WESTINGHOUSE et al. v. NEW YORK AIR-BRAKE CO. et al.

WESTINGHOUSE AIR-BRAKE CO. v. SAME.

(Circuit Court, S. D. New York. November 20, 1893.)

Nos. 4,976, 4,977, and 5,315.

1. PATENTS—ANTICIPATION—AIR BRAKES.
A patent for a device to be used in connection with a quick-acting automatic air brake is not anticipated by a prior patent for a somewhat similar device, used in combination with the old direct-action air brake, which patent contained no suggestion of how the device could be adapted to the automatic system; it appearing further that, if it were so reorganized and reconstructed as to be used in the automatic system, it would be utterly inoperative for accomplishing its purpose.

2. SAME—INVENTION.
Where several patents cover a series of progressive inventions, all tending to the accomplishment of a given result, and it appears that the last of the series contains the first successful embodiment of these inventions, and that the improvement thereby added was only devised after a series of practical experiments for the purpose of obviating previous defects, this shows that the conception of such improvement involved invention.

3. SAME—LIMITATION—"SUBSTANTIALLY AS DESCRIBED."
A claim covering a combination "substantially as described" should not be limited to a construction which does violence to the other wording thereof, and which is not specified either in the description or claim, especially when such construction does not appear to be material, and only affects the apparatus when not in use.

4. SAME—INFRINGEMENT.
Infringement is not avoided by simply dividing one element of the patent into two parts, so arranged that the action of one necessarily causes the action of the other in the same way as though they were one, and their combined operation performs the same function and produces the same results as the device of the patent.

5. SAME—COLORABLE CHANGES.
The fact that defendants have made a different construction of one device, which is concededly inferior to that of the patent, while retaining all the other elements thereof, suggests that the difference is only a colorable one, merely designed to avoid the claims of the patent.

6. SAME—DIVISIONAL PATENTS—ENLARGEMENT OF CLAIMS.
Where a device covered by a divisional patent is described in the original application therefor as capable of being employed in connection with and supplementary to another device, which generally accomplishes the same purpose, but is not claimed in such connection, a subsequent amendment, so as to claim it only in combination with such other device, is not an enlargement, and does not render the claim invalid.

7. SAME—COMBINATION—WHAT CONSTITUTES.
When a supplementary device is only intended to operate in case the main device fails to work, but the two are so related that the very failure of the latter so directs a force that it causes the former to act, there exists the co-operation which constitutes a true combination.

8. SAME—LIMITATION.
Claims for an air-brake emergency valve "controlled" by a "piston connected to said valve," and for a "piston stem, a valve on the piston stem controlling the passage," etc., call for a piston mechanically connected with the valve, and are not infringed by a device in which the valve is unseated by a piston whose stem merely rests against it, but which cannot be reseated by the piston for want of actual connection therewith.

9. SAME—INFRINGEMENT.
A claim in an air-brake patent for a combination containing a port through the center of the piston, described as substituted for a side port,

with which the patent dispenses, is not infringed by a device having no such center port, but using a side port in combination with different elements which are admitted by the patent to be part of the prior art.

10. SAME—ESSENTIAL SIMILARITY—APPARENT DIFFERENCES.
If a device has all the vital elements of a combination essential to the operation of a patent and to the achievement of the result sought, working in substantially the same way, infringement is not avoided by a method of construction which, owing to a different relative arrangement of the parts, the substitution of mechanical equivalents, and variations in matters not covered by the claims, is in appearance utterly unlike the patented device, and in some respects apparently superior thereto.

11. SAME—PARTICULAR PATENTS.
The Westinghouse quick-acting automatic air brake, No. 376,837, was not anticipated or limited by the previous patents, Nos. 162,465, to Ford, Welsh & Westinghouse, and 360,070, to Westinghouse; and is valid as to the first, second, and third claims, but void as to the sixth, for want of invention.

12. SAME.
The Westinghouse divisional air-brake patent, No. 448,827, shows invention, and is valid.

13. SAME.
The Westinghouse air-brake patent, No. 172,064, is limited to a combination having a port through the center of the piston.

14. SAME.
The first and second claims of the Park patent, No. 393,784, are limited to an air-brake emergency valve mechanically connected with the piston which operates it.

15. SAME.
The Westinghouse patent for an improvement in operating cocks for fluid-pressure brakes, No. 222,803, was not anticipated by the Westinghouse patent, No. 141,685, or by the Fay & Cairns patent, No. 141,685.

In Equity. Suits for infringement of railroad air-brake patents. Decrees for complainants as to some of the claims in suit and dismissing the bills as to others.

Kerr & Curtis, Geo. H. Christy, Frederic H. Betts, and J. Snowden Bell, for complainants.

John D. Kernan, (J. E. Maynadier and Causten Browne, of counsel,) for defendants.

TOWNSEND, District Judge. These are three bills in equity for the alleged infringement of letters patent No. 376,837, granted to George Westinghouse, Jr., January 24, 1888; patent No. 393,784, granted to Harvey S. Park, December 4, 1888; patent No. 172,064, granted to said Westinghouse, January 11, 1876; patent No. 222,803, granted to said Westinghouse, December 23, 1879; and patent No. 448,827, granted to said Westinghouse, March 24, 1891. All of these patents are for improvements in railroad brakes. They describe and claim various devices used in the operation of automatic quick-action freight brakes, including the valve on the engine, operated by the engineer, and different forms of emergency valve apparatus on the cars.

The main defenses interposed to the chief patents in suit are noninfringement and lack of patentable novelty, upon the theory that the inventions therein claimed have been already described by said Westinghouse in other patents not in suit. The parties in interest are the same in each case, but a difference in the ownership of the

patents sued upon necessitated separate suits in the two earlier cases. The patent sued upon in the third case is for a modification of the invention claimed in one of the other patents which had not been patented when said suits were brought. The three cases will be considered in the order of the relation of the patents to each other.

To understand the scope of the various claims of the patents in suit it will be necessary to examine the state of the prior art. The first practical air brake is known as the "plain brake," and is described in patent No. 88,929, granted to George Westinghouse, Jr., April 13, 1869. It consisted of a pump, operated by steam from the locomotive boiler, which compressed air into a reservoir located under the locomotive cab, which reservoir communicated by a pipe with a cock or valve in said cab, called the "engineer's valve," which was so located as to be readily manipulated by the engineer. From this valve a pipe extended back under the tender, and was connected to a similar pipe under the entire length of the first car by a flexible hose. Each of the succeeding cars had a similar pipe similarly connected. This pipe was called the "train pipe." From the train pipe of each car a branch pipe communicated with the forward end of a cylinder called the "brake cylinder." This cylinder was provided with a piston, the stem of which was connected with the brake levers on the car. When the engineer wished to apply the brakes, he opened the engineer's valve, and the compressed air from the main reservoir flowed back through the train pipe and branch pipes into the brake cylinder on each car, pushing the pistons backward, causing the piston stems to operate the brake levers and force the brake shoes against the wheels. When he wished to release the brakes, he so shifted the valve as to shut off the flow of compressed air from the main reservoir, and to open a port or vent leading from the train pipe to the open air. Thereupon the compressed air in the brake cylinders escaped into the open air, the pressure of the pistons was removed, and the pistons were forced forward again by means of springs, thus moving the brake shoes away from the wheels. The validity of this patent was sustained in Westinghouse v. Air-Brake Co., 9 O. G. 538. The operation of this plain brake was open to certain objections. It was too slow, and was attended by danger of collision in case one part of the train became detached from the other part.

The next brake to be considered is known as the "automatic brake," which appears to have been patented by George Westinghouse, Jr., about 1872 or 1873. It embodied the addition of an auxiliary reservoir and a triple-valve device to each car. Each reservoir was of sufficient capacity to operate its brakes once, and thus to provide for automatic action in case of accident. The triple-valve device was located at the junction of connections between pipes leading to the train pipe, the brake cylinder, and the auxiliary reservoir. In addition to these three ports, there was a fourth port, leading to the open air.

The operation of this brake was radically different from that of the "plain brake." In the former the compressed air was stored

in the main reservoir until required for the application of brakes; in the latter the main and auxiliary reservoirs and train pipe were always charged with compressed air at working pressure, to prevent the application of the brakes. When the engineer wished to apply the automatic brake, he shifted the engineer's valve so as to cut off the flow of compressed air from the main reservoir, and open a port from the train pipe to the open air. The effect of this was to reduce the air pressure in the train pipe, and cause a back pressure from each auxiliary reservoir through the triple valve, which shifted it so as to close the port from the branch pipe to the train pipe, and stop the escape of air from the auxiliary reservoir, to close the port leading from the brake cylinder to the open air, and to open the port leading from the auxiliary reservoir, and connect it with the port leading to the brake cylinder. Thereupon the compressed air in the auxiliary reservoir flowed into the brake cylinder, and applied the brakes. It will thus be seen that, while the former system was operated by pressure from the main reservoir, the latter was operated by withdrawal of pressure. The result was automatic action in case of accidents whereby air was caused to escape from the train pipe, as by bursting of hose, or the train breaking in two. In such cases the release of pressure operated the triple valve, and automatically applied the brakes.

It is necessary here to consider "train-brake graduation" or "service stops," as distinguished from "emergency stops." While for the latter it may be necessary to admit to the brake cylinder the full pressure of compressed air, say 70 or 80 pounds, yet where it is desired merely to slow up without stopping, it may be necessary to admit only, say 10 or 20 pounds, graduating the amount of flow according to the character of service desired. It is important to bear this distinction in mind, because the appliances hereafter to be considered have been so devised as to provide therefor, and that such graduation shall be under the control of the engineer.

