engine, an intake manifold, an air inlet in said manifold, valve means for said air inlet, an exhaust line, valve means for said exhaust line, a throttle, throttle actuating means, means holding said air inlet valve means in closed position, mechanism responsive to the speed of the engine to open said air valve when the speed exceeds a predetermined value, means operated by the throttle actuating means to interrupt the operation of said mechanism when said throttle is open wider than the idling position, and mechanism interconnecting said air inlet valve means and said exhaust line valve means for insuring that when either of said valve means is in open position the other valve means is in closed position.

15. In an internal combustion engine, an intake manifold, an air inlet in said manifold, valve means for said air inlet, an exhaust line, valve means for said exhaust line, a throttle, throttle actuating means, means holding said air inlet valve means in closed position, means operative only when said throttle actuating means is in the idling position of said throttle to open said air inlet, and a single shaft upon which both of said air inlet valve means and exhaust line valve means are fixed, said different valve means being situated relatively to each other so that when one of the valve means is in open position the other valve means is in closed position.

16. In an internal combustion engine, an exhaust manifold having two outlet passages, separate valve means for controlling each passage, one of said valve means being

adapted to be automatically manipulated and the other of said valve means being adapted to be manually manipulated, and positive means for manipulating each of said valve means to close up said exhaust manifold.

17. The combination as specified in claim 8, wherein said exhaust line includes two outlet passages one controlled by valve means movable with said air inlet valve means to close its passage when said air inlet is open, and the other being manually controlled.

18. The combination as specified in claim 8, wherein said exhaust line includes two outlet passages one controlled by valve means movable with said air inlet valve means to close its passage when said air inlet is open, and the other being controlled by valve means actuated by an ordinary brake lever.

19. The combination as specified in claim 8, wherein said exhaust line includes two outlet passages one controlled by valve means movable with said air inlet valve means to close its passage when said air inlet is open, and the other being controlled by valve means actuated by an ordinary brake lever adapted to close said other passage during the first stages of depression of said brake lever, and mechanism whereby said brake lever can be further depressed while said other passage is held closed by its valve means.

20. In an internal combustion engine, an exhaust passage, a valve controlling said passage, an arm upon said valve, a link pivoted to said arm, a brake shaft, said link having a longitudinal slot in its end spaced from said arm and said shaft lying in said slot, a cam and a brake lever upon said shaft, the cam including a cam surface and a circumferential surface, a device upon said link adapted to ride upon said surfaces, and means urging said link toward said shaft, said brake lever being adapted to be actuated to first cause said device to ride upon said cam surface to move said valve to the closed position of said passage and to thereafter cause said device to ride over said circumferential surface while said valve is held closed.

21. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, throttle actuating means, air inlet means in said intake manifold, means holding said air inlet means in closed position, means operative when said throttle actuating means is in its retarded position and the engine speed is above a predetermined speed adapted to open said air inlet means and to hold it open until the throttle actuating means is advanced, and mechanism for closing said exhaust line when said air inlet means is open to build up pressure in said cylinder adapted to retard the advancement of said piston upon its ex-

haust strokes, whereby to produce a braking action against said piston.

22. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, throttle actuating means, air inlet means in said intake manifold, means holding said air inlet means in closed position, means operative when said throttle actuating means is in its retarded position and the engine speed is above a predetermined speed adapted to open said air inlet means and to hold it open until the throttle actuating means is advanced or the engine speed has fallen to said predetermined speed, and mechanism for closing said exhaust line when said air inlet means is open to build up pressure in said cylinder adapted to retard the advancement of said piston upon its exhaust strokes, whereby to produce a braking action against said piston.

23. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, a throttle, throttle actuating means, air inlet means in said intake manifold, means holding said air inlet means in closed position, means operative only when said throttle actuating means is in the idling position of said throttle and the engine speed is above a predetermined speed adapted to open said air inlet means, means for closing said air inlet means when said throttle is advanced, and mechanism for closing said exhaust line when said air inlet means is open to build up pressure in said cylinder and for opening said exhaust line when said air inlet means is closed.

