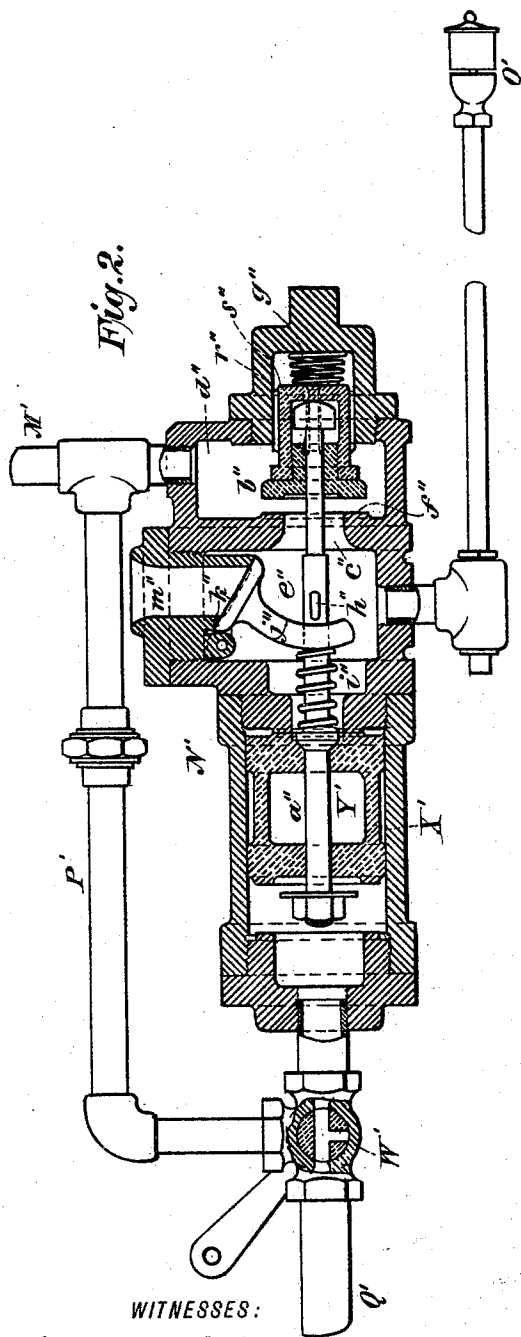


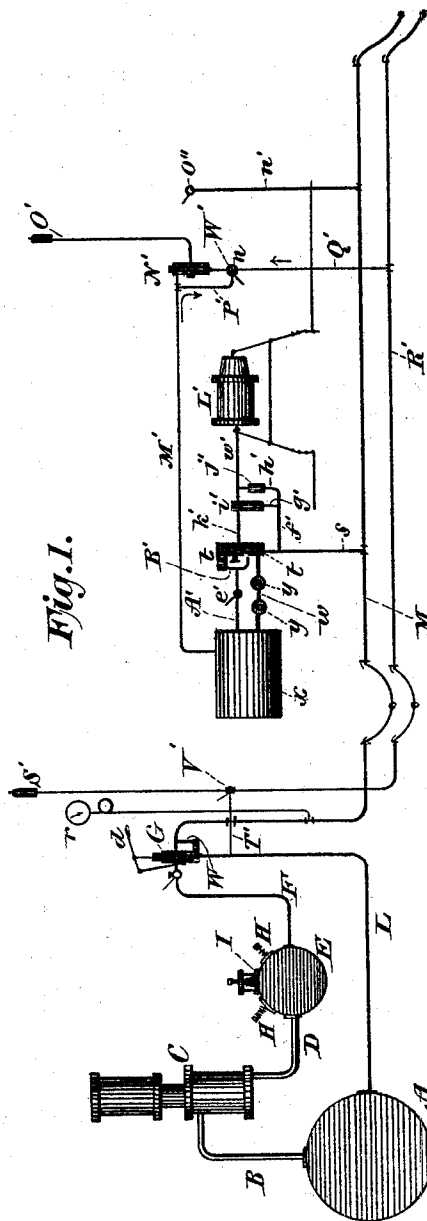
E. A. TRAPP.
AIR BRAKE MECHANISM.

No. 585,927.

Patented July 6, 1897.



WITNESSES:
Edwin H. Dieterich.
G. Dieterich.



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Fig. 3.

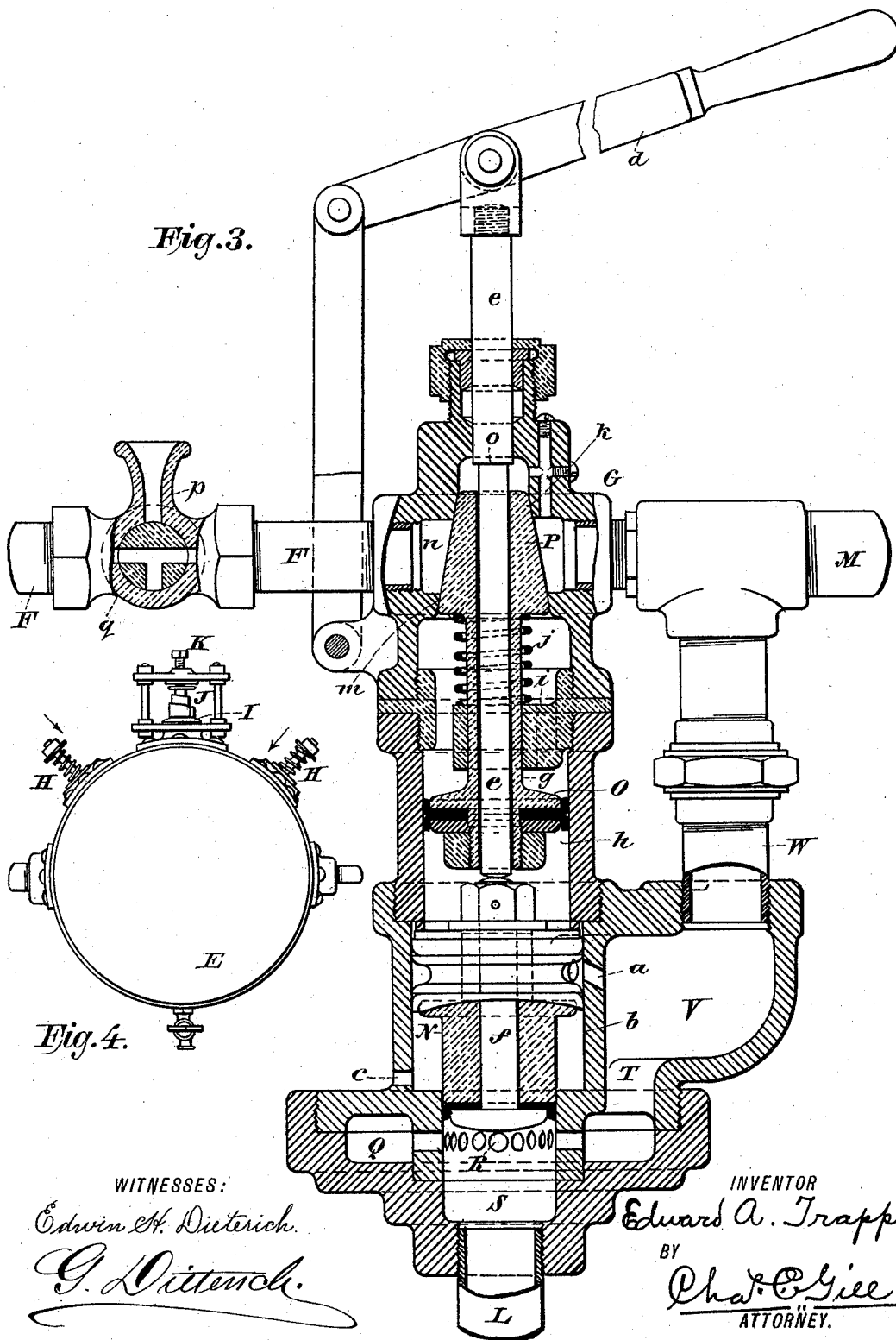


Fig. 4.