The chief objection to this automatic brake lay in the fact that it was not capable of successful operation on long trains of freight cars. The time consumed by the progressive operation of the brakes between the grip on the first and last car allowed of so much slack motion between them as to cause violent shocks. This automatic brake was publicly tested near Burlington, Iowa, in 1886. The growing importance of the subject of automatic freight graduation, the inadequacy of existing systems to protect the lives of railroad employes, and the disastrous results therefrom, had become so evident that in 1885 the Railway Car Builders' Association arranged for a series of experiments known as the "Burlington trials." The Westinghouse Company, and several other companies engaged in the manufacture of brake apparatus, competed at these trials. None of the competitors succeeded in stopping long trains of freight cars without violent and disastrous shocks. In 1887 the trials were renewed. There were five competing parties, including one of the leading experts for the defendants, and the complainant company. The latter then presented an improved apparatus, covered by patent No. 360,070, granted to George Westinghouse,

Jr., March 29, 1887. The report of the committee of the Car Builders' Association shows that they considered "the field for improvement open as wide as in 1886," and concluded that air brakes actuated by electricity were the only ones likely to be capable of successful operation on long trains of freight cars. The improved Westinghouse apparatus, while it reduced the length of time between the application of the first and last brakes, produced greater shocks than did the automatic apparatus of the preceding year.

In this condition of affairs, George Westinghouse, Jr., set himself to work to obviate these difficulties. Upon the conclusion of the 1887 trials he renewed his investigations and experiments, and by certain changes and improvements in the old apparatus, and the introduction of new elements, he succeeded, in the latter part of the year 1887, in constructing a quick-action automatic brake, capable of being successfully applied to a train of 50 freight cars, and operative under all conditions of practical railway service. On October 1, 1887, he applied for a patent for this apparatus, and on January 24, 1888, the patent was granted. Said patent, No. 376,837, is the first of the patents in suit. Before proceeding to consider in detail the claims of this patent, it should be stated that the following were among the requirements for the practical operation of air brakes: (1) The regulation of the force to be applied to the brake shoes so as to secure all necessary graduations from the mere slackening of speed to the service stop, and from the service stop to the emergency stop; (2) the automatic operation of the brakes in case of accident; (3) the practically simultaneous operation of the brakes on each car, so that, in long trains of freight cars, shocks might be avoided; (4) the control of all these operations by the engineer; (5) certainty of operation under all conditions.

It is not denied that George Westinghouse, Jr., was an original and meritorious inventor, the first inventor of the plain brake, the first to put an air brake into successful use, and the first to graduate air pressure in the brake cylinders. These facts appear in the opinion of the court in Westinghouse v. Air-Brake Co., supra. It is not denied that he was the first inventor, both of the Westinghouse automatic brake, and of the Westinghouse quick-action automatic brake. It appears that he was the first to provide an operative brake system without the use of electricity, and a device whereby the operation of the apparatus was controlled by the engineer. It is admitted by the expert for defendants that the Westinghouse quick-action automatic brake was the first practical system on long trains. It is not denied that immediately after its introduction it went into successful extensive use, and that 125,000 of said brakes have been furnished to the railroad companies of this country within a period of a little more than three years. But defendants claim that by patent No. 162,465, to said Westinghouse and two associates, and by said patent No. 360,070, to said Westinghouse, he showed how practical air brakes could be made, and successfully operated. They admit that they have adopted these confessedly great inventions; but they deny infringement on the

ground that said patents Nos. 162,465 and 360,070, which imperfectly disclosed said great inventions, are not in suit. They further claim that the patents in suit are for mere minor improvements upon and modifications of said inventions, which did not require any exercise of creative thought. Further defenses will be considered later.

We will now examine these other great inventions. They are comprised in what is known as the "Westinghouse quick-action automatic brake" apparatus. The devices embodied therein are covered by said patent No. 360,070, and by patent No. 376,837, the patent in suit. The claims of defendants as to the scope of patent No. 162,465 will be considered in this connection. It may be said in a general way that the "quick-action" element was added to, or the quick action was secured in, the automatic apparatus by such an arrangement of the triple valve in connection with vents on each car as to make the opening of such vents, and the consequent reduction of train pressure, practically simultaneous on each car. Its efficiency was increased by the utilization of the vented air to hasten the action of the ordinary brake force. Patent No. 376,837 was issued to George Westinghouse, Jr., January 24, 1888, for improvement in fluid-pressure automatic brake mechanisms. Its object, as stated by the patentee, was "to facilitate the application of brakes with great rapidity, and full or approximately full force, as from time to time required, by the provision of means whereby the admission of air from the brake pipe to the brake cylinders may be effected as directly as practicable, and through passages of as large capacity as may be desired." The apparatus comprises a casing, or air chamber, containing the triple-valve device already referred to, which governs communication between the train pipe, the auxiliary reservoir, and the brake cylinder, and also an emergency apparatus. The patentee states that the construction and operation of the triple-valve device, except as to certain improvements therein, accord substantially with other such devices previously patented by him in patents Nos. 220,556 and 360,070. It is not necessary to consider it in this connection further than to say that it consists of a slide valve and free moving piston, so arranged as to be operated by variations of pressure in the train pipe. When a service stop is desired, a slight reduction of train pipe pressure is made by the engineer. By reason of this withdrawal of pressure, the free moving piston, which has heretofore been forced forward against the auxiliary reservoir by said train-pipe pressure, is now forced backward by the excess of pressure in the auxiliary reservoir, until its movement is arrested by the decrease in auxiliary reservoir pressure, or by the striking of its stem against another stem which is backed up by a spring. It has then, as already described, closed the charging port from the branch pipe, closed the port from the brake cylinder to the open air, opened the port leading from the auxiliary reservoir into the brake cylinder, and thereby caused the brakes to be applied.

The quick-action element, which is the subject of the claims alleged to be infringed, is only called into action for emergency stops.

This emergency action is secured in the patent in suit by means of a separate supplemental piston and valve in a supplemental valve chamber below the main slide valve of the triple-valve device. This chamber connects the train pipe with the brake cylinder, communication between them being regulated by the supplemental valve, opening outwardly, or downwards, and a check valve, opening inwardly, or upwards. These valves are held upon their seats, under ordinary conditions, by a spring bearing upon their stems. In the bushing which forms the valve face of the main slide valve, are four ports, governed by said slide valve. One of these ports leads to the brake cylinder, two lead to the supplemental valve chamber on the upper or inner side of the supplemental piston, and one leads to an exhaust port. When an emergency stop is to be made, the engineer throws his engineer's valve wide open, thereby causing a sudden and material reduction of pressure. The excess of auxiliary reservoir pressure then forces the main piston stem against said other stem, overcoming the tension of its spring, drives the main piston to the extreme limit of its stroke, and thereby uncovers the ports leading from the auxiliary reservoir to the supplemental valve-chamber. This pressure drives the supplemental piston outwardly, or downwards, against the stem of the supplemental valve, and forces it from its seat. Thereupon the preponderance of train pipe pressure in the brake pipe opens the check valve, and the air from the train pipe rushes directly from the brake pipe to the brake cylinder. The result of this operation is twofold. It hastens the application of the brakes on the car on which it is operated; and, by venting the train pipe, it hastens a similar reduction of pressure, and consequent similar operation in the next succeeding triple-valve device on the next car. The release of the brakes is accomplished by the admission of air from the main reservoir.

It is alleged that defendants have infringed claims 1, 2, 3, and 6, of this patent. The first of these claims is as follows:

"In a brake mechanism, the combination of a chamber or casing having direct connections to a brake cylinder and to a brake pipe, respectively, a valve controlling communication between said connections, and a piston or diaphragm which is independent of and unconnected with a triple-valve piston, and is actuated by pressure from an auxiliary reservoir in direction to impart opening movement to said valve, substantially as set forth."

The second claim includes:

"A check or nonreturn valve controlling communication between said valve and the brake-pipe passage of the chamber, substantially as set forth."

The third claim is as follows:

"In a brake mechanism, the combination, with a triple valve, of a supplemental chamber or casing having passages leading to a brake cylinder and to a brake pipe, respectively, a supplemental valve controlling communication between said passages, a supplemental piston operating independently of the triple-valve piston and adapted to impart opening movement to said supplemental valve, and a passage establishing communication between said supplemental piston and an auxiliary reservoir, substantially as set forth."

These three claims will be considered together. The defense to these claims is noninfringement. Defendants have used two devices, each of which complainants claim is an infringement. The

earlier device is known as "defendants' quick-action triple valve;" the later is "defendants' modified quick-action triple valve." Each of these devices has a chamber, or casing, with direct connections to brake cylinder and train pipe, and a controlling valve, as in complainants' patent. Each has an emergency piston and valve and check valve. The first form of defendants' apparatus has two emergency pistons and valves, or rather one emergency piston and valve, actuated by a sudden or large reduction of pressure, as in complainants' apparatus, and connected by means of a port with a supplemental piston and valve and check valve, like the single emergency piston valve and check valve of complainants. The second, or modified, apparatus differs from the first in the elimination of one of the pistons with its valve and port of the emergency attachment, and modification of the check valve. It is not claimed that this modified check valve is an infringement of the second claim of the patent in suit.

