To all whom it may concern:

Be it known that I, JOHN WILLS CLOUD, a citizen of the United States, and a resident of 82 York road, King's Cross, in the county of London, England, have invented a new and useful Improvement in Automatic Vacuum-Brakes, of which the following is a specification.

This invention relates to automatic vacuum-brakes for railway and like vehicles; and it has for its object to provide improved means for quickening the action of such brakes and also increasing the brake force throughout a train when the brakes are applied.

The invention comprises devices by means of which these objects are attained in partial or service applications of the brakes and devices by means of which the same objects are attained in the case of both full and partial applications of the brakes.

Devices known as "accelerating-valves" have heretofore been constructed for the purpose of obtaining a quickened action in full applications of the brakes; but the employment of these devices has usually entailed the disadvantage of requiring a partial application of the brakes to be made slowly in order to avoid bringing the accelerating-valves into operation, and thereby causing a full application of the brakes when this is not desired. Moreover, such accelerating-valves are not adapted for quickening the action of the brakes in partial or service applications.

According to the present invention means are provided whereby a limited amount of air can be introduced into the brake system at one or more points when a partial application of the brakes is made for the purpose of quickening such application, and at the same time all danger of making a large free opening from the atmosphere to the brake system, and thereby causing a full application of the brakes, is avoided. In some cases means are also provided for opening the brake system to the atmosphere through one or more comparatively large orifices for the purpose of quickening a full application of the brakes.

In carrying out the invention the limited supply of air may be admitted to the brake system by automatic means, which are operated when a sudden small increase is made in the pressure of the air in the train-pipe, or the admission of such limited supply may be through a manually-controlled valve. The limitation of the supply may be attained by the employment of a reservoir normally containing air at atmospheric pressure and external to the brake system. This reservoir is brought into communication with the brake system when it is desired to effect a quick application of the brakes. The reservoir is recharged with air at atmospheric pressure by means hereinafter explained. Such a reservoir will be hereinafter referred to as a "vestibule-reservoir" by reason of its being located between the atmosphere and the brake system. Where air is to be admitted to the brake system by means of a valve which is automatically operated on an increase of pressure in the train-pipe, the amount of such air may be limited by causing the valve to close promptly by means hereinafter described when the desired rise in pressure in the brake system has taken place. In a modified form the valve may be directed operated through a mechanical connection with the brake piston or rigging, in which case the reservoir is closed to the atmosphere when open to the brake system and open to the atmosphere when closed to the brake system.

In order that the invention may be clearly understood, it will now be described with reference to the accompanying drawings, which illustrate, by way of example, various methods of carrying the same into practical effect.

Figure 1 is an elevation, partly sectional, illustrating vacuum-brake-operating apparatus applied to an engine and a vacuum-brake applied to one vehicle of a train in which vestibule-reservoirs are employed for obtaining a quickened application of the brakes. Figs. 2, 3, and 4 are detail views drawn to an enlarged scale hereinafter described. Fig. 5 is a sectional view illustrating a modified form of accelerating-valve. Figs. 6 to 10 are similar views showing further modified forms of accelerating-valves, and Fig. 11 is a view of an accelerating-valve which is operated by the brake-piston.

Referring now to Fig. 1, the train-pipe is indicated at 1, the brake-cylinder, which is of any usual vacuum type, at 2, and the ejector, which may also be of any usual type, at 3. Any means for admitting air to the train-pipe for the purpose of applying the brakes may be used in this invention, by the ejector, for example; but in Fig. 1 a special brake-valve, illustrated at 4 and hereinafter described, is shown. Connected to the train-pipe at intervals along the train and preferably on every car which is provided with
a brake-cylinder, is an accelerating device. (Indicated at 5.) Said device comprises a casing 6, inclosing a poppet-valve 7, and is connected to the train-pipe below the valve 7 through a passage 8 and above said valve through a pipe 9 to the vestibule-reservoir 10. This reservoir is permanently in communication with the atmosphere through a small leak-hole 11. The valve 7 is connected by a stem 12 to a diaphragm 13, which divides the space above the valve 7 from a chamber 14, hereinafter termed the “operating-chamber,” and said chamber communicates with the space below the valve 7 through a restricted passage 15, provided in the stem 12 of the valve.