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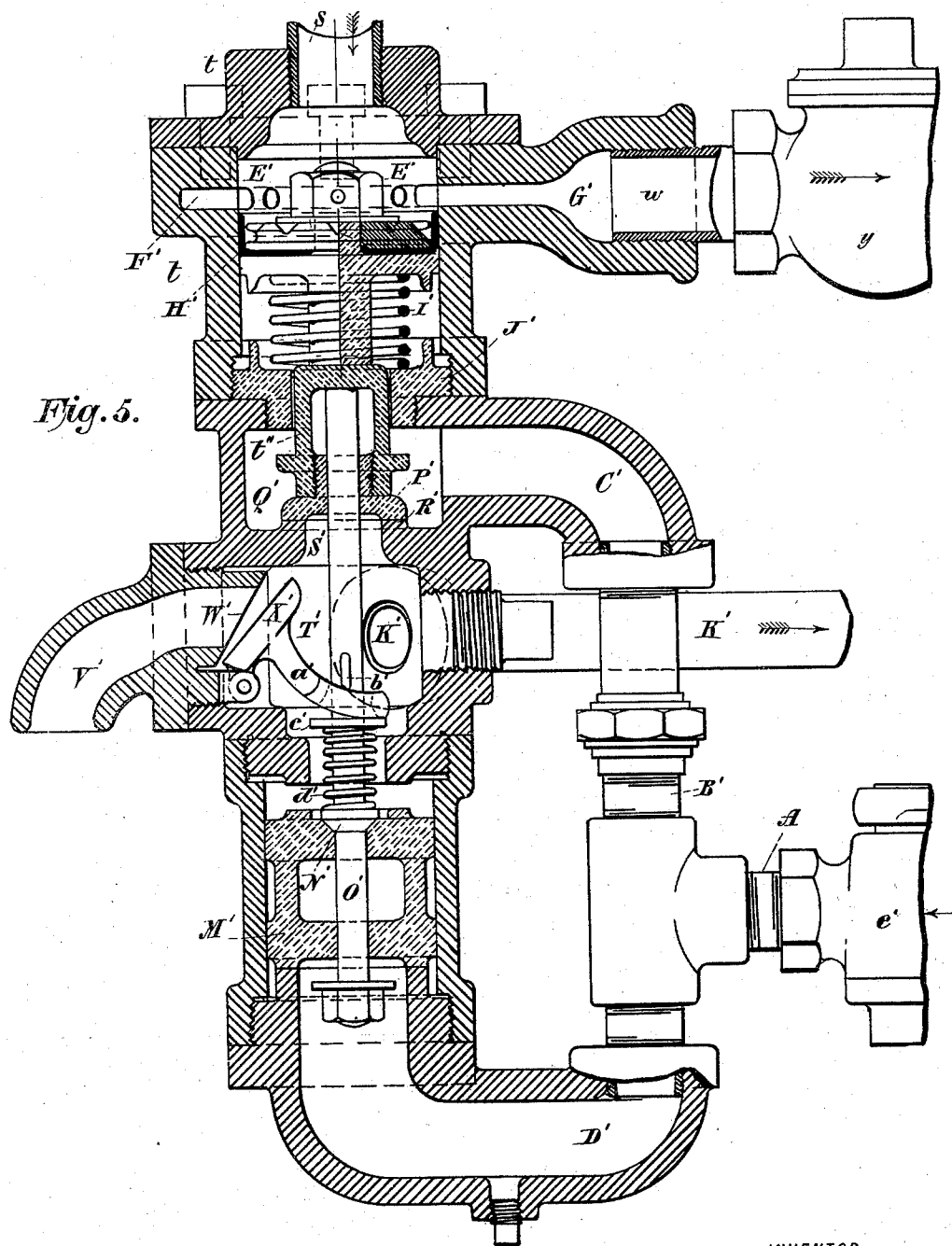
(No Model.)

4 Sheets—Sheet 3.

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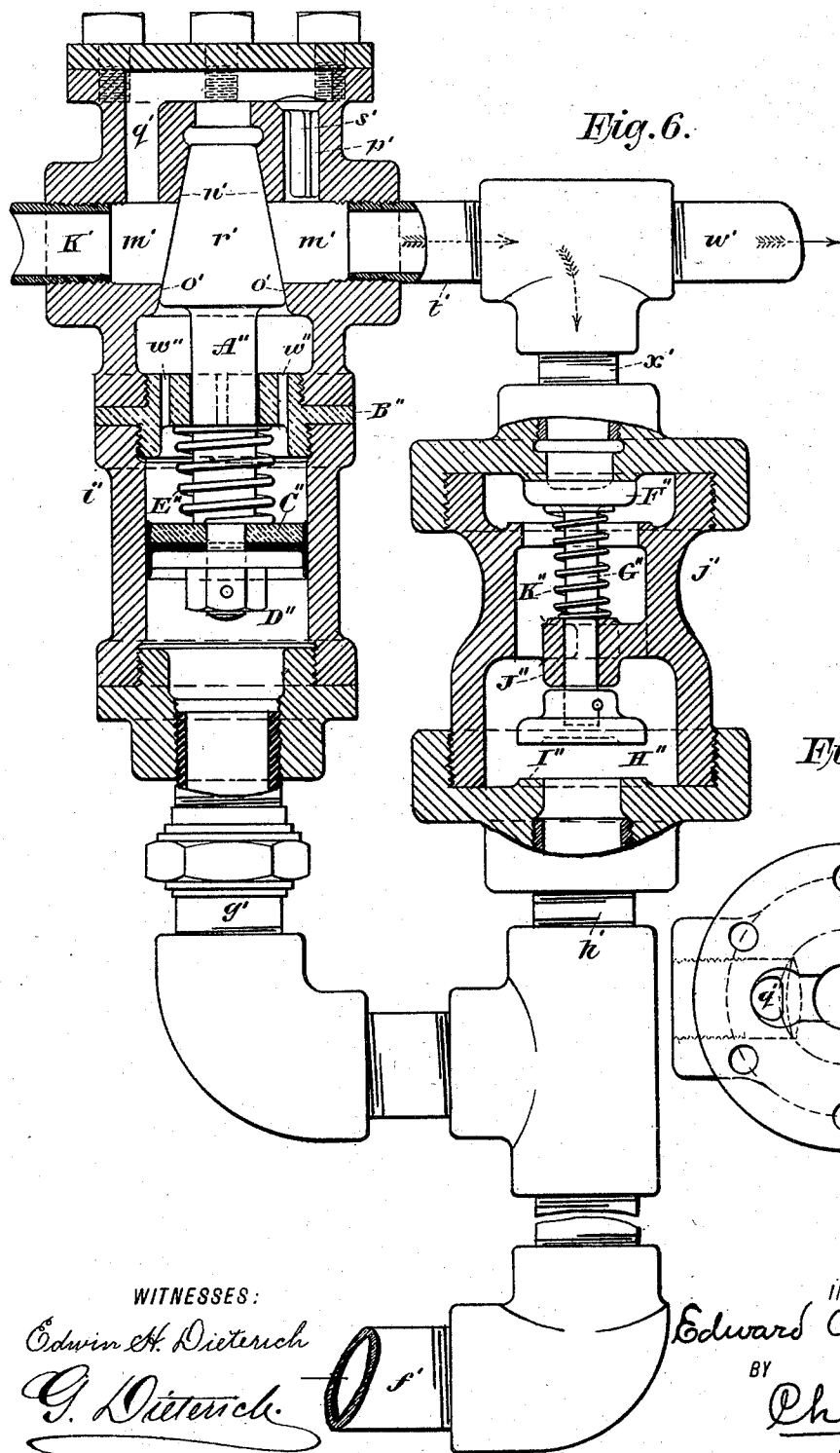
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4 Sheets—Sheet 4.

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WITNESSES:

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UNITED STATES PATENT OFFICE.