The general questions of infringement claimed to be applicable to both devices will first be considered. Defendants claim that their emergency apparatus, as well as that of the patent in suit, is merely a combination of the invention described in the automatic relief valve of one patent, not in suit, with the invention, whereby reservoir pressure was utilized to operate an emergency valve, described in a certain other patent not in suit. The first of these patents is patent No. 162,465, issued to Messrs. Ford, Welsh, and said Westinghouse, April 27, 1875, for an improvement in automatic air escapes for railway air brakes. At the date both the old plain-brake apparatus, depending for its braking operation upon the transmission of compressed air from the engine to the brake cylinders, and the automatic system, depending upon the release of the pressure of compressed air to apply the brakes, were in use. Patent No. 162,465 was only designed for use in connection with the plain-brake apparatus. The object of the invention was "to provide for the more immediate escape of the compressed air from the brake cylinders after it has done its work." It was a patent for an invention, not for applying brakes, but for quickening the release of the brakes in the plain-brake system. The invention comprised an auxiliary reservoir connected with the brake pipe, and having a lift valve controlling vents from the train pipe into the open air. This valve was so arranged that when there was an equilibrium of pressure it remained on its seat. Through the center of the valve was a small hole, leading to said reservoir. When air was transmitted from the engine, to apply the brakes, it flowed through said hole into said reservoir, making the same pressure there as in the train pipe; but when the air was discharged from the train pipe to release the brakes the excess of pressure of the air within said chamber unseated said valve, and allowed the air to be rapidly vented from the brake cylinder and brake pipe into the open air.

The defendants claim that they took their relief valve from this patent, and that Westinghouse embodied this idea in patent No. 376,837, and that it was not first conceived in said patent. They say that the first result in each case was to quicken the action of each

succeeding automatic relief valve; and the difference in secondary results—that in one case it released, in the other applied, brakes—is immaterial.

I do not think this patent anticipates or limits, in this connection, patent No. 376,837, for the following reasons: The sole object of the invention was to quickly release brakes in the direct system. It was intended to obviate the difficulty arising from the fact that in the direct system the escaping air, being expelled simply by its own expansion, came out very slowly. It was not adapted to the application of brakes, or in any way to the automatic brake system, although that system had then been invented. Counsel and experts for defendants admit that radical and material modifications were required before it could be practically applied to railroad service under the automatic system. There is no suggestion in the patent of any way in which it could be adapted to the automatic system, nor, if so adapted to apply the brakes, does it appear how it could then be operated to release them. No provision is made for graduation for ordinary service stops in any case. In Electric Light Co. v. Westinghouse, 55 Fed. 504, Judge Green, citing cases, says:

"And for this cause alone the Khotinsky patent cannot be relied upon in this case as an anticipation of the plaintiff's patent. It does not anticipate, because it neither describes, nor deals with, nor certainly provides for the difficulty, nor prescribes with precision the remedies, which form the subject-matter of Edison's invention."

It appears from the evidence that if patent No. 162,465 were so reorganized and reconstructed as to be used to apply brakes in the automatic quick-action system, it would then be utterly inoperative for accomplishing the purpose of the original invention. But, say counsel for defendants, given the solution of the problem how to release pressure quickly in a long pipe, its application to a different system, for a different purpose, in a different way, and producing a different result, is a mere double use. The considerations already suggested would seem to be a sufficient answer to this claim.

It may be added, as is forcibly urged by counsel for complainants, if this was merely a thing that "any competent mechanic could do," why was George Westinghouse the only person to whom it occurred to do it, and how to do it? The claim of defendants that all this was done in patent No. 360,070 will be considered in connection with that patent. Even if Mr. Westinghouse, in patent No. 376,837, did, as claimed by defendants, throw his mind back to patent No. 162,465, and use it as a basis for a part of the contrivance of patent No. 376,837, he did not reinvent patent No. 162,465, but he invented and created a new device, adapted to new conditions, and developed in new combinations, which produced new and different results. These facts would seem to bring this branch of the case within the rule as stated in Ansonia Brass & Copper Co. v. Electrical Supply Co., 144 U. S. 11, 12 Sup. Ct. 601:

"If an old device or process be put to a new use which is not analogous to the old one, and the adaptation of such process to the new use is of such a character as to require the exercise of inventive skill to produce it, such new use will not be denied the merit of patentability."

In Walk. Pat. (2d Ed.) p. 54, § 68, it is stated that:

"Novelty is not negatived by anything which was neither designed nor apparently adapted nor actually used to perform the function of the thing covered by the patent, though it might have been made to perform that function by means not substantially different from that of the patented invention."

It seems to me, therefore, that the invention described in patent No. 162,465 did not anticipate the invention described in the patent in suit.

As was said by Mr. Justice Brown, in Topliff v. Topliff, 145 U. S. 161, 12 Sup. Ct. 825:

"It is not sufficient to constitute an anticipation that the device relied upon might, by modification, be made to accomplish the function performed by the patent in question, if it were not designed by its maker nor adapted nor actually used for the performance of such functions."

The next patent to be considered is No. 360,070, granted to George Westinghouse, Jr., March 29, 1887, for fluid-pressure automatic brake mechanism. This was the first patent issued for the Westinghouse automatic quick-action system. The defendants say that this patent fully disclosed another confessedly great invention, namely, the utilization of the air vented from the train pipe, to quicken the application of brakes. They further urge, with great force that, even if certain modifications were required in patent No. 162,465, before it could be adapted to act in the automatic quick-action system, yet that, in connection with patent No. 360,070, it shows the combination of everything vital and essential in the patent in suit. The complainants deny these claims, and urge that the facts already stated as to the defects developed at the Burlington trials in the apparatus constructed in accordance with this patent call for the application of the rule laid down in Loom Co. v. Higgins, 105 U. S. 591, where the court, in disposing of a similar claim said:

"This argument would be sound if the combination claimed by Webster was an obvious one for attaining the advantages proposed,—one which would occur to any mechanic skilled in the art. But it is plain from the evidence, and from the very fact that it was not sooner adopted and used, that it did not for years occur in this light to even the most skillful persons."

In patent No. 360,070, Westinghouse sought to secure both service and emergency action by the use of a single piston,—the piston of the triple valve already described. This piston was so arranged as to have only a slight range of motion for a service stop. A great reduction of pressure for an emergency stop would cause the piston to travel through its entire range of motion, and to uncover an emergency port, through which train-pipe pressure passed from the train or brake pipe into the brake cylinder. The radical difference between this patent and the patent in suit consists in the differences of construction and operation involved in the addition to the latter of the separate emergency apparatus.

The defendants claim that the secret of the success of the patent in suit lies not in the use of a separate piston to operate the emergency valve, but in the substitution therein of a lift valve, such as was used in patent No. 162,465, in place of the slide valve of patent No. 360,070. One of the experts in one of the

other cases, and all the counsel in this case, refer to the tendency of the slide valve of patent No. 360,070 to stick to its seat, especially if used in connection with a large port, such as is found necessary for the successful operation of patent No. 376,837. Figure 8 of the patent in suit shows a slide valve as interchangeable with a lift valve. The device shown in complainants' exhibit of its automatic brake system has a lift valve. The experts for complainants testify fully as to the advantages secured by the use of the separate emergency valve and piston, and in this testimony they are not contradicted by the experts for defendants.

In this connection, and as having an important bearing upon this question, the evidence as to the practicability of patent No. 360,070 will be considered. It appears that the apparatus constructed thereunder did not operate satisfactorily in the Burlington trials. But it also appears that these defects were not occasioned by any inherent defects in the construction of the device shown in patent No. 360,070, and that, when the accessory parts were afterwards adjusted, and, as testified by Mr. Westinghouse, "when the passages through the quick action portion of the triple valve were made sufficiently large, practically the same results were obtained in train stopping as were subsequently obtained by the kind of valve shown in patent No. 376,837." It seems to me that this uncontradicted evidence is entitled to great weight as against the contention of defendants' counsel that "the essential matter in patent No. 376,837 is the use of the lift valve instead of a slide valve." This conclusion is strengthened by the evidence of Mr. Massey, one of the experts for defendants, and the patentee of defendants' quick-action triple valve. As complainants' counsel agree that the cause of the difficulty in patent No. 360,070, and the way in which it was obviated in patent No. 376,837, are fully and clearly stated by Mr. Massey, I give his evidence in full upon this point. Mr. Massey was asked on direct examination as follows:

"Int. 4. Mr. Henry B. Stone, in his deposition, says that he has no doubt that the Westinghouse quick-action automatic brake was the first practical quick-action triple valve which made the automatic brake system practical on long trains; and, as I interpret the testimony of Mr. H. Herman Westinghouse, he says the same thing. What is the practical objection, if any, to the quick-action triple valve of 360,070, and how is that remedied by the apparatus of 376,837? Before answering, state what is meant by the 'Westinghouse quick-action automatic brake.' A. The term 'Westinghouse quick-action automatic brake,' as used by Mr. Stone, undoubtedly refers to the quick-action triple valve described in patent 376,837, and illustrated on sheet 2 of that patent. It is also the quick-action triple valve which is illustrated in the Westinghouse catalogue of 1890. In the quick-action triple valve described in 360,070, in addition to the triple valve, the stem of the piston came in contact with an emergency valve, and the extreme motion of the triple-valve piston caused the emergency valve to open a small passage between the train pipe and the brake cylinder, thus causing a local exhaust of the air from the train pipe, and therefore reducing the pressure in the train pipe quicker than would be done by the vent through the engineer's valve. The port which was opened by the emergency valve was necessarily restricted in size, as, in order to be effective, the piston of the triple valve must be able to open it within a moderate reduction of train-pipe pressure, and therefore with but little force in addition to that consumed by the piston in moving the ordinary triple-valve mechanism. If the emergency valve had

been arranged to open a very large port, the time required to exhaust the train pipe through the engineer's valve sufficiently to allow the piston to open the emergency valve would be materially increased. This defect in the emergency valve of 360,070 would not be serious in trains of moderate length, as under, say 25 cars; but in the 50-car train used at Burlington in May, 1887, the effect was disastrous. This defect is remedied in 376,837 by using a supplemental piston to open the emergency valve, and actuating that piston by fluid pressure from the reservoir through a passage controlled by a valve which is actuated by the triple-valve piston. In this case the triple-valve piston has only to open a comparatively small port in addition to its regular function, and fluid pressure in the auxiliary reservoir then causes the supplemental piston to open the emergency valve."

