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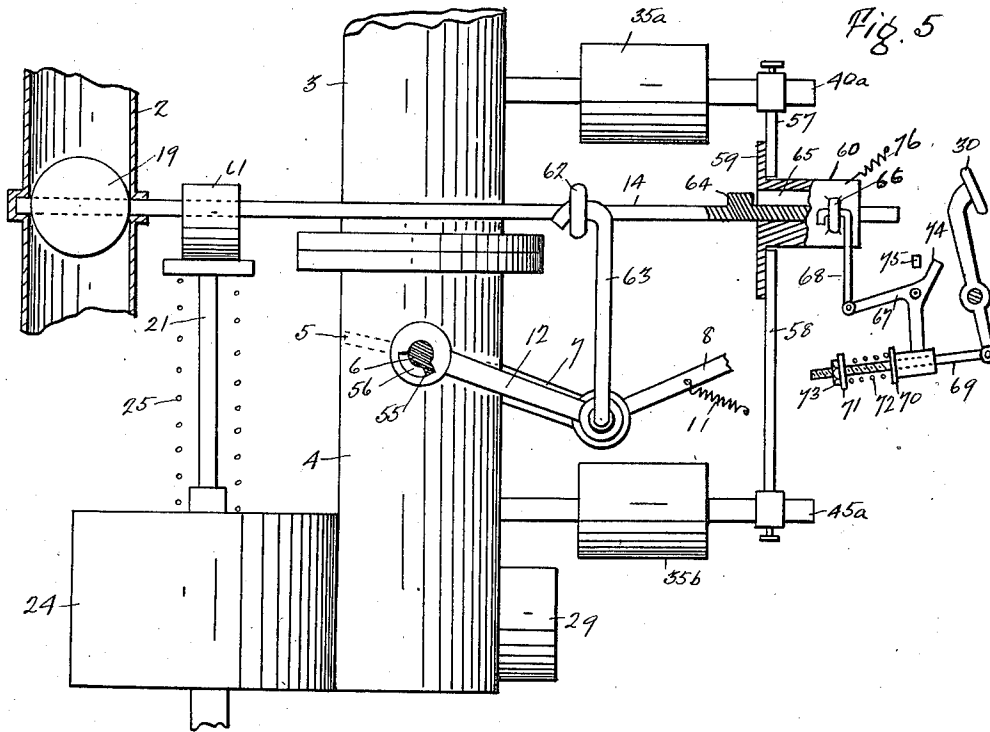
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METHOD AND MEANS FOR BRAKING VEHICLES

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METHOD AND MEANS FOR BRAKING VEHICLES.

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My invention relates to improvements in methods and apparatus for applying a braking force for slowing down and/or stopping a vehicle.

5 The principal object of my invention is to utilize a braking force generated within an internal combustion engine carried by a vehicle and to apply said force through the mechanism connecting the vehicle wheels
10 with the engine.

Another object of my invention is to automatically control the application of said braking force by automatic means responsive to engine speed and load when deceleration
15 and/or stopping is desired.

Other objects in general are to provide improvements upon the invention described in an application for patent by George L. Ertz S. N. 20,126 filed April 2, 1925, and
20 these improvements I am now enabled to adapt at minimum cost and maximum efficiency.

Referring to the drawings in which the same numbers indicate like parts:—

25 Fig. 1 is a view showing the application of my invention to an internal combustion engine in an automobile.

Fig. 2 is a vertical section and part view along the lines 2—2 of Fig. 1.

30 Fig. 3 is an alternative construction of part of Fig. 1.

Fig. 4 is a diagram illustrating the valve timing of the engine in Fig. 1.