The operation of the improved device is as follows: In applying the brakes if the pressure in the train-pipe is increased so quickly that the pressure in the operating-chamber 14 cannot equalize therewith sufficiently rapidly through the restricted passage 15 the excess pressure above the valve 7 above that on the top of the diaphragm 13 will lift the valve, thereby opening communication between the vestibule-reservoir 10 and the train-pipe. A sudden rush of air will thereupon occur from the vestibule-reservoir into the train-pipe and brake system sufficient to obtain on one vehicle and to propagate to the next a quick partial application of the brakes. This rush of air is limited in amount by the size of the vestibule-reservoir, because, although the valve 7 provides a wide passage of communication between the vestibule-reservoir and the train-pipe, air cannot continue to pass therethrough faster than it enters the vestibule-reservoir through the restricted passage 11. Meanwhile valve 7 is resetted, providing that no more air is admitted to the train-pipe through the engineer’s operating-valve—that is to say, by means of the ejector or brake valve. The capacity of the vestibule-reservoir 10 is suitably proportioned to the cubical contents of the corresponding section of train-pipe and of the brake-cylinder on any vehicle, so as to provide a sufficient increase in train-pipe pressure to give a quick partial application of the brakes without any material aid from the air which may pass the small opening 11 into the vestibule-reservoir in the shortest time that the valve 7 may be open. Furthermore, the capacity of the operating-chamber 14 and the cross-sectional area of the passage 15 in the valve-stem 12 must be relatively so proportioned that soon after the pressure of the air contained in the vestibule-reservoir 10 has approximately equalized with the increased train-pipe pressure through the opening of the valve 7 said valve will close if the engineer’s operating-valve be immediately closed on the engine, but will remain open longer if the engineer’s operating-valve be permitted to remain open. If air be admitted to the train-pipe through the engineer’s operating-valve so as to increase the pressure in the train-pipe very slowly, equalization of the pressure in the operating-chamber 14 with that in the train-pipe takes place through the restricted passage 15 with sufficient rapidity to prevent the valve 7 from opening and the accelerating device is not brought into action.

The passage 11, which admits air from the atmosphere to the vestibule-reservoir so as to restore normal atmospheric pressure therein, may obviously be made in any part of the casing 6 between the valve 7 and the diaphragm 13, if desired.

In order to admit a limited supply of air to the train-pipe for the purpose of effecting with certainty a partial application only of the brakes, the engineer’s operating-valve, whether this be an ejector or special brake valve, may be provided with a vestibule-reservoir, normally containing air at atmospheric pressure, which can be put into communication with the train-pipe when desired. In Fig. 1 a brake-valve 4 is shown provided with such a vestibule-reservoir, the operation of which will now be described. The valve comprises a lower casing 16, a plan view of which is shown in Fig. 2, a disk-valve 17, of which a plan is shown in Fig. 3, the ports being shown in full lines for the sake of clearness, and a cross-section in Fig. 4, and a cover 18. The valve 17 is mounted on a spindle 19, provided with an operating-handle 20. The inner face of the casing 16, to which the valve 17 is applied, is provided with three ports 21, 22, 23, of which the port 21 leads to passage 24, connected with the train-pipe, port 22 leads to passage 25, forming a connection with the vestibule-reservoir 26, and port 23 communicates with the atmosphere through the passage 27. The face of the valve 17, which is shown in Fig. 3, is provided with two pairs of ports 28, 29 and 30, 31, respectively, connected by channels 32, 33, as clearly seen from Figs. 3 and 4. The operation of the device is as follows: Assuming that the handle 20 occupies with reference to the ports in the valve 17 the position indicated by the line A A, Fig. 3, there are four principal operating positions to which the valve may be removed. These are indicated at B C D E in Fig. 2, and the resultant connections are as follows: In position B, called the “charge” position, the vestibule-reservoir 26 is connected, through passage 25, ports 22, 30, channel 33, ports 31, 23, and passage 27, with the atmosphere, the port 21 to the train-pipe being closed. In position C, called the “lap” position, all ports are shut. In position D the vestibule-reservoir 26 is connected, through passage 25, ports 22, 29, channel 32, ports 28 and 21, and passage 24, to the train-pipe. The reservoir is made of such capacity as will give a partial application of the brakes only. It is obvious that the area
of the openings of the ports will vary according to the exact position to which the handle is moved, but that in the position indicated at D the pressures in the train-pipe and vestibule-reservoir can very quickly equalize, the ports being then open to their fullest extent. As the handle is moved farther in the counter-clockwise direction port 29 in the valve makes connection with port 23 in the casing, by which means the train-pipe and vestibule-reservoir will both be opened to the atmosphere first through a restricted passage, which is gradually enlarged until in position E a wide opening is made from the atmosphere through passage 27, ports 23, 29, channel 32, ports 28, 22, and passage 25, to the vestibule-reservoir, and ports 28, 21, and passage 24, to the train-pipe. In this position, therefore, a full application of the brakes will be made.

