No. 731,894. PATENTED JUNE 23, 1903.

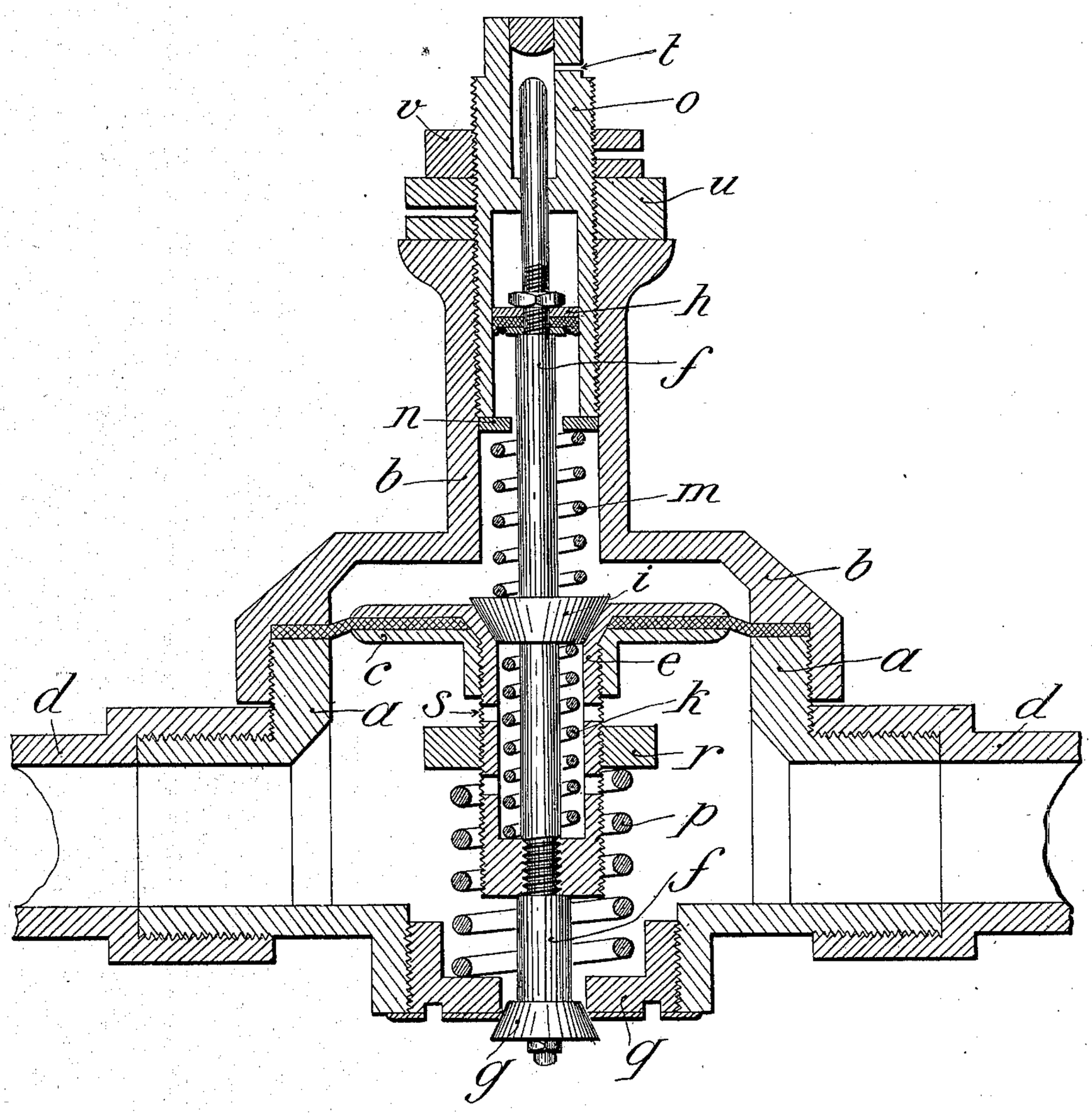
P. HALLOT.

RAILWAY BRAKE.