35 Fig. 5 is an alternative construction of the apparatus shown in Fig. 2.

Referring particularly to Figs. 1, 2, 3, and 4, an internal combustion engine 1, which is of the well known four cycle type, is equipped with an exhaust pipe 2 and an intake manifold 3 to which latter is attached
40 any well known make of carburetor 4 for supplying engine 1 with air and liquid fuel, or a combustible mixture. The supply of combustible mixture from 4 through 3 is controlled by the usual butterfly valve 5 which
45 is also a balanced valve which permits easy manipulation. The valve 5 is held on a spindle 6 suitably journaled in the mixing chamber walls of carburetor 4 and on one end of
50 spindle 6 is fixed a throttle arm 7 to which the accelerator rod 8 is flexibly joined for controlling the speed of engine 1 by means of a button 9. The rod 8 is slidably mounted in a pivoted bearing 10 and a normal position
55 of the rod 8 is as shown, whereby the

valve 5 is normally held substantially closed for idling conditions by a spring 11 connected between suitable positions on rod 8 and part of engine 1.

On the other end of spindle 6 a second
60 arm 12 is fixed having an enlarged portion 13 through which passes a rod 14 which forms an extension of the armature of a solenoid 15 which may be suitably fastened by a
65 bracket 16 to the flange of carburetor 4.

The armature 14 may be constructed of brass up to and including a collar 17 fastened thereon and designed to contact with the arm 13 on one face thereof so that when
70 current is passed through the windings of solenoid 15, the armature 14 will open the valve 5 but at the same time when no current is passing through 15, the valve 5 will be
75 solely manipulated by the will of the driver by means of the accelerator rod 8.

The end of armature 14 is linked through a lever 18 to a second balanced throttle valve 19 placed in the exhaust pipe 2 and an extension 20 is firmly connected to armature
80 14 for operating a valve 21 controlling the admission of atmosphere through ports 22 and 23 to the interior of the float chamber 24 of carburetor 4 and a spring 25 serves to normally retain valve 21 off its seat in port
85 23. It will be noted that upon opening the valve 5 by the movement of armature 14, that the bevelled edge 26 on the end of extension 20 is so designed as to seat the valve 21 firmly in port 23 thereby cutting off the
90 supply of atmosphere through the port 22 and thus cutting off the supply of fuel passing from the float chamber 24 through the passage 27 to the fuel orifice 28 whence it is normally mixed with air through the port 29 and supplied to engine 1 by its suction.
95

A foot brake lever 30 is pivotally connected to a rod 31 slidably mounted in a pivoted bearing 32 and a depression of pedal 30 causes the end of rod 31 to make a contact
100 between spring terminals 32 and 33, terminal 32 being mounted on and insulated from the manifold 2 and terminal 33 being mounted on and insulated from the casing of solenoid 15.

At a suitable point in manifold 2 between
105 the valve 5 and engine 1 is placed a pipe 34 connected at one end to the interior of a casing 35. The other end of casing 35 is connected by a pipe 36 to a point in the mixing chamber of carburetor 4 between the valve 5
110

and the atmosphere inlet 29 and this point may be at the constriction or throat, of the ordinary venturi 37, with which most carburetors are equipped.

5 A piston 38 moves in one end of casing 35 responsive to engine vacuum applied there-
to through the pipe 34 and a spring 39 nor-
mally returns piston 28 to a predetermined
10 position. A rod 40, made of non-conducting
material, is fastened to piston 38 and on the
end of rod 40 is placed a metal contact 41
adapted to close a circuit between the spring
terminals 42. In the other end of casing 35
15 is placed a second piston 43 which is respon-
sive to the engine induction vacuum applied
through pipe 36. A spring 44 normally re-
turns piston 43 to a predetermined position
and a rod 45, made of non-conducting mate-
20 rial is firmly fastened in piston 43 and has
on its end a metallic contact point 46 adapt-
ed to close an electric circuit between spring
terminals 47. Spring terminals 42 are
passed through insulation in casing 5, as are
25 spring terminals 47, and said terminals are
connected on one side to a lead wire 48 fas-
tened to one pole of a storage battery 49, the
other pole of which is ground at 50. On
the other side of casing 35, said spring ter-
30 minals are connected in parallel with the
lead wire 48 which then passes through the
windings of solenoid 15 and thence to the
spring contact 32. The brake pedal 30 is
grounded at 51 and thus it will be seen that
35 when the circuit is closed by means of the
rod 31 forming a contact between springs 32
and 33 that a current will energize the sole-
noid 15. An air vent 52 is provided in cas-
ing 35 in order to permit the free movement
40 of pistons 38 and 43 responsive to the vac-
uum of engine 1. A wire 53 is connected to
the spring 33 and leads from any part of the
ignition system of engine 1 for short circuiting
the same, if desired.