EDWARD A. TRAPP, OF NEW YORK, N. Y.

AIR-BRAKE MECHANISM.

SPECIFICATION forming part of Letters Patent No. 585,927, dated July 6, 1897.

Application filed July 28, 1896. Serial No. 800,775. (No model.)

To all whom it may concern:

Be it known that I, EDWARD A. TRAPP, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Air-Brake Mechanism, of which the following is a specification.

The invention relates to improvements in air-brake mechanism for railway-cars; and it consists in the novel features and combinations of parts hereinafter described and claimed.

In accordance with my invention a complete new system of brake mechanism is produced, and each of the various essential features of the system, as well as the combination of these features, will be fully described hereinafter. The various essentially novel valve constructions are not to be limited to brake mechanism entirely, nor to the use of any special fluid or liquid as a motive force. My new air-brake system comprises, for the locomotive, the usual compression-pump and main reservoir for compressed air and also a novel engineer's valve and an auxiliary reservoir which supplies the said pump and into which the compressed air from the main train-pipe line is, under the control of the engineer, exhausted. The said auxiliary reservoir on the locomotive is furnished with valved inlets and a valved outlet which is set to open at a predetermined air-pressure within the said reservoir. The engineer's valve on the locomotive possesses new and advantageous features, which are described in detail hereinafter, and said valve is connected by pipes with the main and auxiliary reservoirs on the locomotive and also with the main train-pipe line extending to all the cars of the train. Each car of the train will be furnished with the usual auxiliary tank or reservoir for compressed air and the usual brake-cylinder and its connections, and in addition each car will have intermediate its tank or reservoir, the brake-cylinder, and main train-pipe line a novel main initial or controlling valve or valves and novel pressure balancing or graduating valves, as hereinafter more fully described.

In accordance with my invention provision is made at each car for the conductor or other

person to signal the engineer by means of the air from the car reservoir or tank and an auxiliary air-pipe line passing to a whistle on the locomotive, and also, should the necessity arise, to exhaust the air from the main pipe-line and apply the brakes. The engineer is enabled by means of said auxiliary pipe-line and its connection with the main reservoir on the locomotive to sound a whistle in each car of the train should he deem it necessary to signal either the conductor or passengers.

The nature of my invention and practical means and methods of carrying the same into effect are described in detail hereinafter with reference to the accompanying drawings, forming a part of this application.

Referring to the accompanying drawings, Figure 1 is a diagrammatic view illustrating the complete system involving my invention applied to a railroad-train for operating the brakes and giving signals either from the engineer's cab to the conductor or passengers within the car or from the conductor in the car to the engineer in his cab. Fig. 2 is a central vertical section of the valves and their casing which are connected with the auxiliary reservoir and auxiliary pipe-line and utilized more particularly with reference to the signal to be given in case of necessity to the conductor or passengers within the car from the engineer's cab. Fig. 3 is an enlarged vertical section of the valve under the control of the engineer in his cab and utilized by him for exhausting the air from the main pipe-line, in order that the air-pressure from the auxiliary reservoir will apply the brakes, this valve being commonly known as an "engineer's" valve. Fig. 4 is an enlarged end view of a supplemental reservoir located on the engine and connected with the usual air-pump, which delivers air to the usual storage-reservoir for compressed air on the locomotive, said supplemental reservoir being also connected by a pipe-line to the engineer's valve. Fig. 5 is an enlarged vertical section of the main initial valve with its proper connections, through which, from the main pipe-line, the air passes to the auxiliary reservoir and through which also the compressed air from the said reservoir passes to the graduating-valves and to the piston of the brake-cylinder. Fig. 6 is an enlarged ver-

tical section of the graduating-valves from which the compressed air passes directly to the brake-cylinder; and Fig. 7 is a top view of the main-graduating-valve casing, the same
 5 being partly in section and the cap on the upper end of said valve being omitted.

In the drawings, referring to Fig. 1, A designates the usual reservoir for the compressed air, located on the engine, this reservoir being connected by a usual pipe B with the air-pump C, which, instead of directly taking its
 10 air from the open atmosphere, is by means of a pipe D connected with the supplemental reservoir E, also located on the engine, and connected by a pipe F with the engineer's
 15 valve G. The reservoir E is provided with the inwardly-opening automatic check-valves H H, of usual construction, and also with the outwardly-opening valve I, which is held
 20 upon its seat by the volute spring J, whose tension is regulated by means of the screw K. The spring J serves to weight the valve I and will be adjusted at will, in order that upon the air within the reservoir E reaching
 25 a certain predetermined pressure it (the said air) will be enabled to elevate the valve I and escape into the atmosphere. The valves H constitute inlet-valves to the reservoir E, and the valve I serves as a means for per-
 30 mitting the escape of the air from said reservoir E when the pressure in the latter becomes unduly great.

The utility of the reservoir E will be more fully understood after the complete system presented has been described, and it constitutes one of the features of the present invention. The engineer's valve (lettered as a whole G) is connected at its upper end by
 35 the pipe F with the reservoir E and at its lower end by the pipe L with the main reservoir A, and the interior construction of the engineer's valve is fully illustrated in Fig. 3, in which it will be observed that the upper
 40 and lower ends of the valve-casing are connected with the main pipe-line M, extending through the train. Within the casing of the engineer's valve are provided the piston-valve N, the piston O, and the conical plug-valve P. The piston-valve N is at the lower end of
 45 the casing of the engineer's valve directly above the inlet-pipe L, leading to the said casing from the main reservoir A. Within the lower end of said casing is formed the annular chamber Q, which, by means of the series of apertures R, communicates with the
 50 central chamber S, formed in the lower end of the said casing and directly into which the pipe L leads. The annular chamber Q directly communicates through a passage T with a chamber V, which, by means of the
 55 branch pipe W, is in communication with the main pipe-line M. The piston-valve N is shown in its upward position in Fig. 3, and when in this position said valve N leaves the
 60 apertures R wholly uncovered and permits a free flow of the air from the pipe L and chamber S into the annular chamber Q, and thence

through the passage T into the chamber V, whence the air passes through the pipe W to the main train-pipe M. The wall of the cas-
 70 ing between the chamber V and the piston-valve N is formed with the aperture or apertures *a*, which are closed by said piston-valve when the latter is in its upper position and
 75 opened when the latter is in its lower position. The lower portion of the valve N is less in diameter than the upper portion of the said valve, and the lower portion of said valve is adapted to the walls of the chamber S
 80 around it, while the upper portion of said valve is adapted to the walls of the cylinder *b*, formed in the valve-casing to receive it. The lower portion of the cylinder *b* is provided with a small outlet or vent *c* to permit the
 85 escape of any air which may gather within the cylinder *b* below the upper enlarged portion of the valve N. The valve N is normally held in its upward position by the pressure of the air from the pipe L, and is depressed
 90 at the proper time by means of the hand-lever *d*, acting through the stem *e*, which, as illustrated in Fig. 3, passes downward through the conical valve P and piston O and has its lower end seated upon the upper end of the
 95 stem *f*, which passes directly through the said valve N. It will be readily observed that upon the depression of the outer end of the handle *d* the stem *e* will be depressed against the valve N and drive the latter down-
 100 ward until the lower end of said valve N closes over the apertures R, which form the communication for the compressed air from the pipe L to the chamber Q and then to the main pipe-line M.