APPLICATION FILED AUG. 23, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1



Witnesses,
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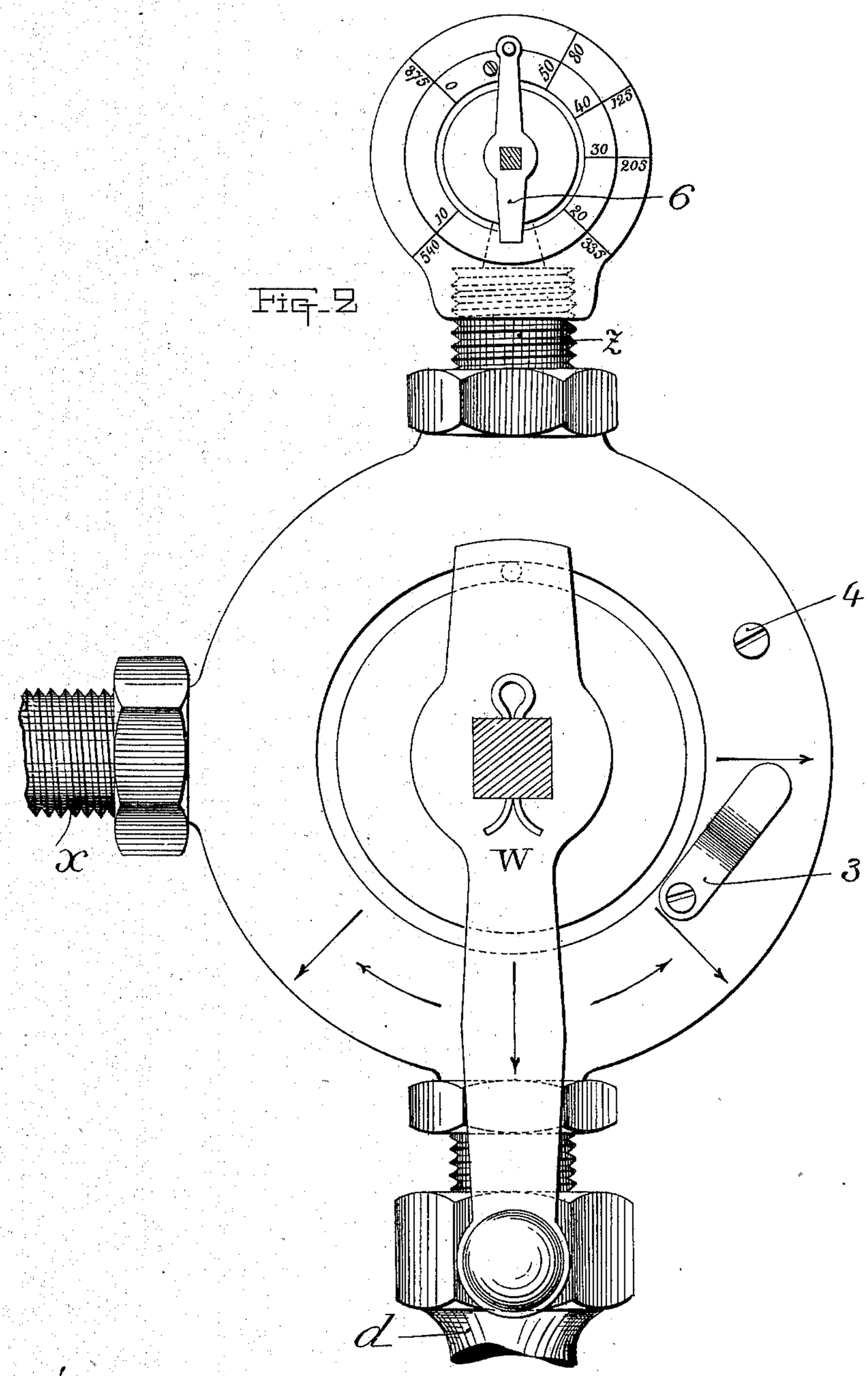
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2



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NO MODEL. 3 SHEETS—SHEET 3.