In the operation of four cycle internal
45 combustion engines, such as my invention is
particularly adapted for, and assuming that
an engine of that type has four cylinders,
each having intake and exhaust valves, said
cylinders are designated A, B, C and D. The
50 usual firing order of said cylinders is A, C,
D, B. Let it be assumed that the piston in
cylinder A is at upper dead center on its
exhaust stroke. Cylinder D will then be at
full compression, cylinder C will be at bot-
55 tom dead center on its power stroke and cyl-
inder B will be at bottom dead center on its
suction stroke.

Let it also be assumed that the valve tim-
ing for each of said cylinders is as shown in
60 Fig. 4 wherein the exhaust closes at EC
which is about five degrees past upper dead
center, the inlet valve opens at IO which is
about ten degrees past upper dead center,
the exhaust valve opens at EO which is
65 about one hundred and thirty-five degrees

past upper dead center and the inlet valve
closes at IC which is about twenty degrees
past bottom dead center.

In the position of the pistons as assumed
above, the vacuum induced by the piston in
cylinder B is serving normally to draw liq-
uid fuel through 28 and air through pas-
sage 29 to the interior of cylinder B and the
amount of said mixture, which governs the
speed of the engine 1, will be controlled by
70 the position of throttle 5. Depending on
the position of throttle 5 will depend the de-
grees of partial vacuum existing on either
side of throttle 5.

For instance, if engine 1 is idling, throttle
5 will be substantially closed and there will
be about twenty inches of mercury vacuum
on the engine side of throttle 5, the idling
mixture being generally supplied to the en-
80 gine through a separate air and fuel passage
(not shown). At this time when throttle 5
is closed, there will be substantially atmos-
pheric pressure on the atmosphere side of
throttle 5, therefore the engine vacuum to
any degree will be applied through pipes 34
90 and 36 for the movement of pistons 38 and
43 respectively.

As the throttle 5 is opened at an increas-
ing degree to wide open, the speed of engine
1 will reach a maximum at light loads and
thereafter the speed of engine 1 will decrease
as more load is applied thereto, such as for
instance when the automobile is climbing a
steep grade. At all wide open positions of
throttle 5, the partial vacuum on either side
100 thereof is substantially equal and therefore
the same will be transmitted equally through
pipes 34 and 36 and in the usual four cycle
engine, with the throttle wide open, said par-
tial vacuum will range from about six inches
of mercury to one-half inch of mercury
when the engine speed passes from a maxi-
mum to a minimum, but varying, of course,
with carbureter constructions.

Therefore the engine vacuum below throt-
11 tle 5 is an indication of engine load and the
vacuum above throttle 5 is an indication of
engine speed.

In conjunction with the factors as already
described, I am now enabled to apply a
braking force to the vehicle carrying engine
1 which will then be normally available ac-
cording to the partial vacuum generated by
engine 1 at a particular speed and this op-
eration is performed as follows:—

If it be assumed that throttle 5 is wide
open, the button 9 will be fully depressed
and spring 11 will be in tension. The air
ports 22 and 23 will be fully open thus en-
suring a free flow of fuel through passage
12 27 and orifice 28. The brake pedal 30 will
be held in its normal position by a spring
30 and the rod 31 will be out of contact
with the springs 32 and 33. At this time the
before mentioned vacuum of six inches of

mercury in manifold 2 will be equally applied through the pipes 34 and 36 to the pistons 38 and 43 respectively whereby the contact 46 will be engaged between the springs 47 but the contact 41 will not be in engagement with the spring 42. Therefore there will be no current flowing from storage battery 49 through the solenoid 15 because while the circuit will be made at 47 the same will be broken between contacts 32 and 33.