The conical valve P is hollow and formed
 105 with the downwardly-extending sleeve *g*, which carries upon its lower end the piston O, the latter closely fitting the interior of the cylinder *h*, formed in the valve-casing for the engineer's valve. The stem *e*, connected
 110 with the handle *d*, passes downward through the said valve P, sleeve *g*, and piston O, but is free of the said parts. Within the valve-casing and directly above the cylinder *h* thereof is provided the guide and support *i*,
 115 through which the sleeve *g* passes and above which may, if desired, be located the coiled spring *j*, which encircles the sleeve *g* and exerts a normal upward tension against the valve P. The valve P is directly between
 120 the pipes F and M and tapers downward and outward. It has no transverse passage through it and is adapted to seat itself both at its upper and lower ends, the casing being provided with the circular seats *k m* therefor.
 125 Within the valve-casing is formed the passage *n*, leading from the pipe F to the pipe M, and vertically within this passage *n* the plug-valve P has its movement. The normal position of the valve P is illustrated in Fig. 3,
 130 in which said valve is shown fully closing said passage *n* and cutting off communication from the pipe M to the pipe F. The stem *e*, passing downward through the valve P, is

provided with the shoulder *o*, which upon the handle *d* being depressed comes into contact with the upper end of the valve *P* and causes the latter to be depressed sufficiently to permit the exhaustion of the air from the pipe *M* through the passage *n* to the pipe *F*, and thence either to the supplemental reservoir *E* or to the open atmosphere through the valve-casing *p*, as may be desired. The first part of the downward movement of the handle *d* and stem *e* causes the downward movement of the valve *N* to close the apertures *R*, thus cutting off the supply from the reservoir *A*, and the continued downward movement of said handle *d* and stem *e* causes the shoulder *o* on the latter to effect the lowering of the valve *P*. The effect of depressing the handle *d* is, as will probably be well understood, to cut off the supply of compressed air from entering the main pipe-line *M* and to permit the air already in said main pipe-line to exhaust back into the supplemental reservoir *E* or into the open atmosphere through the casing *p*, as may be required. As soon as the engineer releases his hand from the handle *d* the latter, owing to the effect of the pressure from the reservoir *A*, will ascend to its normal position. (Shown in Fig. 3.) Upon the pressure being released from the handle *d* the air-pressure acting upward through the pipe *L* against the lower end of the piston-valve *N* will cause the latter to ascend, and the upward movement of the latter acting upon the stem *e* will drive the latter and the handle *d* to their upward position. The conical valve *P* may be aided in its upward movement by the spring *j*, but the latter will not be an absolute necessity, since the pressure in the chamber *V* will, while the piston-valve *N* is in its lower position, pass through the apertures *a* and act against the lower end of the piston *O*, connected by the sleeve *g* with said valve *P*, and instantly drive said valve to its upward position as soon as the engineer's hand has been removed from the handle *d*.

The form of the valve *P* is of great importance, since the engineer is enabled thereby to graduate the exhaustion of the air from the pipe *M* at will. By thrusting the stem *e* downward to varying degrees the passage *n* will be correspondingly opened, and hence the escape of the air from the pipe *M* to the pipe *F* may be varied at will. A downward thrust of the stem *e* would drive the valve *P* to its fully-open position and permit a very free escape of the air to the pipe *F*, while at intermediate points between its upward and its lowest positions the valve *P* would more or less open the passage *n*, and the escape of the air from the pipe *M* would be regulated accordingly.

The air exhausted from the pipe *M* to the pipe *F* will usually pass directly through said pipe *F* to the supplemental reservoir *E*, which supplies the pump *C*. The pipe *F* is, however, provided with the two-way valve *q*, which,

as illustrated in Fig. 3, may be turned to compel the passage of the air from the pipe *M* downward through the pipe *F* to the reservoir *E* or to direct the air exhausting from the pipe *M* into the open atmosphere through the outlet *p*. In all ordinary cases the valve *q* will close the casing *p*, but in the event of a sudden emergency in which it might be desired to instantly and as fully as possible exhaust the air from the pipe *M* the valve *q* would be turned to open the pipe *F* directly to the atmosphere. It is desirable, however, that the air returning through the pipe *M* should enter the reservoir *E* and be used for supplying the pump *C*. The main pipe-line *M*, in convenient relation to the engineer's valve *G*, will be provided with a suitable gage *r* for the guidance of the engineer, and said pipe-line *M* below each car of the train will be connected by a pipe *s* with the valve-casing *t*, (shown in Fig. 5,) and thence by means of the pipe *w* with the auxiliary reservoir *x*, of well-known construction. The pipe *w* is provided with one or more automatically-operating check-valves *y* to prevent the return of the compressed air from the reservoir *x*. From the reservoir *x* the pipe *A'* returns to the valve-casing *t*, said pipe *A'* connecting with a branch pipe *B'*, which at its upper end opens into the neck *C'* and at its lower end into the neck *D'*. The valve-casing *t*, with its interior parts, is intermediate the reservoir *x* and the graduating-valves through which the air passes directly to the brake-cylinder, and said casing, with its interior parts, is fully illustrated in Fig. 5, to which attention is directed. As above mentioned, the main pipe-line *M* is, by means of the pipe *s*, connected with one end of the casing *t*, and at this end of said casing is formed the cylinder *E'* and annular chamber *F'*, the latter communicating with said cylinder at its extreme end, and also with the nozzle *G'*, which receives the end of the pipe *w*, having the automatic checking-valve *y*, and leading directly to the auxiliary reservoir *x*.

The communication from the pipe *s* to the pipe *w* is controlled by the piston-valve *H'*, which is adapted to move in the said cylinder *E'* and has a tendency to return to its closed position, owing to the interposition of the coiled spring *I'* between it and the washer *J'*. The piston-valve *H'* is in Fig. 5 shown in its fully-open position, and in this position it is held by the pressure of the air in the pipe *s* and main pipe-line *M*. When the air is exhausted from the main pipe-line *M* by the action of the engineer's valve *G*, the valve *H'* will instantly close the annular chamber *F'* from communication with the pipe *s* and thus cut off the passage for the air from said pipe *s* to the pipe *w*, leading to the auxiliary reservoir *x*. While the pressure of the air exists in the main pipe-line *M* the valve *H'* will remain in its open position (shown in Fig. 5) and communication will remain established from the pipe *s* to the pipe *w*, and at

such time there will be no passage of the compressed air from the auxiliary reservoir x through the pipe A' to the casing t . When, however, the air is exhausted from the main pipe-line M by the action of the engineer's valve G and pressure is relieved from the outer end of the piston-valve H' , the pressure of the air from the reservoir x , passing through the pipes A' B' and necks C' D' , will act instantly and pass from the valve-casing t through the pipe K' to the graduating-valves, (shown in Fig. 6,) and thence to the brake-cylinder L' , for the purpose of applying in the usual way the brakes. When the pressure is relieved from the pipe s , the pressure exerted by the air from the reservoir x will act upon the piston M' in the casing t and drive the latter upward against the shoulder N' on the valve-stem O' , and thus the piston and stem will be moved toward the pipe s . The stem O' enters and abuts against the cap t'' , screwed on the valve P' , and the said cap t'' is in contact with the stem of the piston-valve H' , the valve P' being within the chamber Q' and adapted to the seat R' , which encircles the passage S' intermediate said chamber Q' and a central chamber T' , which leads directly into the pipe K' , passing to the graduating-valves. The chamber T' is provided with an exhaust-nozzle V' , upon which is formed the seat W' , adapted to receive the valve X' , the latter having a shank a' upon the stem O' and being between the projection b' and stop c' on said stem. Between the stop c' and shoulder N' of the stem O' is provided the coiled spring d' , which retains the stop c' against said shank a' of the valve X' . When the stem O' starts to move toward the pipe s for the purpose of closing communication from the latter to the pipe w , the stop c' , acting through the shank a' , will close the valve X' against its seat W' and thus seal the exhaust V' and leave the pipe K' as the only escape for the compressed air from the central chamber T' . The said movement of the stem O' toward the pipe s elevates the valve P' from its seat R' , and hence the exhaust V' is not only closed during said movement of the stem O' , but the passage S' is open for the compressed air from the neck C' to the central chamber T' , and thence to the pipe K' and graduating-valve. The thrust of the valve-stem O' toward the pipe s is effected when the pressure in the pipe s is released by the force of the compressed air from the auxiliary reservoir x acting upon the end of the piston M' and driving the latter against the shoulder N' of the stem O' and finally moving both piston and stem toward the pipe s . The pressure of the air from the auxiliary reservoir x is within both the necks C' and D' at all times, but has no effect either to move the piston M' or enter the chamber T' except when the pressure in the pipe s is reduced by the engineer's valve G , and when the pressure in the pipe s is thus reduced the piston M' , being of greater surface area than the valve P' , will by the