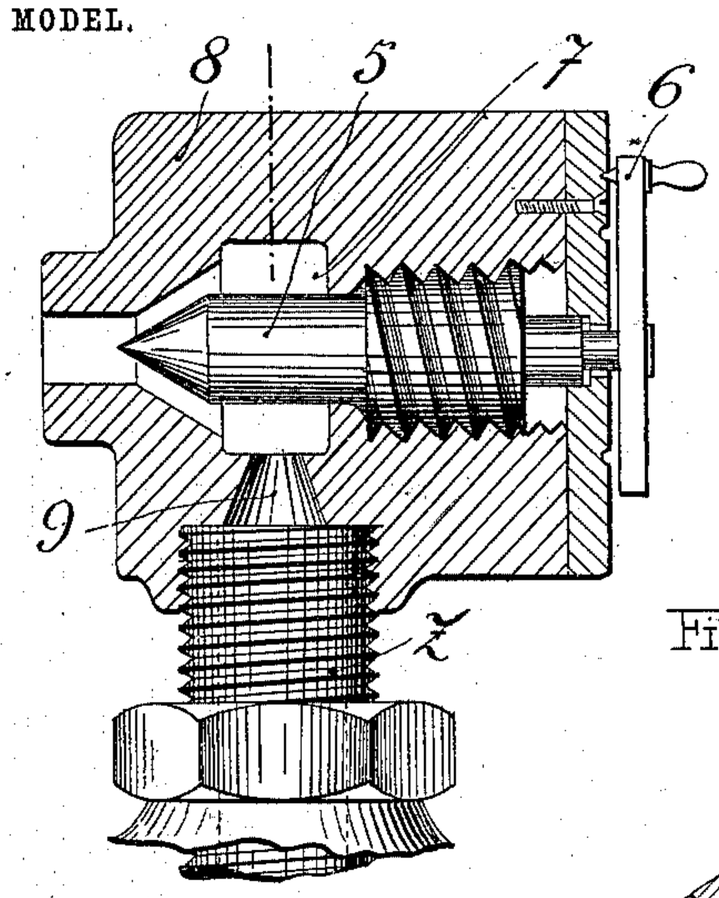


FIG. 4

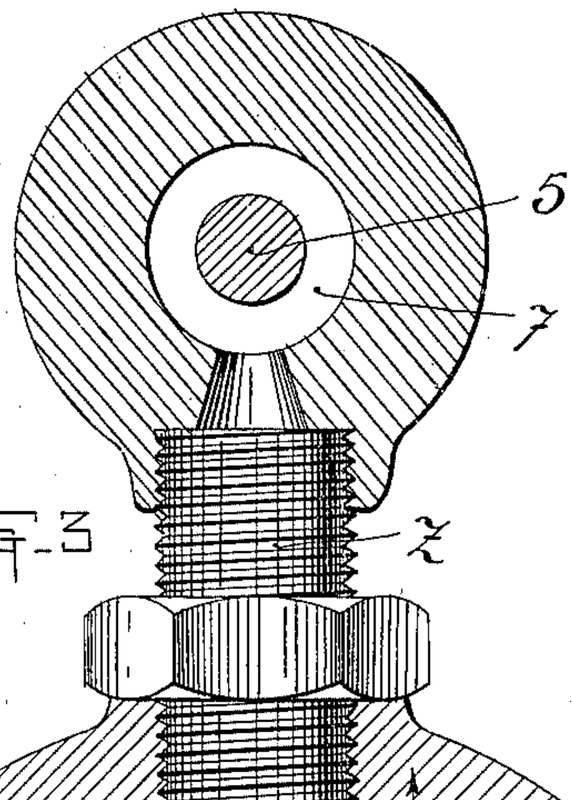
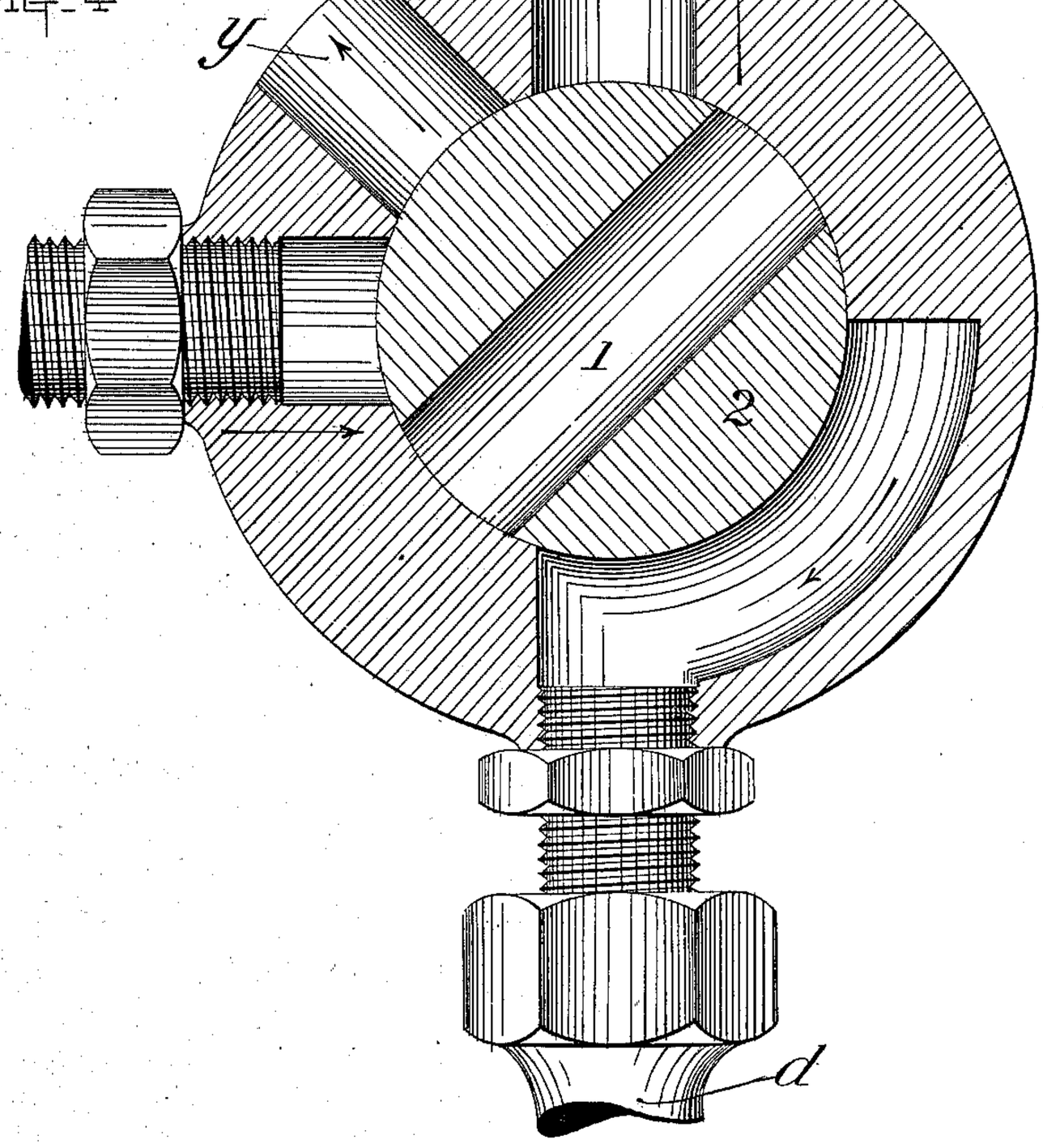


FIG. 3



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No. 731,894. Patented June 23, 1903.

UNITED STATES PATENT OFFICE.

PAUL HALLOT, OF VINCENNES, FRANCE.

RAILWAY-BRAKE.

SPECIFICATION forming part of Letters Patent No. 731,894, dated June 23, 1903.

Application filed August 23, 1901. Serial No. 73,066. (No model.)

To all whom it may concern:

Be it known that I, PAUL HALLOT, engineer, a citizen of France, residing at 79 Rue de Fontenay, Vincennes, France, have invented certain new and useful Improvements in Railway-Brakes, of which the following is a specification.

This invention relates to certain improvements in railway-brakes designed to increase the rapidity of the response to the controlling-gear of all the brakes of a long train and to render the application of all the brakes simultaneous. These results are obtained by the use of a pressure-reducing accelerator, (fitted under each carriage,) combined with a special controlling cock or valve located on the engine.

The accelerators tried up to the present but very imperfectly fulfil the purpose required of them, as they can only work with a somewhat considerable reduction of the pressure, and, indeed, they can only be brought into action in emergency stoppages. In any case they do not expedite the coming into action of the tail-brakes relatively to those of the head.

In the annexed drawings, Figure 1 shows the improved accelerator in vertical section. Fig. 2 is an elevation of the controlling cock or valve provided with its pressure gage or regulator. Fig. 3 is a vertical section thereof. Fig. 4 is a sectional view of the reducing-valve.