24. In an internal combustion engine, a carburetor, a cylinder, a piston in said cylinder, an intake manifold between said carburetor and cylinder, an exhaust line with which said cylinder is adapted to communicate, a throttle, throttle actuating means, air inlet means in said intake manifold, means holding said air inlet means in closed position, means operative only when said throttle actuating means is in the idling position of said throttle and the engine speed is above a predetermined speed adapted to open said air inlet means, means for closing said air inlet means when said throttle is advanced or the engine speed has fallen to said predetermined speed, and mechanism for closing said exhaust line when said air inlet means is open to build up pressure in said cylinder and for opening said exhaust line when said air inlet means is closed.

25. The combination as specified in claim 8, an ignition circuit, and means whereby said ignition circuit can be closed when said

air inlet is closed and can be broken when said air inlet is open.

26. The combination as specified in claim 8, a normally closed ignition circuit, and means for breaking said ignition circuit the instant said valve means is actuated to open said air inlet, for maintaining said ignition circuit broken all the while said air inlet is open, and for allowing said ignition circuit to be made the instant said valve means closes said air inlet.

27. In an internal combustion engine, a cylinder, means for feeding an explosive mixture to said cylinder, a piston in said cylinder, a driving connection between said piston and a vehicle, an intake manifold between said explosive mixture feeding means and said cylinder, an exhaust line with which said cylinder is adapted to communicate, means for moving said explosive mixture feeding means to the idling position of said engine whereby said vehicle can propel said piston, mechanism responsive to the speed of the engine for causing the feed of air to said cylinder to the exclusion of explosive mixture when the speed exceeds a predetermined value while said explosive mixture feeding means is in the idling position of said engine and said vehicle is propelling said piston, and mechanism for closing said exhaust line when said air feeding means is operating to build up pressure in said cylinder adapted to retard the advancement of said piston.

28. In an internal combustion engine, a cylinder, means for feeding an explosive mixture to said cylinder, a piston in said cylinder, an intake manifold between said explosive mixture feeding means and said cylinder, an exhaust line with which said cylinder is adapted to communicate, means for controlling said explosive mixture feeding means, mechanism responsive to the speed of the engine for causing the feed of air to said cylinder to the exclusion of explosive mixture when the speed exceeds a predetermined value while said explosive mixture feeding means is in the idling position of said engine and said engine is being operated by a force other than that of the explosion of the mixture in said cylinder, and mechanism for closing said exhaust line when said air feeding means is operating.

29. In an internal combustion engine, a cylinder, means for feeding an explosive mixture to said cylinder, a piston in said cylinder, an intake manifold between said explosive mixture feeding means and said cylinder, an exhaust line with which said cylinder is adapted to communicate, means for controlling said explosive mixture feeding means, mechanism responsive to the speed of the engine for causing the feed of air to said cylinder to the exclusion of explosive mixture when the speed exceeds a predetermined value while said explosive mixture feeding means

is in the idling position of said engine and said engine is being operated by a force other than that of the explosion of the mixture in said cylinder, mechanism for closing said exhaust line when said air feeding means is operating, an ignition circuit, means for holding said ignition circuit closed when explosive mixture is being fed to said cylinder, and means for causing said ignition circuit to be broken when air to the exclusion of explosive mixture is being fed to said cylinder.

30. In an internal combustion engine, a cylinder, means for feeding an explosive mixture to said cylinder, a piston in said cylinder, an intake manifold between said explosive mixture feeding means and said cylinder, an exhaust line with which said cylinder is adapted to communicate, means for controlling said explosive mixture feeding means, mechanism responsive to the speed of the engine for causing the feed of air to said cylinder to the exclusion of explosive mixture when the speed exceeds a predetermined value while said explosive mixture feeding means is in the idling position of said engine and said engine is being operated by a force other than that of the explosion of the mixture in said cylinder, means for interrupting the operation of said mechanism when said explosive mixture feeding means is open wider than idling position or the engine speed falls below said predetermined value, and mechanism for closing said exhaust line when said air feeding means is operating and for opening said exhaust line when said air feeding means ceases to operate.

Signed at Bridgeport, in the county of Fairfield, and State of Connecticut, this 12th day of April A. D., 1926.

LESTER H. MESSINGER, JR.