action of the compressed air in the neck D' be driven toward the pipe s and open the valve P' , in order that the air under pressure of the auxiliary reservoir x may at once enter the central chamber T' and find its passage through the pipe K' to the graduating-valves, and thence to the brake-cylinder. The difference in surface area between the piston M' and the valve P' enables the air in the neck D' to move said piston and open said valve. After the air has ceased to exhaust from the main pipe-line M and pipe s the pressure in said pipes will be restored and will act on the piston-valve H' to drive the latter inward from the annular chamber F' , so as to reopen communication from the pipe s to the pipe w and also at the same time close the valve P' , open the valve X' , and move the piston M' to the position in which it is shown in Fig. 5. The opening of the valve X' is to permit the air from the central chamber T' to exhaust through the nozzle V' , and the closing of the valve P' cuts off the air from the reservoir x from entering said chamber T' and pipe K' . During the closing of the valve P' the projection b' on the stem O' strikes the shank a' of the valve X' and causes the latter to open on its hinge, as shown in Fig. 5. The parts will remain in the position in which they are shown in Fig. 5 until the engineer by means of the valve G again exhausts the air from the pipe s and main pipe-line M , and on the happening of such occasion the air-pressure in the neck D' will again move the piston M' , valve-stem O' , and piston-valve H' toward the pipe s , closing thereby the valve X' and opening the valve P' , in order that the compressed air from the reservoir x may again enter the central chamber T' and pass through the pipe K' to the graduating-valve, and thence to the brake-cylinder. The pipe A' will be provided with a suitable cut-out valve e' of well-known construction and purpose.

The graduating-valves receive the air from the pipe K' , and said valves are fully illustrated in Figs. 6 and 7. The pipe K' leads to the upper end of the casing for the graduating-valves, and at the lower end of the casing for the graduating-valves a pipe f' leads directly to the pipe s , which is, as above described, connected with the main pipe-line M . The pipe f' , through the branches g' h' , leads to both of the casings for the graduating-valves, which casings are for convenience lettered i' j' , respectively. The upper end of the casing i' receives the discharge end of the pipe K' and is formed with the transverse passage m' , valve-seats n' o' , vertical passage p' , and the passage q' , which extends upward from said passage m' and passes above the conical plug-valve r' and above the downwardly-acting check-valve s' . The passage m' at its outlet end is connected by a pipe t' with the pipe w' , leading to the brake-cylinder, and also by a branch x' with the upper end of the casing j' for the supplemental

graduating-valve. The conical plug-valve r' tapers downward and outward and is adapted to seat itself, both at its upper and lower circumferential edges, upon the seats n' o' and to close the passage m' . The conical valve r' has no transverse passage through it, and all movement of the air from the pipe K' to the pipe t' is around said valve r' , and the volume of air thus passing around the valve r' is, owing to the form of the valve, capable of being regulated at will in accordance with the position of said valve with respect to the passage m' . The valve r' is shown fully closed in Fig. 6, and under such condition there is no communication for air between the pipe K' and pipe t' . A slight downward movement of the valve r' will afford a corresponding communication for the air from the pipe K' to the pipe t' , and a greater downward movement of the valve r' will afford a correspondingly greater passage for the air around the said valve to the pipe t' . Hence the position of the valve r' and the extent of its reciprocation toward or from its seats n' o' will govern the extent of the passage open for the air from the pipe K' to the pipe t' , and this feature of the construction is also of great importance, since by reason of the form and arrangement of the valve r' the extent of the opening in the passage m' may be regulated at will. When the valve r' is in its closed position, as shown in Fig. 6, any air-pressure in the pipe t' may exhaust upward through the passage p' and into the pipe K' ; but the valve s' will prevent any movement of the air from the pipe K' to the pipe t' . The valve r' has a downwardly-extending stem A'' , which passes through a guide B'' and carries the piston C'' , the latter being within the cylinder D'' , and said stem having between the washer B'' and the piston C'' the coiled spring E'' , which exerts a downward tension against said piston, and consequently tends to draw the valve r' from its seat. Within the adjacent casing j' for the supplemental graduating-valve is provided the upwardly-acting valve F'' , having a downwardly-extending stem G'' , carrying upon its lower end the valve H'' , adapted to close upon the seat I'' , surrounding the inlet from the branch pipe h' , leading into the lower end of the said casing j' from the pipe f' , which, as above mentioned, connects directly with the pipe s .

The valve-stem G'' passes through a guide J'' and has between said guide and the valve F'' the coiled spring K'' , which has an upward tension to close the valve F'' and open the valve H'' . When the reservoir-pressure is on the pipe s and through the latter on the pipe f' and branch pipes g' h' , the said pressure will act against the piston C'' in the casing i' to retain the valve r' in its closed position, and said pressure will at the same time act against the valve H'' and valve F'' to retain the latter closed and the valve H'' open. When, however, the reservoir-pressure is exhausted from the main pipe-line M and pipe

s , the pressure will be withdrawn from the pipe f' and branch pipes g' h' , and at such time the pressure from the auxiliary reservoir x will act upon the upper end of the valve r' to drive the latter downward and open the passage m' to the pipe t' , and upon leaving the pipe t' will, through the branch pipe x' , drive the valve F'' downward from its seat, the valve F'' being resisted in this movement by the spring K'' and the valve r' being assisted in its downward movement by the spring I' . The upper end of the valve r' is exposed to the pressure of the air in the pipe K' , and hence when the pressure is relieved from the piston C'' at the lower end of the casing i' the pressure from the auxiliary reservoir x , acting through the pipe K' and passage q' , is enabled to open the valve r' . The valves r' F'' will only remain open so long as the pressure in the pipe K' is greater than the pressure in the pipe f' and main pipe-line M , and hence with any excess of pressure in the pipe M and pipe f' the valves r' and F'' will close. The exhausting of the air from the main pipe-line M by the engineer's valve G results in the opening of the valves r' F'' and the passage of the air through the pipe w' to the brake-cylinder L' and the applying of the brakes to the wheels.

From the auxiliary reservoir x a pipe M' passes to the casing N' of the valve shown in Fig. 2, which controls the whistle or signal O' , and said pipe M' is connected by the branch pipe P' with the pipe Q' , which passes from the lower end of said casing N' to the auxiliary pipe-line R' , which extends throughout the train and leads at the engine to the whistle or signal S' . At the engine the pipe R' is connected with the main pipe L , passing from the reservoir A by means of the connecting-pipe T' . At the junction of the pipe R' and pipe T' is provided the two-way valve V' , which may be operated by hand. At the junction of the pipe P' with the pipe Q' is also provided a two-way valve W' , which may be operated by hand, either by the conductor in the car or by one of the passengers. The signal O' may be sounded by the engineer from his cab, and the signal S' is intended to be sounded by the conductor or a passenger in the car.