The accelerator consists of a metal casing or box formed in two parts *a* and *b*, which are screwed together and provided with an elastic diaphragm *c*. The lower part *a* is interposed in the main conduit *d*. The diaphragm *c* is perforated at its center to allow of the passage of a hollow cylinder *e*, with which it is rigidly connected and which is itself rigid with the central spindle *f*, which is screwed into its base. On one end of the central spindle *f* is fixed a valve *g*, by means of which the accelerator communicates with the atmosphere, and on the other end is a piston *h*, having a surface or area equal to that of the valve *g*. On a level with the opening of the cylinder *e* is a valve-cone *i*, fitted slidably on the spindle *f* and normally pressed upward by a spring *k*, bearing against the smaller base of the cone *i*. This action is, however, counteracted by the preponderating action of an adjusting-spring *m*, bearing on the one hand against the larger base of the cone *i* and on the other hand against a washer *n*, the position of which can be varied by means of the regulating-screw *o*. A third spring *p* is arranged between the screw-plug *q*, which closes the part *a*, and a nut *r* serves to adjust its initial tension and therefore the sensitiveness of the valve *g*. The cylinder *e* is provided with numerous holes *s*, and the part of the accelerator situated above the piston *h* communicates with the atmosphere through an orifice *t*.

In reality the piston *h* does not intervene in the working of the apparatus, its object being to compensate for the effect of the pressure on the valve *g*, and thus render the action of this valve independent of the pressure existing in the main conduit. A further object of the interposition of the opposing spring *k* is to compensate for the various kinds of modifications that the tension of the spring *m* would undergo by reason of variations of temperature or from other causes. These causes producing effects of the same kind, but in a contrary direction, on the two springs *m* and *k* would have no result which would insure the constancy of the regulation of the apparatus. Furthermore, the essential function of the spring *k* is to raise the cone *i* and keep it away from the cylinder *e* to a greater or less extent directly a fall of pressure in the main conduit *d* has caused the diaphragm *c* to descend a certain distance and has thus withdrawn the cone *i* from the preponderating action of the spring *m*.

The apparatus is thus reduced to two groups of movable parts: First. The first group comprises the diaphragm *c*, the cylinder *e*, the spindle *f*, and the valve *g*, the whole of this arrangement being kept raised and the valve closed by the action of the spring *p*, which is so adjusted that the valve only opens at a certain preponderance of the pressure above the diaphragm or by a certain fall of pressure in the main conduit *d*, which comes to the same thing, since the same pressure exists on both sides of the diaphragm. Second. The second group is formed by the movable cone *i*, which is suspended between the two antagonistic springs *m* and *k*, the first of which preponderates so long as the diaphragm *c* is raised, whereas it ceases to act directly

this diaphragm has fallen a certain amount. This action may be regulated to the required degree by means of the screw *o*. Under these conditions when the engineman causes compressed air to enter the main conduit *d* the cone *i* will rise until equilibrium of pressure be established above and below the diaphragm *c*. When he will establish the necessary reduction of pressure under the diaphragm to cause the valve *g* to open, the whole of the parts of the first group will fall sharply, so compressing the spring *p*, and they will only rise again under the action of this spring when the equilibrium of pressure is restored in the two parts of the apparatus through the play which takes place between the cylinder *e* and the cone *i*, which latter is raised by the spring *k*. For the whole of the very brief period during which the valve *g* remains open a certain fraction of the air from the main conduit *d* has escaped into the atmosphere, so that each accelerator transmits to the succeeding one a perfectly definite reduction of pressure greater to a known extent than that which it itself received.

It will be readily understood that by arranging a special manometer at the entry and the exit of the apparatus the tension of the spring *m* may be empirically regulated, and hence the movements of the valve *i* in such a manner that the reduction of pressure transmitted will be equal to the amount of reduction of pressure received increased by a well-known fraction of this latter—for example, one-twentieth. Once this result has been obtained the screw *o* is rendered immovable by the nut *u* and the counter-nut *v*. All the apparatus are regulated in the same way.

The characteristic property of the apparatus allows the braking of all the coaches simultaneously. In fact, the fall of pressure in the main conduit will increase progressively from coach to coach according to the course of a geometrical progression the ratio of which is equal to 1.05 in the example chosen, so that by calling d' the initial reduction of pressure, d^n the reduction received by the accelerator of the coach of row n, we have: $d^n=(1.05)\, n'\, d'$.