The length of time required in the use of the single valve of patent No. 360,070 to open a sufficiently large port, above referred to, appears to have been in the mind of Westinghouse in providing a separate piston of the patent in suit to open the emergency valve, for in the description of this improved invention it will be remembered he states that:

"Its object is to facilitate the application of brakes with great rapidity, and full or approximately full force, as, from time to time, required, by the provision of means whereby the admission of air from the brake pipe to the brake cylinders may be effected as directly as practicable, and through passages of as large capacity as may be desired."

It seems to me, in view of this testimony of defendants' expert, and the other evidence already considered, that the defendants have failed to sustain the burden of proving that the conceded success of the patent in suit was due to the substitution of a lift valve instead of a slide valve.

But certain other considerations are suggested by counsel for defendants in this connection, namely, that in patent No. 360,070 Westinghouse describes a combination whereby auxiliary reservoir pressure is utilized so as to impart opening movement to the emergency valve, and vent the air from the train pipe to the brake cylinder; and that in patent No. 376,837 the operation of such apparatus was through a passage controlled by a valve actuated by the triple-valve piston. And defendants further claim that this patent is limited, by the words and figures of the specification, to a construction where the emergency valve is only exposed to auxiliary reservoir pressure by the excess stroke of the triple valve opening a passage.

Upon these claims, among others, is laid the foundation of the main defense, namely, that this broad fundamental conception of the inventor having been disclosed to the world in patent No. 360,070, they are now entitled to avail themselves of it, and to use it in connection with the suggestions contained in patent No. 162,465 in making their apparatus. They admit that patent No. 376,837 describes an improvement on patent No. 360,070, but they claim that said improvement is merely a minor invention.

The consideration of the general questions of pioneership involves the inquiry as to whether the patented device contained an invention which, for the first time, enabled "a law of science, or force of nature, to be used so as to accomplish a practical and beneficial result." Judge Shipman, in Dederick v. Seigmund, 1 U. S. App.

227, 2 C. C. A. 169, 51 Fed. 233; Machine Co. v. Lancaster, 129 U. S. 263, 9 Sup. Ct. 299. In this inquiry is necessarily involved the determination, in this case, of the question as to whether this great invention was so disclosed to the world in patent No. 360,070 as to make it available without a further exercise of the inventive faculty. The argument of counsel for complainants and defendants on this question seems to assume that whether the defendants are infringers or not largely depends upon whether patent No. 376,837 is or is not a pioneer patent. It is questionable whether a court may safely depart from the ordinary rules in the construction of a patent because it may seem to bear the brand of pioneership. In the present case, too, the application of the principle is not without difficulty, because the inventor is confessedly a pioneer, the question being whether he had not already blazed a pathway through the forest before he laid out or opened the practicable public highway. I have therefore attempted to dispose of the questions herein by a consideration of the prior art, and a comparison of defendants' devices with the patent in suit, independently of the doctrine of pioneership. If this doctrine is applicable, the case seems to fall within the principle stated and followed by Judge Coxe in Mergenthaler Linotype Co. v. Press Pub. Co., 57 Fed. 502. In either case, "a strict construction should not be resorted to if it becomes a limitation upon the actual invention, unless such construction is required by the claim, it being understood that the construction should not go beyond and enlarge the limitations of the claim." Smead Warming & Ventilating Co. v. Fuller & Warren Co., 6 C. C. A. 481, 57 Fed. 626.

It will be remembered that the provision for a separate emergency piston to open the emergency valve, and for the operation of that separate piston by pressure from an auxiliary reservoir in direction to impart opening movement to the emergency valve, was new with Westinghouse in patent No. 376,837. But it will be remembered that in patent No. 360,070 Westinghouse had provided for the utilization of reservoir pressure, to cause the single piston of the triple valve to make an extreme travel for an emergency stop, and to thereby uncover an emergency valve. The considerations already suggested, seem to show that each of the patents already discussed —patents Nos. 162,465, 360,070, and 376,837—marked a forward step in the progress of the freight brake system, and that each contributed an important and essential element of invention thereto. The scope of these patents has been already considered. If all that is claimed as to the inventions disclosed in the patents not in suit be admitted, it still appears that the patent in suit describes an improvement on patent No. 360,070, which was not applied for until more than six months after patent No. 360,070 had been granted, and after a series of practical experiments, undertaken for the purpose of obviating the difficulties encountered and defects developed in the Burlington trials of 1887. "Experiments made to ascertain the practicability of the new use are strong evidence to prove that invention was required to conceive of it." Merwin, Patentability, 92.

It further appears that the apparatus constructed under said patent was the first successful embodiment of these great inventions, and furnished the first and only practical solution of the problems of automatic quick-action freight brakes. It further does not appear that the success of the invention embodied in the patent in suit is not due to the use of the separate emergency piston and valve. It seems to me most significant that with patent No. 360,070 before the world for six months, and under the pressure of competitive trials, no one so grasped the inventions claimed to be disclosed in patent No. 360,070 as to embody them in a successful working apparatus until after the patent in suit had been applied for; and that, when defendants constructed an apparatus, they adopted the separate emergency piston and valve of the patent in suit. And, as patent No. 376,837 accomplished this result by the use of a separate piston, and as defendants' apparatus has accomplished this result, also by the use of one or two separate pistons, they must be held to have infringed the first and third claims of said patent, unless said claims are to be so limited in terms, or by the information disclosed in patents Nos. 162,465 or 360,070 or both, as to show that defendants' device is not embraced therein.

In this connection it will be necessary again to examine the first claim of the patent in suit, which is as follows:

"In a brake mechanism, the combination of a chamber, or casing, having direct connections to a brake cylinder and to a brake pipe, respectively; a valve, controlling communication between said connections; and a piston or diaphragm, which is independent of, and unconnected with, a triple-valve piston, and is actuated by pressure from an auxiliary reservoir in direction to impart opening movement to said valve, substantially as set forth."

Defendants claim that complainants' emergency piston is not "independent of, and unconnected with, a triple-valve piston," except in the sense that there is no dependence or connection by direct mechanical action, and that complainants are, in fact, limited to a construction in which the emergency piston is dependent upon, and connected with, the triple-valve piston, and in which the emergency valve is not exposed to auxiliary reservoir pressure, except by the excess stroke of the triple valve opening a passage.

These propositions will be considered together. In the drawings of the patent it appears that, while the emergency piston is distinct and separate from the triple-valve piston, yet that it is operated by reservoir pressure, admitted by means of an excess stroke of the triple-valve piston. In this sense the action of complainants' emergency device may be said to be dependent upon the action of the triple-valve piston. A similar element of dependence is to be found in the operation of defendants' device, for, before their emergency piston can operate to apply the brakes, some movement of the triple-valve piston is necessary in order to shut off the exhaust from the open air. In neither of said devices is there any direct mechanical connection between the triple-valve piston and the emergency piston,—in each there is an indirect communication,—although it is mechanically more remote in the first device of defendants. Under these circumstances it is questionable whether

such incidental communication is material upon the question of infringement. I do not think the language "independent of, and unconnected with," should be construed to mean "dependent on, and indirectly communicating with," so as to necessarily cover such indirect dependency, or to make it an essential feature of the invention, and thus do violence to the language of the claim.

But the learned senior counsel for defendants assumes that the second form of defendants' apparatus contains all the parts covered by claim 1 of patent No. 376,837, but he forcibly claims that the parts do not operate "substantially as set forth" in the patent. It was claimed by him that the description and all the drawings of said patent showed an emergency valve, not exposed to auxiliary reservoir pressure except by the excess stroke of the triple valve opening the passage; and that, in that event, the case would fall within the rule laid down by Judge Wallace, and affirmed by the United States supreme court in Snow v. Railway Co., 121 U. S. 617, 7 Sup. Ct. 1343. But counsel for complainants having called my attention to figure 12 of said patent, and the description thereof, I have carefully examined and considered the same, and, while I cannot find therein any description of the particular way in which the requisite air is to be admitted, it does not appear that the emergency piston is not there shielded from auxiliary reservoir pressure except by the excess stroke of the emergency piston, because, in ordinary braking, where there is no excess stroke, such reservoir pressure is directly exerted upon said piston. In the description of the invention by the patentee there is no statement that the emergency valve is to be shielded from reservoir pressure until it is brought into operation. No such limitation is stated in the claim; no movement of the triple-valve piston is described in Fig. 12. The emergency piston may or may not be shielded from auxiliary pressure. Therefore, when the patentee claims the combination "substantially as described," he ought not to be held to a construction not specified, either in the description or claim, especially where such construction does not appear to be material, and where it only concerns the apparatus when not in use, and does not affect it at all when in operation. Rob. Pat. 517, 750. The rule that the claim must be limited to the invention does not necessitate reading into the claim something not specified or necessarily implied therein, Lake Shore & M. S. Ry. Co. v. National Car-Brake Shoe Co., 110 U. S. 229, 4 Sup. Ct. 33; Electric Light Co. v. Westinghouse, 55 Fed. 498. The distinction between this case and Snow v. Railway Co., supra, appears from the opinion of Judge Wallace in said case, where he says:

"The plain and explicit language of the specification requires a construction of the first claim which will enable the defendant to escape liability as an infringer. * * * The specification states that 'the piston is disconnected from its rod to prevent any lateral strain being communicated to it.' * * * The drawings show a detached piston rod, and all the co-operative devices are conformed and adjusted to a detached rod."