With the construction of brake-valve above described it will be seen that when a partial application of the brakes has been made the brake-valve need only be moved to the lap position when it is desired to stop the admission of air to the train-pipe, as well as the admission of air from the atmosphere to the vestibule-reservoir. If therefore a subsequent stronger application of the brakes be desired, the lever is moved to the proper position and a rate of admission of air to the train-pipe corresponding to the position of the lever will be obtained, as the reservoir has not in the meantime had atmospheric pressure restored therein. After the pressures in the vestibule-reservoir and train-pipe have been equalized a further application of the brakes by means of this valve can be obtained by moving the handle to the position of full application or by first moving it to the charge position, so as to recharge the vestibule-reservoir.

In some cases the lap position C is omitted, and the handle 20 is returned to charge position B after each partial or complete application of the brakes, and in other cases in place of controlling the admission from the atmosphere to the vestibule-reservoir by means of the valve a small orifice may be provided in the wall of the reservoir to permit of the reservoir being recharged with air at atmospheric pressure, in which case the ports 30, 31 and connecting-channel 33 are omitted.

In place of applying the vestibule-reservoir to a special engineer's brake-valve it may be employed for the same purpose in cases where the admission of air to the train-pipe is controlled by the ejector-handle in a manner which will be readily understood by those skilled in the art and which it is not necessary, therefore, to further describe.

In Fig. 5 a modification of the valve shown at 5, Fig. 1, is illustrated, in which an additional passage-way between the operating-chamber 14 and the train-pipe is provided when the valve is opened. The stem 12 of the valve is made tubular and surrounds a fixed pin 36, provided with a central orifice 37 of comparatively large bore. Said stem has a cap 38, having a small orifice 39, through which communication is always maintained between the operating-chamber 14 and the train-pipe 1 through the orifice 37. One or more orifices 40 are provided in the stem 12, the inner ends of which are covered by the fixed pin 36 when the valve 7 is in its closed position, as shown in the drawings, but which when the valve is raised are uncovered, and thereby provide an increased area through which air may pass from the train-pipe through the central orifice 37 into the operating-chamber 14. By this means when the valve is opened equalization of the pressures in the operating-chamber and the train-pipe takes place very readily through the orifices 40, and a sure closing of the valve is obtained. The closing of the valve may be assisted by the use of a spring, as shown. The operation of the valve under variations of pressure in the train-pipe is substantially the same as that hereinbefore described with reference to the valve illustrated in Fig. 1 and need not be further discussed.

Referring to Fig. 6, this shows how a vestibule-reservoir may be applied to an accelerating-valve 34 of known type which has already been used. The construction and operation of the valve proper are already well known, and the effect of the vestibule-reservoir 10 applied to it will be readily understood from the description of the same with reference to Fig. 1.