The valve-casing N' , with its interior mechanism, is fully illustrated in Fig. 2, in which it will be observed that at the end of the casing into which the pipe Q' leads is formed the cylinder X' , within which the piston Y' is adapted to have a reciprocating motion. Through the piston Y' passes the valve-stem a'' , which at the upper end of said casing N' carries the valve b'' , which has a surface area less than that of the piston Y' and is adapted to be seated around the opening c'' , which leads from the valve-chamber d'' to a substantially central chamber e'' within the said casing N' . The valve b'' is given a normal tension toward its seat f'' by means of the spring g'' pressing against the outer end of

said valve. Upon the stem a'' within the chamber e'' are provided the projection h'' and coiled spring i'' , between which projection and spring is placed upon said stem a'' the shank j'' of the valve k'' , the latter being adapted to open or close the exhaust-port m'' . In the position in which the piston Y' and valve b'' are illustrated in Fig. 2 the air from the auxiliary reservoir x is enabled to pass from the pipe M' into the chamber d'' and thence through the opening c'' into the central chamber e'' , whence it will pass to and sound the whistle O' . When the piston Y' and valve b'' are in the position illustrated in Fig. 2, to permit the sounding of the whistle O' the valve k'' will be closed over the exhaust-port m'' ; but when the valve b'' is seated and the piston Y' is moved toward the pipe Q' the projection h'' , coming against the shank j'' of the valve k'' , will turn the latter upon its hinged connection and permit such air as may be in the central chamber e'' to exhaust through the port m'' . When the valve b'' is seated, no air from the reservoir x can reach the signal O' . The valve b'' is elevated from its seat by air-pressure from the reservoir A passing through the pipe L , pipe T' , valve V' , pipe-line R' , and pipe Q' and acting against the piston Y' in the casing N' . The pipe R' , being connected with the pipe L , will receive compressed air therefrom when the engineer turns the valve V' to open the communication, and hence when the valve W' is in the position in which it is illustrated in Fig. 2 the compressed air may pass through the pipe Q' into the said casing N' and act against the piston Y' to move it and through it the stem a'' for the purpose of opening the valve b'' and closing the exhaust-valve k'' . Thus when it is desired to sound the signal O' the engineer will simply operate the valve V' to allow air to enter the pipe R' for the purpose of acting on the piston Y' to open the valve b'' , and thus permitting the air from the reservoir x to reach and sound the whistle O' .

When the valve W' is turned to cut off the casing N' from the pipe Q' , the compressed air from the auxiliary reservoir x will pass through the pipe M' , branch pipe P' , and pipe Q' into the auxiliary train-pipe R' , and thence said air will pass upward to and sound the whistle S' . Thus the conductor is enabled to signal to the engineer when desired. When the engineer desires to signal to the conductor or to the passengers in the car, he will simply turn the valve V' in order to direct the air from the pipe L and branch pipe T' into the auxiliary train-pipe R' , and thence the air will ascend through the pipe Q' into the lower end of the valve-casing N' and lift the piston Y' and valve b'' , closing at the same time the valve k'' . Under this condition the air from the auxiliary reservoir x will pass into the casing and thence to the signal O' , as above described.

The weight of the piston Y' helps to return

the valve b'' to its seat f'' , and the upper end of the valve-stem a'' is free within the valve b'' , but carries a shoe or head r'' within a cap s'' , Fig. 2, screwed upon the valve b'' . During the descent of the valve-stem a'' the shoe or head r'' pulls downward on the valve b'' , and during the ascent of the stem a'' , under the action of the piston Y' , the said head or shoe r'' presses against the said cap s'' , and thereby lifts the valve b'' from its seat and compresses the spring g'' .

The valve within the casing N' is utilized wholly in connection with the signal O' , and is auxiliary to the main system, which is intended for the operation of the brakes. The auxiliary train-pipe line R' carries no compressed air, and is only used when a signal is to be sent from the train to the engineer or from the engineer to the train.

In each car of the train the main pipe-line M may be provided with the auxiliary pipe n'' , having at its upper end the valve o'' within convenient reach of the conductor, and by which, should occasion render necessary, he may instantly exhaust the air from the main pipe-line M and apply thereby the brakes.

The plug-valve r' and its connected piston O'' (shown in Fig. 6) are similar to the plug-valve P and piston O of the engineer's valve. (Shown in Fig. 3.) In the engineer's valve, when the parts are held depressed to a greater or less extent by the handle d , the air from the chamber V enters through the apertures a and cushions the piston O , so that the engineer on moving the handle d to its varying intermediate positions may have a positive force to work against and be enabled to more accurately and conveniently set the lever-handle d than would be the case if the valve P were entirely free to fall to its lowest position. The said plug-valves r' P are, as above described, seated at their upper and lower ends, and below each valve is a chamber in which the larger end of the valve may reciprocate. The opposite sides of the casings inclosing the plug-valves r' P correspond in form with the opposite sides of said valves and closely engage the latter when said valves are in their closed position.

When the valve r' , Fig. 6, lowers from its seats the air in pipe K' passes around it and also escapes below it, and through the apertures w'' in the washer B'' acts against the upper surface of the piston C'' . The air at opposite sides of said piston acts in opposite directions, and hence the plug-valve r' automatically opens more or less, according to the varying air-pressure on the piston C'' , whereby the flow of air toward the power-cylinder may be kept under control.

The twin valves F'' H'' are of importance and are sensitive to the varying air-pressures in the pipes K' and M . Any excess of pressure at the upper side of the valve F'' causes the latter to leave its seat and permit such excess to exhaust around it to the pipe f' .

Thus should any undue pressure of air be sent to the power-cylinder the same would be prevented from improperly acting on the brakes since such pressure would open the valve F". The position of the valves F" H" fluctuates with the variations of pressure in the pipes K' M, and hence the engineer by thoughtfully operating the engineer's valve may regulate at will the degree of pressure to be exerted on the brakes in accordance with existing conditions, such as the character of grades over which the train is moving and other circumstances, as hereinafter described. Should an emergency application of the brakes be required, the engineer will promptly exhaust the air from the train-pipe by opening the two-way valve *q* in the pipe F, under which condition the valve H" will fully close and the full pressure of the air from the car-reservoir will pass to the brake-cylinder and act in a well-known manner upon the brakes.

The special construction of the valves shown in Figs. 2, 3, 5, and 6 is new, so far as I am aware, and I do not relinquish my right to control them for other power mechanism or system than those herein specifically shown and described. The invention is not, therefore, limited solely to the air-brake mechanism nor to mechanism using air as the motive force.

The pipe *w'* is in effect simply a continuation of the pipe K' to the power-cylinder L' and has been given herein the letter *w'* to avoid possible confusion.

The operation of the mechanism comprising the compressed-air system has been described with reference to the construction and movement of the various valves forming a part of the system and illustrated in the accompanying drawings, and hence a brief review only of the operation seems all that may be necessary.

The pump or compressor C takes its air from the tank or reservoir E and delivers it through the pipe B to the main tank or reservoir A, which by means of the pipe L is connected with the lower end of the casing for the engineer's valve G, as shown in Figs. 1 and 3. The lower end of the casing for the engineer's valve is connected with the main pipe-line M by means of the chamber V and branch W in order that the compressed air from the reservoir A may enter the main train-pipe line M and pass thence to the auxiliary reservoir *x* on each car of the train. The main train-pipe M is also connected with the upper end of the casing for the engineer's valve in order that the pressure in said main pipe-line may at the proper time exhaust through said casing and the pipe F, connected therewith, and enter the auxiliary tank or reservoir E on the locomotive. The reservoir or tank E may thus be kept supplied with air which has already been under pressure and which is more desirable for the pump C and tank A than ordinary atmospheric air. It is necessary, however, that the auxiliary

tank or reservoir E be provided with the valved inlets H, and I deem it desirable that the said reservoir or tank E be also provided with the weighted valve I, which will open outwardly and permit the escape of the compressed air from said tank or reservoir E upon the pressure becoming unduly great in said tank or reservoir E. The pipe F, intermediate the tank or reservoir E and the engineer's valve, will preferably be furnished with the valve *q*, which will only be used when the engineer desires to suddenly exhaust the air from the main train-pipe line M into the open atmosphere. The pressure of the air in the main reservoir A and the pipe L, leading therefrom, will retain the piston N and plug-valve P of the engineer's valve in their upward position except at such times as it may be necessary for the engineer, by the depression of the lever *d*, to move said piston and plug-valve to their lower position for the purpose of cutting off the supply of air from the pipe L and permitting the exhausting of the air from the main pipe-line M, through the engineer's valve-casing, to the tank E, or to the open atmosphere through the valve *q*. The form of the valve P is such as to enable the engineer to regulate to a nicety the extent that the air from the main pipe-line M shall exhaust.