The valve 19 will be normally as shown permitting free passage of exhaust gases through exhaust pipe 2 to atmosphere.

15 If now it be desired to decelerate, the release of the foot from button 9 will immediately close valve 5 and the vacuum above 5 will jump from twenty inches of mercury to about twenty-six inches of mercury due to the high rate of piston speed and this vacuum will then cause piston 38 to jump and engage the contact 41 between springs 42. At the same time the closing of throttle 5 diminishes the vacuum below the same to substantially atmospheric pressure whereby the contact 46 is disengaged from the terminals 47.

If now the brake pedal 30 be depressed a predetermined amount for slowing the automobile, a contact will be made between the rod 31 and the terminals 32 and 33 whereby current from the storage battery 49 passes through 48, 42, 41, to the windings of solenoid 15 thence to the terminal 32 thence through the rod 41, and the foot pedal 30 to the ground 51.

The sudden energizing of solenoid 15 thereupon immediately causes a jump of the armature 14 whereby the throttle 5 will be thrown wide open, the valves 21 and 19 will be fully closed, the accelerator rod 18 also being fully depressed against the action of spring 11.

45 In this manner by the reopening of valve 5, a partial vacuum of predetermined degree will be again equally applied through pipes 34 and 36 to the pistons 38 and 43 respectively whereby 41 will be disengaged from terminals 42 and the contact 46 will be re-engaged between the terminals 47 thus ensuring the continuity of the passage of current for maintaining the energizing of solenoid 15.

55 The closing of port 23 thus prevents the access of atmosphere to the interior of float chamber 44 so that the engine vacuum now being applied to orifice 28 is ineffective for withdrawing liquid fuel therethrough and thus solely pure air is supplied to the inlet 29, and manifold 3 to the cylinders of engine 1.

65 Thus the cylinders A, B, C and D on their intake strokes are supplied solely with pure air and this air will be supplied under a comparatively low degree of vacuum. The

air is then compressed on the compression stroke of any particular cylinder and the work of compression is returned to the engine on the expansion stroke of the cylinder until the exhaust valve opens at EO. The opening of the exhaust valve at EO then permits the expulsion of part of the air to the exhaust pipe 2 but the same is trapped therein due to valve 19 being closed and therefore on the exhaust stroke of any particular cylinder a predetermined degree of compression will be obtained in the exhaust pipe 2 of a particular cylinder, which compression is a back pressure against the rotation of the parts of engine 1 and thus a braking force is automatically generated for decelerating the automobile, it being assumed of course, that the clutch connecting engine 1 with the rear wheels and the usual transmission gears are in engagement.

If it be assumed that the braking force is applied in cylinder A at the top of its compression stroke, it will be noted that the exhaust valve on cylinder B will be open to the exhaust pipe 2 therefore there will be overlapping discharges of compressed air from one cylinder to the other so that the compression stroke in each cylinder will really not start at a sub-atmospheric pressure but may be adjusted to start at a super-atmospheric pressure and the amount of this pressure may be calibrated by any particularly desired annular clearance between the circular butterfly valve 19 and the interior of exhaust pipe 2.

It will thus be seen that the braking force may be applied through the compression of air in the engine and additionally through the brakes connected to foot pedal 30 (not shown) and foot pedal 30 may be calibrated for causing the rod 31 to close the contacts 32 and 33 with any desired degree of travel.

With the valve 5 wide open, due to the action of solenoid 15, the deceleration of engine 1 will continue to a point where the vacuum applied to piston 43 is insufficient to retain the contact 46 in engagement with the terminals 47 whereupon the circuit will be broken thus causing solenoid 15 to be de-energized whereupon valves 19 and 21 will open and valve 5 will close to the idling position and the time for closing valve 5 in this manner may be calibrated for any particular engine speed so that engine 1 will never remain dead at that particular speed.