And in said case Judge Wallace held, and the United States supreme court, affirming his decision, held, that it was "impossible

to ignore the particular construction of these two parts which is thus pointed out as material." In said case the claim stated the combination where "constructed and operated, substantially as described." In Van Marter v. Miller, 15 Blatchf. 562, Judge Wallace states the rule as follows:

"In construing a patent, it is, first, pertinent to ascertain what, in view of the prior state of the art, the inventor has actually accomplished, and, this having been found, such a construction should be given as will secure the actual invention to the patentee, so far as this can be done consistently with giving due effect to the language of the specification and claim."

The words "substantially as set forth" mean "substantially as set forth in regard to the combination which is the subject of the claim," and they should be given a construction commensurate with the real invention so as to protect the inventor. Lake Shore & M. S. Ry. Co. v. National Car-Brake Shoe Co., supra; Winans v. Denmead, 15 How. 330; Grier v. Castle, 17 Fed. 523. A patentee may, of course, by the language of his claim, restrict the scope of his rights under his invention; but, as no such restriction is to be found in said claim, we are limited to a comparison of the operation of the structural law of the patented machine with that of the alleged infringing machine. Rob. Pat. 962.

It remains to further consider certain suggestions in regard to the piston and supplemental piston of defendants' earlier device. When this emergency piston is called into operation by a sufficient reduction of pressure it is not, as in complainants' device, so driven by auxiliary reservoir pressure as to act directly on the emergency valve, but, when so forced down, it opens a port whereby train pressure is admitted to the upper side of the other piston, which, being thereby forced down, imparts opening movement to an emergency valve leading to the brake cylinder. We have here the triple-valve piston and two other pistons used to accomplish the work of the one piston in complainants' device. And defendants claim that in their device there is not the combination of triple-valve piston and emergency valve, because the first of these two pistons does not impart opening movement to the emergency valve, its only function being to uncover a port whereby air is admitted to the brake cylinder, and the train pipe is vented. They further claim that the second supplemental piston in said device is not actuated by reservoir pressure, but by train pressure. Of the two separate or emergency pistons of the defendants, one opens a port which admits train pressure to the other. The former is directly actuated by pressure from the auxiliary reservoir. The latter is directly actuated by train pressure. But the latter is indirectly actuated by pressure from the auxiliary reservoir in the sense that such pressure necessarily results in operating it through the intermediate operation of the former. The question is whether this combination of devices is the same as the device of complainants. It seems to me that it is. The component parts of the combination operate together "to perform the same function, and to produce the same result." It is merely dividing complainants' piston into two parts, so arranged that the action of one necessarily causes the

action of the other in the same way as though they were one. "A patent for a device cannot be avoided by dividing it into two parts, which, when combined, produce the same result in substantially the same way. * * * With reference to the object in view,—the raising and lowering of the fingers, which is the useful purpose contemplated,—the effect is identical. The means * * * are substantially the same, and they operate, * * * in substance, in the same manner. To hold otherwise would be to give to immaterial variations capacity practically to destroy the value of any patent whatever." Judge Woodruff, in Wheeler v. Reaper Co., 10 Blatchf. 181. In the case of Strobridge v. Lindsay, 6 Fed. 510, a case somewhat similar to the one at bar, was presented. The complainant was the owner of a patent for a coffee mill. The claim in suit was for "a detachable hopper and grinding shell, formed in a single piece," etc. The defendants, having been enjoined, made a new mill in which the hopper and grinding shell were cast separately. Judge Acheson held that this did not avoid infringement, and said:

"The change is but colorable. Although cast in two pieces, yet, when put together for use, the hopper and grinding shell are substantially, and for all practical purposes, 'formed in a single piece.' "

The same view was held by the supreme court of the United States in Robertson v. Blake, 94 U. S. 728.

I have not overlooked the distinction between the atmospheric pressure on both sides of the emergency valve of complainants, and the auxiliary reservoir pressure on one side, counterbalanced by train pressure on the other side, of defendants' device. This difference does not affect the operation of the emergency piston. The concession by defendants that complainants' valve is for this reason a better valve does not seem to me to help the defendants. If the defendants have made a different construction in this respect, which is inferior to that of the patent in suit by reason of its tendency to leak, while retaining the other elements of the combination of complainants, it seems to me that this fact suggests that the claimed difference is only a colorable one, merely designed to get rid of the claims of the patent in suit. Strobridge v. Lindsay, supra. Besides, these advantages of complainants' construction over that of defendants, suggested by counsel for defendants, were not what the inventor was seeking to obtain. He was not trying to invent a nonleakable valve, nor a valve which should necessarily be limited in arrangement, or shielded in a particular way, while not in operation. The object of his invention was to provide an emergency valve which should act certainly and effectively in an emergency. The question is whether the operation of defendants' device, when in action, is the same, and produced the same results, as that of complainants. "In determining the question of infringement the court or jury * * * are to look at the machines, or their several devices or elements, in the light of what they do, or what office or function they perform, and how they perform it, and to find that anything is substantially the same as another, if it performs substantially the same function in substantially the same

way to obtain the same result." Justice Clifford, in Machine Co. v. Murphy, 97 U. S. 120; Cantrell v. Wallick, 117 U. S. 689, 6 Sup. Ct. 970; Brass Co. v. Miller, 9 Blatchf. 77. In regard to all these alleged differences of construction, the language of the supreme court in Sessions v. Romadka, 145 U. S. 45, 12 Sup. Ct. 799, seems to be directly in point, where Mr. Justice Brown, speaking for the court, says:

"In view of the fact that Taylor was a pioneer in the art of making a practical metallic trunk fastener, and invented a principle which has gone into almost universal use in this country, we think he is entitled to a liberal construction of his claim, and that the Romadka device, containing, as it does, all the elements of his combination, should be held an infringement, though there are superficial dissimilarities in their construction."

What has already been said has been directed chiefly to the combination described in the first claim of complainants' patent. The additional check value claimed in the second claim is found in the defendants' first device. The elements of the third claim are in the main the same as in the first claim, and the additional element—a passage between the supplemental piston and auxiliary reservoir—is found in defendants' device. As a result of these considerations, I have reached the conclusion that the first form of defendants' apparatus, the "quick-action triple valve" infringes the first three claims of the patent in suit, and that the second form, the "modified quick-action triple valve," infringes the first and third claims of the patent in suit.

The sixth claim of patent No. 376,837 reads as follows:

"In a brake mechanism, the combination of a triple-valve casing, a supplemental valve chamber composed of an inner section which is formed integral with the triple-valve casing, and a separable outer section, each having a lateral air pipe or passage, and a supplemental valve seat formed in a division plate or partition, interposed between, and secured to, the two sections of the supplemental valve chamber, substantially as set forth."

The alleged invention herein consisted in so arranging the triple-valve casing as to include therein part of the chamber of the emergency valve, leaving the other part to be made separately. In this way it is claimed that the construction of the apparatus was simplified. It is admitted that the construction of defendants' casing is the same as that claimed by complainants. The defense is lack of invention. I think the defense is fully made out. If it required any inventive talent to suggest the details of construction, they are found in the Massey patent, No. 358,867. But it seems to me that it is merely a convenient way of putting the parts together, which would have occurred to any one. "It is but the display of the expected skill of the calling, and involves only the exercise of the ordinary faculties of reasoning upon the materials supplied, by a special knowledge and the facility of manipulation which results from its habitual and intelligent practice, and is in no sense the creative work of that inventive faculty which it is the purpose of the constitution and the patent laws to encourage and reward." Justice Matthews, in Hollister v. Manufacturing Co., 113 U. S. 59, 5 Sup. Ct. 717; Deere & Co. v. J. I. Case Plow Works, 6 C. C. A. 157, 56 Fed. 841.

As already stated, the third case is based upon a patent which had not been granted when the other suits were brought. As it involves a further consideration of the devices and defenses already discussed, it will be disposed of in this connection. This suit is for the alleged infringement of claims 1 and 2 of patent No. 448,827, granted to George Westinghouse, Jr., March 24, 1891, for an air brake. This is a divisional patent, having been originally applied for as part of patent No. 376,837, which has just been considered. Said claims are as follows:

"(1) In a fluid-pressure brake apparatus, normally operated by a triple-valve device, the combination, with such an apparatus, of a valvular appliance having a casing provided with supply and discharge passages or connections, and a valve controlling an exhaust port from the supply passage to the discharge passage for quickly releasing pressure in the supply passage, said valve being actuated to open the exhaust port by a greater than normal reduction of pressure in the supply passage, independently of the action of the triple-valve device, substantially as set forth."

"(2) The combination, with a triple-valve mechanism, of a discharge valve controlling an exhaust port from a supply passage to a discharge passage for quickly releasing the pressure in the supply passage, said valve being actuated to open the exhaust port by fluid pressure in an auxiliary reservoir on reduction of pressure in the supply passage below the normal degree, in whatever position the slide valve of the triple-valve mechanism may be brought by such reduction, substantially as set forth."