Fig. 7 is a sectional view of a modified form of accelerating-valve. The device comprises a casing, the interior of which is divided into two parts by a partition 42, one part being connected through the nozzle 43 with a vestibule-reservoir (not shown in the drawings) and the other part being connected through the nozzle 41 with the brake-cylinder and also with the train-pipe 1 and having its end closed by the diaphragm 13, on the other side of which is the operating-chamber 14. The diaphragm is pierced with a small orifice 15, through which the pressure in the operating-chamber 14 will equalize with that in the train-pipe, and carries a stem 44, which is in operative connection by means of the pin 45 with a slide-valve 46, adapted to cooperate with a port 47 in the partition 42 and with a port 48 leading from the space within the casing to the atmosphere. There is provided a small amount of clearance between the slide-valve 46 and the portion of the casing containing port 48, as indicated at 35. The diaphragm 13 and the parts connected therewith are normally maintained in the positions shown in the drawings by means of a suitable spring 49 and a collar 50, mounted on the stem 44, cooperates with a plug 51.
controlled by a spring 52 in a manner herein-
after explained to determine the positions
which the diaphragm and connected parts as-
sume under varying conditions of pressure on
the two sides of the diaphragm. The opera-
tion of the device is as follows: When a grad-
ual increase is made in the pressure of air in
the train-pipe, the pressure in the operating-
chamber 14 equalizes with sufficient rapidity
through the orifice 15 to prevent any move-
ment of the diaphragm 13 against the spring
49. When, however, a sudden small in-
crease is made in the train-pipe pressure the
diaphragm 13 is moved against the pressure
of the spring 49 until the collar 50 comes into
contact with the plug 51, whereupon the pres-
sure of the spring 52 is added to that of
the spring 49 to resist further movement of
the diaphragm 13. By this movement of the
diaphragm the slide-valve 46 is moved to
open the port 47, thereby putting the vesti-
bule-reservoir in communication with the
train-pipe. The entry of air from the atmos-
phere to the vestibule-reservoir is restricted
through port 48 and restricted passage 53, this
being the equivalent of the passage 11 in
the reservoir shown in Fig. 1. If no further
increase is made in train-pipe pressure be-
ond that occasioned by the passage of air
from the vestibule-reservoir thereinto, the
pressure of air in the operating-chamber 14
will thereafter equalize with that in the train-
pipe through the restricted passage 15 and
the spring 49 will return the diaphragm to its
normal position in which the port 47 is closed.
If a sudden large increase is made in the pres-
sure of the air in the train-pipe, the spring 52
will be compressed as well as the spring 49
and the diaphragm 13 will be moved to such
a position that the atmospheric port 48 will
be uncovered, owing to the increased travel of
the slide-valve 46, and communication be
opened between the train-pipe and the at-
mosphere through the ports 47 and 48, where-
by a quickened full application of the brakes
will be obtained. In place of a single pas-
sage 15 in the diaphragm 13 the arrange-
ment of two or more passages opened by the
progressive movement of the diaphragm in a
manner similar to that shown in Fig. 5 may
be employed with the arrangement shown in
this figure.

In Fig. 8 another modified form of accelerat-
ing device similar to that shown in Fig. 1 is
illustrated, but provided with different means
for insuring a prompt closure of the valve
when desired, so as to limit the amount of air
admitted to the train-pipe in order to effect a
partial application of the brakes. In this ar-
rangement the operating-chamber 14 has no
other connection with the train-pipe except
by a return-pipe 53 from the brake-cylinder
2. When a rise of pressure is made in the
train-pipe, there is momentarily a lower pres-
sure in the brake-cylinder than in the train-
pipe or in the branch pipe conducting air to
the brake-cylinder, and this momentary dif-
fERENCE of pressure is much greater when the
brake-piston is moved rapidly by a sudden
admission of air in applying the brakes than it
is when the piston is moved gradually by a
comparatively slow admission of air in apply-
ing the brakes. Consequently when a sud-
den increase is made in the train-pipe pres-
sure the valve 7 will be lifted and will admit
air from the vestibule-reservoir 10 to the
train-pipe, but will be closed again by the ap-
proximate equalization of pressure in the
brake-cylinder 2, and therefore in the operat-
ing-chamber 14, through return-pipe 52, with
the train-pipe, consequent partly upon the
stoppage in the movement of the brake-pis-
ton. One advantage attained by this ar-
rangement is that the return-passage from the
brake-cylinder to the operating-chamber 85
may be comparatively large, and the acceler-
ating-valve 7 can be caused to open or to re-
main closed, as desired, with less careful op-
eration.

In some cases the vestibule-reservoir (shown
in Fig. 8) may be omitted and the pipe 9 com-
nunicate direct with the atmosphere through a
suitable orifice.

In Fig. 9 a device similar to Fig. 7 is illus-
trated; but the small passage-way 15 is dis-
pensed with, and the operating-chamber 14
is connected to the brake-cylinder by return-
pipe 53, similar to the arrangement shown in
Fig. 8. The operation of this modification
will be readily understood from the descrip-
tion hereinabove given of the operation of
Figs. 7 and 8 and need not be further de-
scribed.