At the same time the same valve action will ensue at any period of deceleration upon the release of foot pedal 30 so that the automobile may be decelerated partly or wholly and engine 1 will die for a predetermined period only.

If desired the terminal 33 may be connected to the lead wire 53 for also short circuiting the ignition of engine 1, but in general this will be unnecessary when provided.

sions are made, as have been shown, for cutting off the supply of liquid fuel through orifice 28 and of course it is obvious that valve 21 may be alternatively placed so as to directly and positively cut off the supply of liquid fuel through the passage 27 but in either case the same result is achieved i. e., cutting off the flow of liquid fuel through orifice 28 responsive to the engine vacuum.

Also it will be noted that in place of the pistons 38 and 43 and the springs 39 and 44 that the well known form of metal bellows closed at one end may be provided and under certain conditions this may be desirable to prevent the action of dust through the port 52 whereby the action of pistons 38 and 44 would be retarded but many equivalents are apparent to those skilled in the art.

An alternative construction is shown in Fig. 3 whereby the valves 18^a, 18^b, 18^c and 18^d are individually supplied for governing the individual cylinders A, B, C, D respectively and in such case said valves will be controlled through suitable linkages connected to the armature 14 in any desired fashion to operate as already described and it will be noted that where the structure shown in Fig. 3 may be used, a higher degree of compression braking force may be obtained in said cylinders because of the reduced compression space due to the elimination of a large portion of exhaust pipe 2.

In the structures already described it can be seen that the elements include generally the use of engine induction vacuum for controlling a balanced valve by means of a solenoid whereby pure air may be supplied to an engine for braking purposes and so constituted that the engine will never be killed below a predetermined number of revolutions per minute.

In another construction shown in Fig. 5, I illustrate like results which may be obtained mechanically without the interposition of electrical influences but in which I utilize the effect of engine vacuum as already described as a control factor.

It will be seen in Fig. 5 that the spindle 6 is arranged with a shoulder 55 thereon and the arm 12 is not fixed to the spindle 6 but revolves thereon and can have a certain movement of free travel due to a recess 56 placed therein for the movement of shoulder 55. Also in the present case, the arm 7 does not work opposite the arm 12 but works in the same plane therewith and arm 7 is, of course, still firmly fixed to spindle 6.

Similar vacuum responsive devices are provided in casings 35^a and 35^b which are respectively joined above and below the valve 5 and the rods 40^a and 45^a are made of metal and respectively extend outside from 35^a and 35^b.

A finger 57 is adjustably fastened on 40^a and a finger 58 is adjustably fastened on 45^a

for substantially contacting with a disc 59 which has a hub 60 adapted to slide on the rod 14 which in the present case is directly connected through the valve 19 and is provided with an eccentric 61 for actuating the valve 21, with an eye 62 adapted to hold a hook 63 connected with the arm 12 and with a key 64 adapted to slide in a keyway 65 in the hub 60.

The hub 60 is also provided with an eye 66 so that the same may be rotated a predetermined amount when the foot pedal 30 is depressed by means of a bell crank 67 connected thereto through a hook 68, and one arm of the bell crank 67 is slidably engaged for operation by the foot pedal 30 through a rod 69, washers 70 and 71, a spring 72 therebetween and an adjusting nut 73. The bell crank 67 has a third arm 74 adapted to go up against a stop 75 upon a predetermined depression of pedal 30.

The operation of this device is as follows:

Similar instrumentalities as already described are provided in casings 35^a and 35^b whereby at predetermined engine vacuums, one of the fingers 57 and 58 will hold the hub 60 in position over the key 64.

When the foot pedal 30 is then depressed for deceleration, it will be seen that the rod 69 will be pulled against the spring 72 and washer 70 to move the bell crank 67 a predetermined distance when arm 74 will come up against stop 75. This movement of bell crank 67 will cause 68 to rotate the hub 60, thereby rotating the rod 14 and throwing the valve 5 wide open against the tension of spring 11. The eccentric (or cam) 61 will also be revolved to close the valve 21 and the valve 19 will be rotated to close exhaust pipe 2.