It appears from the specification that the object of said invention was "to provide means for effecting the rapid admission of fluid under pressure to a desired delivery receptacle, by means of, and coincidentally with, a reduction of pressure in the receptacle of a fluid supply," and that the means by which this object was to be attained could be used with or without a triple-valve apparatus. All the drawings except the first show the appliance as connected in operative relation with such triple-valve apparatus. The alleged invention consists of a valve controlling communication between a supply passage from the train pipe and a delivery passage to the open air, or a brake cylinder. This valve is held in position by a spring, so as to close ports leading to the delivery passage, and not to be moved from its seat by ordinary reductions of pressure for service stops. There is also a diaphragm and valve stem interposed between the supply passage and a passage to a special reservoir or an auxiliary reservoir. Said controlling valve is connected to said valve stem. Train-pipe pressure passes through a small passage in said diaphragm into said reservoir, thus equalizing pressure on the opposite sides of said diaphragm. Upon a sudden reduction of pressure, sufficient for an emergency stop, the excess pressure on one side of said diaphragm moves it and its valve stem and the said controlling valve, downwardly, so as to open said ports, and allow the compressed air to pass through the delivery passage to the open air or brake cylinder.

Defendants admit infringement of claims 1 and 2; but they urge that said claims are void, alleging the following reasons:

"(1) They must be construed to cover (a) the mere transfer of the automatic relief valve of 162,465 from the direct system to the automatic system, which is a mere double use, and not an invention; (b) the mere substitution for the automatic relief valve shown in 360,070 of the automatic relief valve of 162,465,

which is a mere substitution, and not an invention. (2) There is no invention described in 448,827, in view of 162,465 and 360,070. (3) The alleged amendments of April 26, 1890, and all of later date, are 'enlargements,' and not amendments. (4) The claims were designedly made far too broad, and must be construed to cover (a) the double use, and (b) a relief valve, whether controlled by a piston or its equivalent, or controlled in any other way, known or unknown."

Most of the claims in support of the second defense have already been discussed; but, as they are forcibly renewed upon a different aspect and in a different connection in this case, they seem to call for a further consideration. Irrespective of the question of the effect of the so-called "amendments," and the action of the patent office thereon, which will hereafter be considered, it seems to me that this divisional patent fairly represents an invention distinct from those which preceded it. The problem presented was how to provide for a certain, sure operation of the emergency valve, and how to rapidly apply brakes for an emergency stop, upon or by means of an emergency reduction of pressure. The solution was accomplished by a valvular appliance so arranged as to operate independently of the triple valve, although capable of being used in combination with it. The essence of the invention lies in providing a means whereby the emergency apparatus may be directly brought into efficient operation, although the triple valve may be stuck fast. I do not find in the argument of defendants anything which renders it necessary again to discuss patents Nos. 162,465 or 360,070, nor do I see any reason for changing the views already fully stated,—that patent No. 376,837 embodies a valuable invention, and that the patent, therefore, is valid. The domain of the conception, as stated by complainants' counsel, consists in the elimination from the apparatus of patent No. 448,827 of all mechanical connection between triple valve and emergency valve whereby the movements of the latter may be controlled by the former. The distinct invention in patent No. 448,827 is the combination of the valve with the triple-valve mechanism, under such relations that it does not need any movement on the part of the triple-valve mechanism in order to operate it. If the invention embodied in patents Nos. 360,070, 376,837, and 448,827 be considered in its entirety, we shall see that it is for the fluid-pressure car brake, consisting of various combinations operating in different ways. The object to be attained by such invention is the successful, practical operation of the brakes on all occasions. One of the exigencies to be guarded against in providing for all contingencies is the possible sticking or wedging of the triple valve. While, therefore, the apparatus covered by patent No. 448,827 is adapted to be used in connection with the triple-valve device, and in combination with a brake apparatus normally operated by such device, yet it is designed to be so constructed that, upon a considerably greater reduction of pressure than that required for a service stop, the pressure from the reservoir on top of the diaphragm will cause it to work in any case. By this means the mechanical dependency of the emergency part of the apparatus upon the movement of the other part is eliminated. This subject will be further discussed in the consideration of said claims.

The defendants claimed, in connection with the proceedings in the patent office, that Westinghouse falsely swore that said improvement had not been patented with his knowledge or consent, and that his application did not contain any description of the invention, patented in patent No. 448,827, until after he had knowledge of the apparatus made by defendants, and that because of such knowledge he made the alleged amendments The first point was not referred to in the briefs or arguments of counsel for defendants. Even if true, it does not seem to be material. Hoe v. Cottrell, 17 Blatchf. 546, 1 Fed. 597. The second point is unsupported by proof. It was not pressed upon the argument of the case. The record shows that the second claim for the combination with a triple-valve mechanism of a "discharge valve," etc., was made before any record evidence of the existence of defendants' valves. I therefore have not considered the matter. The history of the patent is important in the consideration of the defenses that the alleged amendments are enlargments, and not amendments. I understand counsel to mean, by "enlargement," such an alteration of the claim of a patent as to enlarge the scope of, or make a total change in, the invention as originally described. It appears from the evidence, and is agreed by the parties, that Fig. 1 of patent No. 448,827 was originally Fig. 13 of patent No. 376,837, and that patent No. 448,827 contains a paragraph which was originally in patent No. 376,837. In the original application, therefore, as a part of patent No. 376,837, the subject-matter of this divisional patent was described in connection with a triple-valve apparatus. It further appears that, when patent No. 448,827 was first applied for, there was but one sheet of drawings, and but one figure, which is Fig. 1 of the present patent, and that the new sheets were inserted in compliance with an express requirement of the patent office. It is further agreed that the record does not disclose any action of the patent office requiring or requesting that Fig. 13 of patent No. 376,837 should be taken out of that application. It further appears from the file wrapper and contents that in the original specification of this divisional patent the valve mechanism therein claimed was described as capable of being employed in connection with, and supplementary to, the automatic triple-valve apparatus, although it was not claimed as so connected. Afterwards, on citation of anticipations, the claims were amended so as to be restricted to a combination of triple-valve and emergency-valve apparatus.

If the original apparatus was an invention, and was described as capable of use independently or in a combination, I do not see how a subsequent amendment, restricting the claim to such combination, can constitute a new invention. The combination was not one where the triple-valve and emergency apparatus acted together in ordinary braking, but one wherein the latter was only operated by a greater than normal reduction of pressure, without requiring for such operation any movement or co-operation on the part of the triple-valve device. It seems to me that the inventor acted clearly within his rights under the law in this regard, and that said amendments were not enlargements of the invention already described. In

Railway Register, etc., Co. v. North Hudson Co., 24 Fed. 793, Judge Nixon said:

"The question is not, as the counsel of the defendants seem to imagine, whether everything which appears in these three claims was incorporated in the fifth claim of the original application, but whether the specifications of that application fairly indicate all that was put into these claims. I do not understand that an inventor applying for a patent and before it is issued, may not amend or enlarge his claims from time to time, in order to embrace everything which was specified at the start."

To the same effect is Singer v. Braunsdorf, 7 Blatchf. 521. In cases of reissue I find the rule laid down as follows:

"It must appear by the description in the original patent that it was the purpose of the patentee to secure the thing specified in the claim of the reissue." Featherstone v. Cycle Co., (1893,) 6 C. C. A. 487, 57 Fed. 631.

A reissue must be for the same invention intended to be embraced in the original patent, and cannot be substantially changed, either by the addition of new matter, or the omission of important particulars, so as to enlarge the invention as intended to be originally claimed. Plow Co. v. Kingman, 129 U. S. 299, 9 Sup. Ct. 259. "If the amended specification does not enlarge the scope of the patent by extending the claim so as to cover more than was embraced in the original, and thus cause the patent to include an invention not within the original, the rights of the public are not thereby narrowed, and the case is within the remedy intended by the statute." Eames v. Andrews, 122 U. S. 40, 7 Sup. Ct. 1073. See, also, Leggett v. Oil Co., 149 U. S. 287, 13 Sup. Ct. 902; Railway Register Manuf'g Co. v. Broadway & S. A. R. Co., 26 Fed. 522. If the rule laid down in the foregoing cases be applied herein, and the original specification contained in patent No. 376,837 and in the original divisional application be examined and compared with the claims in suit, it will be found that all the elements and the combination covered by said claims were described in, or embraced within the scope of, said original specification.

The considerations already suggested seem to raise a question as to the co-operation of the elements of the combination as claimed. Where subordinate "elements are so united that by their reciprocal influence upon each other, or their joint action on their common object, they perform additional functions, and accomplish additional results, the union is a true combination." Rob. Pat. 155. Whether the elements act successively or simultaneously is of no consequence, provided they coact to produce a new and useful result, in accordance with the co-operative law described in the claim. Id. 156; Holmes Burglar Alarm Co. v. Domestic Tel. Co., 42 Fed. 220. In Hoe v. Cottrell, 1 Fed. 597, Judge Shipman sustained the patent for a combination because the beneficial results involving a new mode of operation were "the product of the successive action of all the elementary parts." Newbury v. Fowler, 28 Fed. 454, holds that a claim for supplemental mechanism, so adapted to a time lock as to remain inert until the time lock was broken, and to be brought into action by such breaking, is a valid claim for a combination. Electric Light Co. v. Westinghouse, supra. In this combination,

when the slide valve of the triple valve gets stuck, instead of acting as a port, it acts as a plug to the port, and thereby causes the emergency valve to be directly operated through its own passage way between the train pipe and the brakes, by the direct reduction of pressure by the engineer. In this view, at least, the parts may be fairly said to act separately to contribute to a unitary result. Such co-operating action is confessedly found in the function of speeding the action of the next succeeding triple valve.

Furthermore, the combination is not denied by the expert or counsel for defendants. In Yale Lock Manuf'g Co. v. Norwich Nat. Bank, 6 Fed. 395, the court, speaking of the independent action of the time lock and bolt lock, says:

"Each mechanism strengthens the weakness of the other, and by its positive advantage fills up the deficiencies of the other. The result is a product of greater efficiency than is fairly represented by the sum of the two results. The result is not a combination of two results, but a result from the combined action of two locks upon the bolt work, each acting independently, but the action of each supplying the lack of the other."