Referring now to Fig. 10, the device there-
in shown is very similar to that shown in Fig.
9; but the operating-chamber 14 is connected,
through a pipe 54, to a port 55 in the partition
42, with which cooperates a port 56 and cav-
ity 57 in slide-valve 46. The return-pipe 53,
which communicates with the brake-cylinder,
connects with the chamber 14 through a port
58, controlled by plunger 59, mounted on the
end of the rod 44 which is carried by the di-
aphragm 13. A suitable channel 60 is pro-
vided in the plunger 59, through which air
can pass to pipe 53 when the port 58 is uncov-
ered. The other parts of the device are the
same as hereinbefore described. In this ar-
rangement on a sudden small increase of
pressure in the train-pipe the movement of
the diaphragm causes the slide-valve 46 to
open the operating-chamber 14 to the atmos-
phere through pipe 54, ports 55, 56, and the
clearance-space 35 above the slide-valve
46 and port 48. The plunger 59 at the same
time covers the port 58, and thereby closes
the connection between the brake-cylinder
and the operating-chamber 14. The pres-
sure in the operating-chamber 14 will rise to
that in the train-pipe by reason of air enter-
ing from the atmosphere through the pipe 54 until it becomes approximately equal to that in the train-pipe, whereupon the spring 49 moves the diaphragm back to its normal position. When a large increase is suddenly made in the pressure in the train-pipe, slide-valve 46 is moved to the limit of its travel and opens the train-pipe and vestibule-reservoird to the atmosphere through port 48, as hereinbefore described with reference to Fig. 7. At the same time air from the atmosphere is admitted to the operating-chamber 14 through port 56, cavity 57, port 55, and pipe 54, and as soon as the pressure in the operating-chamber 14 approaches sufficiently near that in the train-pipe the springs 49 and 52 will operate to return the diaphragm 13 and slide-valve 46 to their initial positions. It will be seen, however, that owing to the small size of the cavity 57 in the slide-valve the flow of air to the operating-chamber 14 is restricted and the rise of pressure in said chamber retarded, by which means a return movement of the diaphragm 13 and valve 46 to their normal positions will be delayed long enough to insure the desired acceleration of the full application of the brakes. After the diaphragm 13 has returned to its normal position the pressure remaining in the operating-chamber 14 can be withdrawn through port 58 and pipe 53 by way of the brake-cylinder when the brakes are released.

Referring now to Fig. 11, the vestibule-reservoir (not shown in the drawings) is connected, through pipe 9 and three-way valve 61, to the branch pipe 8 from the train-pipe, said valve 61, which has a cross-channel 62 and a second channel 63, being provided with a lever 64, having a pin-and-slot connection with the piston-rod 65 of the brake-piston. The channel 63 in the valve 61 is arranged to cooperate with an atmospheric port 66, provided in the valve-casing. The operation of this device is very simple. When the brakes are released and the brake-cylinder piston is in its lowest position, the valve takes up the position shown in the drawings, in which the vestibule-reservoir communicates with the atmosphere through channel 63 and port 66 and the branch pipe 8 from the train-pipe is closed. On an increase of pressure being made in the train-pipe the brake-piston moves upward in order to apply the brakes, and thereby rotates valve 61, which first closes the atmospheric port 66, thereby cutting off the vestibule-reservoir from the atmosphere, and then opens said reservoir to the train-pipe through the channel 62 of the valve. By this means a limited amount of air under pressure from the vestibule-reservoir is admitted to the train-pipe every time the brakes are applied, and thereby a quickened application of the brakes is obtained. It will be seen, however, that when air is withdrawn from the train-pipe in order to effect the release of the brakes the vestibule-reservoir will also be partially exhausted of air at the same time, since it remains in communication with the train-pipe through the channel 62 until the piston of the brake-cylinder is returned to the release position, when channel 62 will be closed and port 66 will be opened. The three-way valve shown is only by way of illustration, and it is evident that the same results may be obtained in other ways, as by a slide-valve operated by the brake-piston or other part of the brake-rigging.