Thereafter upon reaching a predetermined rate of deceleration, or upon stopping the automobile, the vacuum applied to casings 35^a and 35^b will be such that the recession of fingers 57 and 58 will cause the disengagement of key 64 from keyway 65 whereupon the tension of spring 11 will cause the closing of valve 5 irrespective of whether foot pedal 30 is depressed or not.

Thereafter the movement of accelerator rod 8 will operate the valve 5 without motion of rod 14.

In this structure it should be particularly noted that the same is designed for the operation of automatic braking effect upon a minimum depression of foot pedal 30 when the arm 74 will come into engagement with the stop 75 and thereafter any further depression of pedal 30 for applying the mechanical brake, will permit the rod 69 to slide through one arm of bell crank 67 as far as may be desired and in this manner a single structure of low cost may be had to obtain like effects.

It will be noted especially that the valves

5 and 19 are balanced valves, i. e., they are of circular form, rotated centrally so that gaseous pressures are balanced at any degree of opening, thus rendering manipulation easy, 5 Therefore the solenoid 15 will require very little current, if used, and if the structure of Fig. 5 be used, the valves will be responsive to low degrees of vacuum.

The spring 76 serves to draw the hub 60 free of the key 64 at the proper periods.

I claim:—

1. The method of decelerating a vehicle impelled by an internal combustion engine, which comprises supplying a gaseous fluid to an engine rotated by the inertia of a vehicle, creating a back pressure in the engine by throttling the discharge of the gaseous fluid therefrom and governing said back pressure by the engine induction vacuum.

2. The method of decelerating a vehicle impelled by an internal combustion engine, which comprises supplying a gaseous fluid at substantially atmospheric pressure to an engine rotated by the inertia of a vehicle, creating a back pressure in the engine by throttling the discharge of the gaseous fluid therefrom and governing said back pressure by the engine induction vacuum.

3. In a vehicle impelled by an internal combustion engine, means for decelerating said vehicle including a valve actuated by the engine suction for throttling the exhaust of the engine.

4. In a vehicle impelled by an internal combustion engine, automatic means for decelerating said vehicle including a valve actuated by the engine suction for throttling the exhaust of the engine.

5. In a vehicle impelled by an internal combustion engine and having a plurality of wheels controlled by brakes, means for decelerating the vehicle including a lever for applying the brakes and additional means actuated by the engine induction vacuum operative on movement of the lever for preventing power impulses in the engine.

6. In combination, a wheeled vehicle impelled by an internal combustion engine, means for applying the power of the engine

to the wheels of the vehicle, means for applying brakes to said wheels, and means for applying additional braking means to said wheels in conjunction with the movement of said first braking means; said last mentioned means being operated by the engine induction vacuum.

7. In a braking system for vehicles, an internal combustion engine having intake and exhaust passages, a throttle in each of said passages, a lever, and means automatically controlled by the suction of said engine for causing the opening of said throttle in said intake passage and the closing of the throttle in said exhaust passage upon the movement of said lever.

8. In a braking system for motor vehicles, an internal combustion engine having an exhaust passage, a throttle in said passage, a brake lever, and means automatically controlled by the suction of said engine for operating the throttle in said intake passage upon a predetermined movement of said lever.

9. In a braking system for motor vehicles, an internal combustion engine having intake and exhaust passages, a throttle in each passage, a fuel chamber having a vent, a valve for closing said vent for preventing the entrance of air to said chamber, and means controlled by the suction of said engine for closing said valve and the throttle in said exhaust passage, and simultaneously opening the throttle in said intake.

10. In a braking system for motor vehicles, comprising an internal combustion engine, means for supplying an explosive mixture to said engine, an exhaust passage for said engine, a lever, and means controlled by the suction of said engine for automatically substituting air for said explosive mixture and for closing said exhaust passage upon a predetermined movement of said lever.

Signed at Wilmington, in the county of Los Angeles, and State of California, this 17th day of April, A. D. 1925.

CHARLES L. STOKES.