The main pipe-line M is connected by the pipe *s* with the valve-casing *t*, and thence by means of the pipe *w*, having the automatic check-valve *y*, with the auxiliary reservoir *x* of each car of the train, and at each car of the train the pipe *s* is by means of the pipe *f'* connected with the casings of the two balancing or graduating valves shown in Fig. 6, whose casings are connected with the valve-casing *t* by means of a pipe K', which passes to the brake-cylinder L'. The auxiliary reservoir *x* is by means of a pipe A' connected with the valve-casing *t* and the arrangement of the pipes and their branches is such that the air from the main pipe-line M passes through the pipe *s* and pipe *w* to the auxiliary reservoir *x* and also to the lower ends of the casings *i' j'* for the balancing or graduating valves shown in Fig. 6.

The pressure of the air in the pipe *s* operates upon the piston H' to hold the latter at its open position in order that the air from the pipe M may enter the auxiliary reservoir *x*, and also in order that the valve P' may be maintained upon its seat R' for the purpose of preventing the air in the auxiliary reservoir *x* from passing to the outlet-pipe K', leading to the graduating-valves and to the brake-cylinder L'. Upon the air in the main train-pipe M becoming exhausted by the action of the engineer's valve the pressure in the pipe *s* will no longer maintain the piston H' in its open position, and at such time the pressure of the air from the auxiliary reservoir *x* will act upon the piston M' to open the valve P' and close the exhaust-valve X', and at such time the air from the auxiliary reservoir *x* will pass into the pipe K' and thence through

the balancing valve-casings $i' j'$ directly to the brake-cylinder L' for the purpose of applying the brakes. As soon as the engineer releases the depressed lever d the pressure of air in the reservoir A will elevate the piston-valve N and plug-valve P of the engineer's valve and reestablish the pressure in the main pipe-line M and its branch pipe s , the result of which is that the pressure of air in the pipe s will reopen the piston-valve H' and close the valve P' , thereby cutting off the escape of the air from the auxiliary reservoir x into the pipe K' and releasing the brakes.

The valves in the valve-casings $i' j'$ (shown in Fig. 6) are subjected to the air-pressure in the main pipe-line M through the branches $g' h'$, and also to the air-pressure passing through the pipe K' to the brake-cylinder L' , and by means of the valves within the casings $i' j'$ the engineer may effectually graduate the pressure to be applied to the brakes. The exhausting from the pipe M is controlled by the engineer by the extent of the depression of the lever d of the engineer's valve, and in accordance with the degree of exhaustion from the pipe-line M the valves in the casings $i' j'$ are opened or closed under the air-pressure from the auxiliary reservoir x . When there is no exhaustion of air from the pipe-line M , the pressure in the latter maintains the plug-valve r' of the casing i' and the valve F'' of the casing j' in the closed position in which they are illustrated in Fig. 6, but upon the air in the main pipe-line M becoming exhausted to a greater or less degree, so that the pressure in the main pipe-line is less than the pressure in the auxiliary reservoir x , the air-pressure in said reservoir x , acting through the pipes K' and t' , will act upon the upper surface of the plug-valve r' and valve F'' and open the latter, thereby to an extent under the control of the engineer opening the valve r' to permit the passage of the compressed air from the pipe K' to the pipe w' , leading to the brake-cylinder L' . The valves in the casings $i' j'$ graduate the degree of air-pressure to be exerted on the brakes under the control of the engineer, who will apply greater or less pressure to the brakes in accordance with attendant circumstances. The gage r will constantly apprise the engineer of the degree of pressure existing in the main pipe-line M .

The method of effecting an emergency application of the brakes has been described hereinbefore.

It has been explained above that in case of emergency the conductor or other person at any car of the train may, by means of the valve o'' , exhaust the air from the main pipe-line M for the purpose of applying the brakes.

At each car of the train will be provided the whistle O' , connected with the auxiliary reservoir x by the pipe M' , which is connected by the branch P' with the pipe Q' , leading to the auxiliary train-pipe line R' . Intermediate the whistle O' and the pipes $M' Q'$ is the valve-casing N' . (Shown in detail in Fig. 2.)

The air-pressure in the pipe M' retains the valve b'' in said casing N' in its closed position, and when said valve is closed the whistle O' will remain silent, since no air at such time will be able to reach it. When, however, the engineer turns the valve V' in order that communication to the auxiliary train-pipe line R' is established with the pipe L , leading from the main reservoir A , the compressed air will pass through said auxiliary train-pipe line R' and enter through the valve W' , the lower end of the valve-casing N' , and, acting against the piston Y' , open the valve b'' , at which time the air in the pipe M' will be enabled to pass to and sound the whistle O' . The whistle O' and the connections just described enable the engineer to signal to the conductor or passengers in the cars should occasion render it necessary for him to do so. The whistle O' is sounded by means of the air from the auxiliary reservoir x , and the compressed air which enters the auxiliary train-pipe line R' from the reservoir A when the valve V' is turned to permit the same simply operates to open the valve b'' .

Upon the locomotive is provided the whistle S' , which is at the end of the auxiliary train-pipe line R' . This whistle S' is operated from the cars or any one of them to signal to the engineer, and it sounds when the conductor or other person in the car turns the valve W' to establish a communication between the branch pipe P' and the pipe Q' , leading to the said auxiliary train-pipe line R' . Upon this communication between the pipe P' and pipe Q' being established the air from the auxiliary reservoir x will pass from the pipe M' to the pipes $P' Q'$, and thence through the pipe R' to the whistle S' , causing the latter to sound. The air which operates the whistle O' passes through the valve-casing N' , while the air which sounds the whistle S' passes around said valve-casing N' .

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In power mechanism, the main reservoir, and the pump for supplying the same, combined with the engineer's valve connected with said main reservoir and with the main pipe-line both for the supply of said main pipe-line from the main reservoir and for the exhaust from said main pipe-line, said engineer's valve comprising within its external casing the piston-valve and plug-valve operable in one direction from a hand-lever, the piston-valve being exposed to the pressure in said reservoir and controlling the passage of the air from said reservoir to the main pipe-line, and said plug-valve being conical in outline and seated at its upper and lower ends at opposite sides of the passage through the valve-casing through which the air from the main pipe-line exhausts; substantially as set forth.

2. In power mechanism, the main reservoir, and the pump supplying the same, combined with the engineer's valve connected with said

reservoir and also with the pipe-line, said engineer's valve comprising the casing containing the piston-valve and the conical plug-valve operable in one direction by a hand-lever and in the opposite direction by the pressure from the said reservoir, said piston-valve controlling the passage through said casing of the compressed air to the main pipe-line, and said plug-valve controlling the exhaust of the air from said main pipe-line; substantially as set forth.

3. In power mechanism, the engineer's valve connected with the supply for compressed air, the main pipe-line and the exhaust from said pipe-line, said valve comprising the piston-valve at its inlet end for compressed air from the source of supply, the conical valve at its inlet end for the air exhausting from the main pipe-line, the chamber controlled by said piston-valve and leading to the main pipe-line, and the transverse passage under the control of said plug-valve intermediate the main pipe-line and the exhaust; substantially as set forth.

4. In power mechanism, the engineer's valve connected with the source of supply, the main pipe-line, and the exhaust, and comprising the casing containing the piston-valve and conical plug-valve and having at its inlet end the annular chamber Q, inlets R thereto, and the chamber V connected with the main pipe-line, and at its exhaust end the transverse passage intermediate the main pipe-line and exhaust and having the seats *k*, *m*, at its upper and lower edges for the reciprocating plug-valve, said plug and piston valves being adapted to be moved in one direction by a hand-lever and in the opposite direction by the pressure acting on the piston-valve; substantially as set forth.

5. In power mechanism, the valve-casing provided adjacent to its inlet end with the cylinder, and having at its opposite end the transverse passage through which the fluid must pass, combined with the piston located within said cylinder and exposed to pressure from said inlet and the conical plug-valve adapted to reciprocate within and at a right angle to the axis of said passage, said piston having a surface area larger than that of said plug-valve; substantially as set forth.