The considerations already stated would seem to cover all the defenses raised by defendants. This patent covers a useful invention. Some such contrivance would seem to be indispensable to the practical operation of the system in emergencies. But, in view of what Westinghouse had already done, it has seemed to me that the history, construction, and claims of this patent, and the state of the art, should be critically examined. The questions involved herein were most forcibly presented by the ingenious and able arguments of counsel. In the consideration of these questions I have had in mind the limitation suggested by Judge Shipman, in delivering the opinion of the circuit court of appeals in Electrical Accumulator Co. v. Brush Electric Co., 1 U. S. App. 320, 2 C. C. A. 682, 52 Fed. 130, where he says:

"When one inventor makes a generic invention, and also subordinate specific inventions, and presents the whole series in a set of contemporaneous applications, the patentee must not be enabled, by an ingenious use of general terms, to enlarge the boundaries of each invention, to extend each into the borders of another, and obtain a series of overlapping patents."

But I am forced to the conclusion that George Westinghouse described, in the original specification of this patent, an improvement upon previous inventions which was capable of use independently, or as part of a combination, but which owed its utility in such combination to its independency of operation in emergencies in supplying the lack of the other part of the combination, and that this useful element involved invention, in order to adapt it to such combination, and to the exigencies of the automatic quick-action freight-brake system.

In suit No. 4,976 it is claimed that defendants, by their first form of quick-action triple valve, have infringed claims 1 and 2 of patent No. 393,784, granted to Harvey S. Park, December 4, 1888. This patent having been assigned to the Westinghouse Air-Brake Company alone, its alleged infringement is for that reason made the basis of a separate suit. The essence of this invention is the

combination of elements for operating the separate emergency valve by train-pipe pressure, instead of by auxiliary reservoir pressure, as in patent No. 376,837. This result was accomplished by providing a separate emergency piston and valve, ordinarily exposed to train-pipe pressure, above said piston, which pressure served to hold the valve on its seat, and was not affected by ordinary reductions of pressure for service stops. But the considerable reduction of pressure necessary for an emergency stop caused air from the train pipe to be vented into the space below said piston, equalizing the pressure on both sides, and acting on the under side of said valve, causing it to be unseated, and to thus allow the train-pipe pressure to be vented directly into the brake-pipe cylinder. The claims alleged to be infringed are as follows:

"(1) In a brake mechanism, the combination of a valve controlling the direct passage of pressure from a train pipe to a brake cylinder, a piston connected to said valve and actuated wholly by train-pipe pressure, and a valve controlling the train-pipe pressure on the piston for opening and closing the communication between a train pipe and a brake cylinder through the direct action of train-pipe pressure, substantially as specified.

"(2) In a brake mechanism, the combination of a train pipe, a brake cylinder, an interposed chamber communicating with the train pipe and brake cylinder, a piston in said chamber, a piston stem, a valve on the piston stem controlling the passage from the interposed chamber to the brake cylinder, and a controlling valve and passages for the admission of pressure from the train pipe to move the piston and open the valve, substantially as and for the purposes specified."

It does not seem necessary to further consider the details of construction of this device, whereby the emergency apparatus is called into operation, because they are not material to the defense of non-infringement. The defendants' first form of quick-action triple valve contains all the elements specified in said claims. But the piston of the emergency valve, in the first claim of said patent, is claimed as "connected to said valve, and actuated wholly by train-pipe pressure." It will be remembered that in defendants' said device there are two pistons which operate the emergency apparatus, instead of the single emergency piston of patent No. 376,837, and of the patent in suit. Of these two pistons, the one which corresponds in construction with the single emergency piston of the patent in suit, and which may therefore be called "defendants' emergency piston," is not fastened to the emergency valve, but merely presses upon it through its spindle, which rests on top of said valve. From this difference in construction there results a difference in the operation of the two devices. In complainants' device said valve is held to its seat by train-pipe pressure on one side of said piston, and upon an emergency application is unseated by means of train-pipe pressure admitted to the other side of said piston. In defendants' device, upon an emergency application, train-pipe pressure upon the emergency piston causes it to unseat said emergency valve. But, as said piston stem is not fastened to said valve, train-pipe pressure on the under side of said piston does not close said valve, but it is seated by combined spring, train-pipe, brake-cylinder, and auxiliary-reservoir pressure.

These differences are material only upon the question whether the defendants have the "piston connected to said valve and actuated wholly by train-pipe pressure," covered by complainants' first claim, so that train-pipe pressure, acting first on one side of said piston, and then on the other side, would operate said valve. "Connected to" means "bound or fastened together," "united, or joined, or coupled to,"—like a "connecting rod." Cent. Dict. I do not think defendants' piston is "connected to" the valve in a mechanical sense. It is certainly not so connected as to close the emergency valve. It therefore seems to me that said device does not infringe said first claim. McClain v. Ortmayer, 141 U. S. 419, 12 Sup. Ct. 76. In the second claim, Park does not claim the piston connected to said valve, and actuated wholly by train-pipe pressure, but claims "a piston stem, a valve on the piston stem controlling the passage from the interposed chamber to the brake cylinder, and a controlling valve and passages for the admission of pressure from the train pipe to move the piston and open the valve, substantially as and for the purposes specified." The description shows that the said valve is controlled in both opening and closing by train-pipe pressure admitted into the piston chamber above and below the piston, and moving the piston. Now, if the valve were disconnected from said piston, as in the first form of defendants' quick-action triple valve, said train-pipe pressure, acting on the piston, would not close the valve, because the piston would have no control over the valve.

Applying the considerations already suggested as to the scope of the claim, it seems to me that the construction described by the patentee embodies, as an essential to its successful operation, a valve connected to said piston, and that therefore it must be covered by said second claim. Rob. Pat. 523; Ex parte Richardson, 7 O. G. 1053. Inasmuch as the means employed by defendants thus differ from those described and claimed as essential in the patent in suit, it seems to me that the complainants' patent is not infringed. I am therefore of the opinion that defendants' first form of quick-action triple valve does not infringe said second claim. It is not claimed that defendants' second or modified form of quick-action apparatus infringes said claims.

Complainants, in suit No. 4,977, further allege infringement of claim No. 3 of patent No. 172,064, issued to George Westinghouse, Jr., January 11, 1876, for an improvement in air-brake valves. This invention was designed to be used in connection with the form of automatic-brake apparatus employed prior to the invention of the quick-action apparatus. The object of the invention of 172,064 was to provide means for the application and release of the brakes by the admission of air from the auxiliary reservoir and the discharge of air from the brake cylinder as in the automatic-brake apparatus. The patent in suit is for an improvement on No. 168,359, granted to said Westinghouse, October 5, 1875. The defense is noninfringement, chiefly on the ground that the defendants have adopted the construction of the said original patent, No. 168,359, which is not in suit. I shall therefore consider these patents together. Patent No.

168,359 provides for a piston and slide valve so arranged that air pressure transmitted through the train pipe shall pass on the under side of the piston, and hold it in an upward position, and thence pass through a side port in the piston-valve case, and certain other ports and passages, into the auxiliary reservoir. The effect of this pressure is to hold the slide valve in position above two connected ports, one leading to the brake cylinder, the other to the open air, so that any pressure in the brake cylinder will escape to the open air, and the brakes will be off. When the pressure is reduced in order to apply the brakes, the back pressure from the auxiliary reservoir depresses said piston so that it passes down and closes the supply ports, and shifts the slide valve so as to open the port leading to the brake cylinder and expose it to auxiliary reservoir pressure, and so as to close the port leading to the open air.

In patent No. 172,064, the inventor dispensed with said side port in the valve case, and substituted therefor a port through the piston itself. The piston was so arranged, in connection with this port, that said port could be opened or closed without moving the slide valve. This was accomplished by having the stem of the piston fitted to the port in the piston, so that it would close the port when moved into it, and open it when removed, and by further providing that the slide valve should be made shorter than the distance between the collars on its stem, thus insuring the necessary slack motion for closing the supply port before the slide valve begins to move. Claim 3 is as follows:

"(3) The slide valve, H, made shorter than the distance between its end bearings, in combination with the port, s, and stem, c', relatively arranged with reference to the operation of the valve, H, while the port, s, is closed, substantially as set forth."

Defendants' device, as illustrated by "defendants' plain triple valve," contains the slide valve, made shorter than the distance between its end bearings on the piston stem. It is also provided with two ports, one of which leads from the train pipe, through the piston chamber, and by other passages, to the auxiliary reservoir. The other port leads from the auxiliary reservoir to the brake cylinder. This port is closed by having the end of the piston stem slide onto it, and cover it, like a valve upon its seat. There is no port through defendants' piston, and consequently no piston stem fitted to enter such port. The two combinations are so arranged as to provide the lost motion in the same way, and to close the supply port before commencing to open the slide valve, and without having to overcome any resistance from the slide valve.

But defendants contend that the port leading from the train pipe to the piston chamber is the equivalent of the port, s, in complainants' claim; that this is the side port of patent No. 168,359; and that patent No. 172,064 was designed to get rid of a side port, and substitute a central port. The inventor states that his invention dispenses with the side port which is found in defendants' device and in patent No. 168,359, and substitutes therefor a port directly through the center of the piston; and the claim in suit is for a combination of valve, port, and stem, "substantially as described."

The defendants accomplish the same result by a combination which contains a port, not through the center of the piston, which does not connect the train pipe and the auxiliary reservoir, but does connect the auxiliary reservoir with the brake cylinder, while the port in their device, which connects the train pipe with the auxiliary reservoir, is the side port of patent No. 168,359, which was dispensed with in patent No. 172,064.