In those cases where the accelerating device has only one valve movement used in connection with a vestibule-reservoir an additional accelerating-valve of any ordinary type controlling a comparatively large orifice from the brake system to the atmosphere may be employed in order to obtain a full application of the brakes. Such accelerating-valve is, however, weighted or provided with a spring, so as not to be operated when only a small increase is made in the pressure of the train-pipe and a partial application only of the brakes is required.

The quickening of partial applications of the brakes which can be obtained by means of the invention hereinabove described has an additional advantage beyond those accruing from the simultaneous application of the brakes throughout the train. It is well known that in operating vacuum-brakes a considerable loss is occasioned by leakage from the train-pipe or brake-cylinder round the ball check-valve or other check to the vacuum-chamber when the brakes are first applied, especially when the pressure increases slowly, as it does toward the rear end of a long train. Owing to the rapidity with which the pressure can be raised in the train-pipe by means of the present invention in all initial applications of the brakes, the check-valves or other checks are very properly closed throughout the train, and the degree of vacuum in the vacuum-chamber, upon which the available power of the brake depends, is conserved to a greater extent than has heretofore been possible with pneumatically-operated valves.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An automatic vacuum-brake apparatus for railway and like vehicles, a reservoir or receptacle normally containing air at atmospheric pressure, provided with means whereby when a sudden small increase of pressure is made in the train-pipe for applying the brakes, said reservoir or receptacle is put into communication with the brake system, so that a portion of the air contained in the reservoir or receptacle will be discharged into the brake system for the purpose of accelerating the application of the brakes.
2. In an automatic vacuum-brake apparatus, a reservoir normally containing air at atmospheric pressure, and a valve device operated by a small sudden increase in train-pipe pressure for opening communication from said reservoir to the brake system for accelerating the rise in train-pipe pressure and the application of the brakes.

3. In an automatic vacuum-brake apparatus, a reservoir having a restricted orifice communicating with the atmosphere, and a valve device operated by a small sudden increase in train-pipe pressure for opening communication from the reservoir to the train-pipe.

4. In an automatic vacuum-brake apparatus, a reservoir normally containing air at atmospheric pressure, and a manually-operated valve mechanism for controlling communication from said reservoir to the train-pipe, whereby certain small sudden increases may be made in the train-pipe pressure.

5. In an automatic vacuum-brake apparatus, a reservoir, a train-pipe, and a manually-operated valve having ports for controlling communication from the atmosphere to said reservoir and from the reservoir to the train-pipe for increasing the pressure therein.

6. In an automatic vacuum-brake apparatus, a reservoir normally containing air at atmospheric pressure, and a manually-operated valve mechanism for controlling communication from said reservoir to the train-pipe, another reservoir normally containing air at atmospheric pressure, and a valve device operated by an increase in train-pipe pressure for opening communication from the second reservoir to the train-pipe for accelerating the application of the brakes.

7. In an automatic vacuum-brake apparatus, a train-pipe, a reservoir normally containing air at atmospheric pressure, an operating-chamber, and means operated by the opposing pressures of the train-pipe and the operating-chamber for controlling communication from the reservoir to the train-pipe.

8. In an automatic vacuum-brake apparatus, a train-pipe, a reservoir normally containing air at atmospheric pressure, an operating-chamber communicating with the brake-cylinder, and a valve device operated by the opposing pressures of the train-pipe and the operating-chamber for controlling communication from the reservoir to the train-pipe.

9. In an automatic vacuum-brake apparatus, a train-pipe, a reservoir normally containing air at atmospheric pressure, an operating-chamber, and a valve device operated by the opposing pressures of the train-pipe and the operating-chamber for controlling communication from the reservoir to the train-pipe and from the atmosphere to the operating-chamber.

10. In an automatic vacuum-brake apparatus, a train-pipe, a reservoir normally containing air at atmospheric pressure, an operating-chamber, a movable abutment subject to the opposing pressures of the train-pipe and the operating-chamber, a valve actuated by said abutment and adapted under a small sudden rise in train-pipe pressure to open communication from the reservoir to the train-pipe, and under a large sudden rise in train-pipe pressure to open a large port direct from the atmosphere to the train-pipe.

In testimony whereof I have hereunto subscribed my name this 5th day of June, 1905.

JOHN WILLS CLOUD.

Witnesses:

GEORGE ISAAC BRIDGES,
A. A. BERGIN.