6. In air-brake mechanism, the main pipe-line supplied from the locomotive, and the auxiliary reservoir *x*, combined with the valve-casing *t* connected with said main pipe-line and with said reservoir by a valved pipe supplying air to said reservoir from the train-pipe, a return-pipe passing from said reservoir to said valve-casing, and the pipe passing from said valve-casing to the power-cylinder, said valve-casing having at its inlet end for air from the main pipe-line the piston-valve controlling said inlet, at its opposite end the piston exposed to the air-pressure from said reservoir, and at its intermediate portion the valve exposed at its outer surface to the pressure of air in said reservoir and be-

ing less in area than the said piston, said valve controlling the passage from said reservoir to the pipe leading to the power-cylinder, whereby upon pressure becoming exhausted against said piston-valve the pressure in said reservoir operating against said piston will open said valve and permit communication from said reservoir to said power-cylinder; substantially as set forth.

7. In air-brake mechanism, the main pipe-line supplied with compressed air from the locomotive, combined with the auxiliary reservoir on the car, the valve-casing *t* on the car and connected with said pipe-line, with said reservoir by supply and return pipes, and with the power-cylinder, said valve-casing containing at its inlet end the piston-valve exposed to the train-pipe pressure and controlling the inlet from the main pipe-line to said reservoir and at its opposite end the piston exposed to the pressure of the air in said reservoir, while intermediate said piston-valve and piston said casing is provided with a central chamber connected by a pipe with the power-cylinder and at one side of said chamber with the valve also exposed to the pressure of the air in said reservoir and controlling the passage of said air from the reservoir to said pipe leading to the power-cylinder, said central chamber being provided with an exhaust and a valve therefor; substantially as set forth.

8. In air-brake mechanism, the main pipe-line supplied with compressed air from the locomotive, combined with the auxiliary reservoir on the car, the valve-casing *t* adjacent thereto and intermediate said reservoir and said main pipe-line, the pipe connecting the inlet end of said casing to said main pipe-line, the valved pipe connecting the said end of said casing with said reservoir, the return-pipe connecting said reservoir with said casing, and the pipe passing from said casing to the power-cylinder, said valve-casing containing at its inlet end the piston-valve exposed to the train-pipe pressure, at its opposite end with the piston exposed to the pressure in said reservoir, at an intermediate point with the valve exposed to the air-pressure in said reservoir and having a smaller area than said piston and being intermediate the supply for air from said reservoir and the pipe leading to the power-cylinder, the rod connecting said piston-valve, piston and valve, the exhaust-valve operable from said rod, and an exhaust-port from the central portion of said casing; substantially as set forth.

9. In air-brake mechanism, the main train-pipe supplied with the compressed air from the locomotive, combined with the reservoir on the car, the valve-casing *t* connected with the main pipe-line and also by a valved pipe with said reservoir for supplying the latter, the return-pipe from said reservoir to said casing, the outlet-pipe from said casing to the power-cylinder, the connected piston-valve,

piston and outlet-valve within said casing and exposed respectively to the train-pipe pressure and reservoir-pressure, and the graduating-valves in said pipe leading to the power-cylinder and connected with the pipe passing from the main pipe-line to said valve-casing, said graduating-valves being exposed to the train-pipe pressure and to the pressure of the air passing through the outlet-pipe to the power-cylinder, and one of said graduating-valves comprising the conical plug-valve having on its stem the piston, while the other graduating-valve comprises the stem having upon its opposite ends the disk-valves; substantially as set forth.

10. In air-brake mechanism, the main pipe-line supplied from the locomotive, the auxiliary reservoir on the car, and the main valve controlling the inlet to said reservoir and the outlet therefrom to the brake-cylinder, combined with the graduating-valves in the outlet-pipe to the brake-cylinder and connected with the train-pipe whereby at their opposite ends they are exposed to the train-pipe pressure and to the reservoir-pressure, said graduating-valves having their casings connected and one of said valves comprising the conical plug-valve exposed at its upper end to air-pressure and at its lower end carrying a piston and being provided with the upwardly-acting check-valve in the passage leading over its reduced end, and the other graduating-valve comprising the stem having the disk valves on its opposite ends and provided with a spring tending to open one of said valves and close the other thereof; substantially as set forth.

11. In air-brake mechanism, the main train-pipe line supplied with air from the locomotive, and the reservoir on the car connected by a valved pipe with said main pipe-line, combined with the auxiliary pipe-line connected at the locomotive with the supply-pipe, the valve *V'* for said auxiliary pipe-line, the valve-casing *N'* connected at one end with the said reservoir and at the other end with the auxiliary pipe-line, the branch pipe connecting the pipes at opposite ends of said casing and having the two-way valve *W'*, and the signal *O'* connected with an intermediate portion of said valve-casing, the said valve-casing containing at its ends connected with the auxiliary pipe-line the piston and at the other end the valve adapted to be actuated by the movement of said piston and controlling the passage from the reservoir to the pipe leading to the signal, whereby the air allowed to enter said auxiliary pipe-line from the engine is enabled by acting against said piston to open said valve and permit the air from the reservoir on the car to sound the signal; substantially as set forth.

12. The air-signal on each car of the train, and means for storing compressed air, combined with means under the control of the engineer on the locomotive for directing said

air to said signals for sounding the latter; substantially as set forth.

13. The signal on each car of the train, and the auxiliary reservoir on each car of the train, combined with means under the control of the engineer on the locomotive for opening the air in said reservoir to said signals for sounding the latter; substantially as set forth.

14. The engineer's valve connected with the main pipe-line and having the exhaust-passage *n*, chamber *h*, and inlet *a* to said chamber, combined with the conical plug-valve *P* adapted to reciprocate within said passage *n* and the piston *O* connected with said plug-valve and exposed to pressure in said chamber *h* to resist the movement of said plug-valve; substantially as set forth.

15. The valve-casing having the central chamber connected with the delivery-pipe, the valve-chamber at one side of said central chamber and connected with the main inlet-pipe, and the cylinder at the opposite side of said central chamber and also connected with said main inlet or supply pipe, combined with the piston in said cylinder and exposed to the fluid-pressure in said main supply-pipe, the valve in said valve-chamber adapted to be seated around the inlet to said central chamber, and the connection intermediate said piston and valve whereby the latter under the pressure of the fluid in the supply-pipe may open said valve and permit said fluid to pass through said valve-chamber into said central chamber and thence to said delivery-pipe; substantially as set forth.

16. The valve-casing having the central chamber connected with the delivery-pipe and having the exhaust, the valve-chamber at one side of said central chamber and connected with the main inlet or supply pipe, and the cylinder at the opposite side of said central chamber and also connected with said inlet or supply pipe, combined with the piston in said cylinder and exposed to the fluid-pressure in said main supply-pipe, the valve in said valve-chamber adapted to be seated around the inlet to said central chamber, the valve in said central chamber controlling said exhaust, and the rod connecting said valves and piston, the whole being constructed and arranged and adapted to operate substantially as and for the purposes set forth.

17. In power mechanism, the reservoir *x*, means supplying the same with the fluid under pressure, and the main valve controlling the outlet therefrom and having the pipe passing to the power-cylinder for supplying the latter, combined with the casing *j'* in said pipe and also connected with the pipe supplying said reservoir, and the twin valves *F''*, *H''* in said casing and adapted to be moved under the varying pressures at the opposite ends of their casing; substantially as set forth.

18. In power mechanism, the reservoir *x*, means supplying the same with the fluid un-

der pressure, and the main valve controlling the outlet therefrom and having the pipe passing to the power-cylinder for supplying the latter, combined with the casing *v* in said
5 pipe and also connected with the pipe supplying said reservoir, and the connected piston and plug-valve in said casing and exposed to the pressures at the upper and lower ends of the latter, said plug-valve controlling the

passage through said casing of said fluid from the reservoir; substantially as set forth.

Signed at New York, in the county of New York and State of New York, this 25th day of July, A. D. 1896.

EDWARD A. TRAPP.

Witnesses:

CHAS. C. GILL,
E. JOS. BELKNAP.