Two further objections are suggested to the claim of complainants that the end port between the auxiliary reservoir and the brake cylinder, is the equivalent of their port through the center of the piston. In the operation of complainants' device the single port is open for the free passage of air from the brake pipe to the auxiliary reservoir, when the train is in running condition, and is closed to apply the brakes. In defendants' device the side port is closed, and the end port is then opened to apply the brakes. Furthermore, the stem of complainants' device is so arranged as to close the central port in the piston, by entering it while the piston is still free to move; while in defendants' device, the moment the piston stem strikes the end port and covers it, the motion of the piston is arrested. I do not decide the question, however, upon these grounds. But inasmuch as complainants claim a combination which contains a port through the center of a piston, described as substituted for a side port, with which said improvement dispenses, and as defendants' device depends upon the use of a side port, and has no port through the piston, but is made up by a combination of different elements, which are admitted in patent No. 172,064 to be a part of the prior art, the combination claimed in claim 3 of said patent is not infringed. A correct construction of the claim must include the port through the center of the piston, substituted for the side port of patent No. 168,359. Perrin v. Railroad Co., 56 Fed. 503. The defendants had the right to use other parts of the combination claimed, provided they substituted for the port through the piston another mechanical structure substantially different in its construction and operation, although it served the same purpose. Eames v. Godfrey, 1 Wall. 78. The patentee is bound by the explicit language of the claim. McClain v. Ortmayer, supra.

In suit No. 4,976, complainants also allege infringement of patent No. 222,803, granted to George Westinghouse, Jr., December 23, 1879, for an improvement in operating cocks for fluid-pressure brakes. This device is known as the "engineer's valve." It is intended to be operated by the engineer on the locomotive engine, "to admit the fluid pressure to the brake pipes and cylinders, fast or slow, as may be desired, to cut off automatically, or stop, such admission of fluid pressure, to hold or retain automatically such pressure, with little or no increase or diminution, and also to permit the escape of the fluid pressure previously admitted or charged into the brake cylinders; and it is important, for convenience in use, that all these functions be performed by movements of a single stem, handle, lever, or crank, so that, so far as the working of the device is concerned, the engineer need give his attention to but a single device." The contrivance described in the patent consists

of a piston case, containing a piston governing a charging valve held up to its seat partly by fluid pressure, and partly by a spring, and an escape valve held down to its seat partly by gravity, and partly by a preponderance of fluid pressure on its upper end. This governing piston is exposed on its under side to fluid pressure, and on the upper side to pressure from a spring. A screw stem worked by a crank arm is so arranged in connection with said spring that by the revolution of the crank arm the downward pressure of said spring upon said piston is increased or lessened. The effect of such change of pressure is to cause the piston to be moved upwards or downwards, according as it is acted upon by an excess of fluid or of spring pressure, and to open or close the charging and escape valves. Beneath the lower end of the escape valve, provision is made for a certain amount of slack motion, so that the governing piston may be moved up or down for a short distance without unseating the escape valve. The effect of this arrangement is to prevent the possibility of both valves being open at the same time.

The operation of said apparatus is as follows: In order to apply the brakes or to open the charging valve, the crank arm is screwed down, and this increase of pressure, transmitted through the stem of the piston head to the charging valve, unseats it, and permits fluid pressure to pass from the boiler or storage reservoir to the train pipe and brake cylinders. This fluid pressure also passes upward to the space below the piston head, and exerts the same pressure upon it as in the train pipe or brake cylinders. The engineer knows, from his engineer's gauge, just how far to screw down his crank, so that when the necessary amount of pressure has passed through to the train pipe or brake cylinder the same pressure will automatically lift the piston and close the charging valve. The crank arm is screwed up in order to open the escape valve, and, after the proper amount has been discharged, the escape valve automatically closes in the same way as already shown in the case of the charging valve.

Complainants claim infringement of claims 2, 3, and 4 of said patent. Said claims read as follows:

"(2) As a means for automatically cutting off the fluid-pressure supply when the desired pressure has been charged into the brake cylinders, a piston head, P, movable by the operative brake pressure or any excess thereof, in combination with the charging valve and a connection from one to the other, substantially as set forth, whereby such movement of the piston head will result in the automatic closing of the charging valve, substantially as set forth.

"(3) The combination of piston head, charging valve, interposed stem, and escape valve, substantially as set forth, with reference to the opening and closing of the charging valve without necessarily opening the escape-valve, substantially as set forth.

"(4) The combination of piston head, charging valve, interposed stem, escape valve, and a single operating stem, adapted by independent connections with both valves to shift both by independent successive motions, substantially as set forth."

Defendants' engineer's valve has a single operating lever and stem, which is worked by moving a handle having a reciprocating motion from one side to the other. It also has a piston case, containing a piston governing a charging and an escape valve, so ar-

ranged that, acting together, they have practically the same functions as complainants' valve. The governing piston is exposed to fluid pressure on both sides. It is also acted upon from below by a bell-crank lever, or bent lever with vertical arms, connected by links to said piston and to a second lever, which second lever is connected with a light spring, the resistance of which corresponds to a uniform variation in the pressures on the opposite sides of said piston as it rises. The marked difference, as claimed by defendants, between the two contrivances, is that, while in complainants' device the turning of the crank arm compresses or relaxes a spring, in defendants' device the moving of the handle directly and positively opens the valve without the interposition of a spring. This is accomplished by having the main lever, which is fastened to said handle, carry an eccentric pin, which passes through said lever, and which moves in the arc of a circle. The right end of the lever is held stationary by a jaw and fulcrum pin; the left end, when said handle is moved to the right, is lifted by the rock-shaft motion imparted by said pin, and strikes against another pin attached to the escape valve, and raises and opens said escape valve. This lever has also an upper jaw, which moves in a pin attached to a bell-crank lever, the arm of which is directly beneath the charging valve. In order to open this valve, the handle is moved to the left, which causes the main lever and pin to move to the left, and to raise the arm of the bell-crank lever, and open the charging valve. Provision is made for slack motion by a space between the top of the escape valve and said pin attached thereto, whereby the left end of the main lever is permitted to have a certain amount of play before it strikes said pin.

In view of these alleged differences of operation the defendants deny infringement. The complainants support their contention by a consideration of the features embraced in their claims, which are common to the two combinations; the defendants rely upon the differences in construction and operation. It appears that George Westinghouse, Jr., was the first inventor of an engineer's valve wherein the charging and exhaust valves could be automatically closed. It is necessarily an important element in the operation of the fluid-pressure brake system, because it sets in motion and controls all the other appliances of said system. Even if originally designed for the direct system, it was described by the inventor as capable of being applied to other systems, and it has been successfully used to operate automatic brakes in regular service. The essential result which the inventor seems to have intended was not, as claimed by defendants, "that the piston shall be pushed in one direction by train-pipe pressure, and in the other direction by a spring only, and that the tension of the spring shall be variable by means under control of the engineer." The spring is not mentioned in any of the claims alleged to be infringed. The essential result aimed at and accomplished was the operation of both valves by a single stem, and their automatic closing after said operation had accomplished the desired result. The claims show the combinations embodied in the invention.

In this connection, reference may be made to the defense that all the elements of these combinations were old, because shown in the patents No. 129,015, granted July 16, 1872, to Messrs. Fay and Cairns, and No. 141,685, granted August 12, 1873, to said Westinghouse. The former patent is for an apparatus for regulating the supply of water and preventing the bursting of pipes in houses. The latter patent is for a triple valve. An examination of these patents confirms the admissions made by defendants' expert, that neither of the structures is capable of performing the functions of the patent in suit, or could be substituted therefor. In view of these admissions, and of the manifest invention involved in the combination of the single elements described in said patents with other elements, and in their adaptation to manual operation for totally different purposes, I have not considered it necessary to consider the construction of said patents in detail.

Returning, now, to the invention embodied in the patent in suit, and bearing in mind the object which the inventor had in view, let us compare the claims in suit with the apparatus of defendant. The piston head, the charging and escape valves, the interposed stem, and the single operating stem of said claims are all to be found in defendants' apparatus. Their combination to form a device for admitting fluid pressure to the train pipe, and automatically cutting off the supply while retaining the necessary operative fluid pressure, and by means of such a connection between said single operating stem and said valves that independent successive motions of said handle shall move them independently of each other, is also found in defendants' apparatus. In each the piston automatically closes the escape valve when the desired pressure is reached, and in each the piston is movable by operative brake pressure, or any excess thereof, as specified in claim 2 of the patent in suit.

But the elements of defendants' device differ from those of complainants in the following particulars: The piston head of defendants, as already stated, is exposed to fluid pressure, alone, on one side, and to fluid pressure plus a spring on the other side, while in complainants' structure the piston head is exposed to fluid pressure, only, on one side, and to spring pressure on the other side. The defendants' device positively and directly opens the valves, as they claim; complainants' device pushes the spring which opens it. It is not necessary to determine whether the fluid pressure is the equivalent of the spring, because the presence or absence of the spring seems to me immaterial, it not being claimed as an element of the combination. The essential similarity seems to consist in the fact that in each contrivance fluid pressure is always practically constant on one side of the piston, and the movement of the piston is regulated by the variations of pressure on its other side, and in each case the piston automatically closes the escape valve when the desired pressure is reached. Defendants' valve is an operative device without the use of the piston. It would only be necessary for the engineer, after he had sufficiently reduced the pressure by opening the exhaust valve, to move the handle back and close it, and vice versa. The piston is essential to the operation of com-