The minimum initial reduction of pressure d' is of necessity equal to that which is necessary to effect the working of the valve of the first accelerator—say, for example, eighty grams. We shall have in this case the following series of successive reductions:

	Theoretic proportions.	Approximate practical proportions.
Car No. 1	80 grams	80
Car No. 10	124 grams	125
Car No. 20	202 grams	205
Car No. 30	331 grams	335
Car No. 40	536 grams	540
Car No. 50	873 grams	875

From which, if a reduction of pressure of eight hundred and seventy-five grams be necessary to work the brakes, it is obvious that the first forty-nine brakes will not come into action before the fiftieth, since it is only the coming into action of the fiftieth accelerator which will determine this reduction of pressure in the main conduit.

As a matter of fact it was hitherto quite different. To transmit with sufficient rapidity a reduction of pressure of eight hundred and seventy-five grams to the fiftieth coach, the engineman is in reality obliged to effect a more considerable reduction of pressure at the head, the effect of which is to bring about a much more rapid and energetic braking at the head than at the tail of the train. This defect is very aggravated by the back pressure which is produced in the main conduit at the moment of the closing of the engineman's valve and the effect of which is to take off the head-brakes.

By referring to the list above it will be seen that the initial reduction of pressure effected by the engineman must vary with the number of coaches in the train.

Figs. 2 and 3 show the special arrangement of the valve or cock of the engineman which enables him to effect by an always identical operation such reduction of pressure as is necessary. The controlling-lever *w* is normally vertical—that is to say, when the valve cuts off the different pipes or passages leading thereto—viz., the main conduit *d*, which extends through an arc of ninety degrees; the pipe *x*, leading to the compressed-air reservoir at six kilograms; the passage *y*, Fig. 3, leading to the atmosphere; the passage *z*, leading to the pressure-reducing regulator—the passage 1 in the plug 2 of the valve deviates forty-five degrees relatively to the lever *w*. Under these conditions it will be seen that by slightly shifting the lever to the right up to the spring 3 the main conduit *d* and the passage *z* are caused to communicate. On arriving at the stop 4 the main conduit *d* is brought into communication with the passage *y* and by bringing said lever back to the left the main conduit *d* and the pipe *x* are caused to communicate.

A pressure-regulator, which is mostly shown in Fig. 4 of the drawings, comprises a metallic body 8, which is adapted to control the passage Z and operates to permit the passage of air through the outlets 9 and 10, leading to the atmosphere, the port 10 being adapted to be opened or closed to a greater or less extent by a threaded valve 5, provided with a handle fixed for controlling the same. The handle 6 travels over two concentric graduation-circles, one indicating the number of coaches in the train, ten, twenty, thirty, and the other the corresponding initial reduction of pressure. On starting the engineman puts the handle over the graduation corresponding to the number of coaches in the train, and he reads opposite the initial reduction of

pressure which he has to produce. To effect this, he turns the lever w rapidly to the right and brings it back directly into the vertical position. A manometer indicates to him, on the one hand, the initial minimum reduction of pressure thus obtained and, on the other hand, the maximum reduction of pressure effected after the complete application of all the brakes. Any engineman will in a very short time be able to determine the right movement to be imparted to the lever w, according to the results indicated by the manometer. It is obvious that the screw pointer 5 will close the passage 7 to an extent so much the greater as the number of coaches in the train is the higher.

The advantages of this system are the following:

First. The accelerator does not obstruct the main conduit d and air passes freely therein, which is not the case with apparatus of this kind which only work by the variable resistance offered to the flow of the air.

Second. The working of the apparatus is independent of the pressure existing in the main conduit, and accidental leakage cannot bring it into action.

Third. The accelerator acts with very slight reductions of pressure, and it allows an amount of air to escape so much the slighter as the reduction of pressure which it receives is itself the smaller.

Fourth. It always increases whatever the amount of reduction of pressure the rapidity of the transmission to the brakes of the last coaches without emptying the main conduit, which is not the case with the known accelerators, which with slight reductions not only do not come into action, but also interfere with the flow of air and which with considerable reductions empty the conduit, thus occasioning waste of air, which retards the putting off of the brakes by diminishing the reserve of air in the main reservoir.

An initial reduction of pressure of, say, eighty grams is made by the engineer from the engineer's valve. This causes the accelerator of car one to open and to escape air until the reduction of pressure becomes eighty-four. Then it closes and accelerator on car two opens until the reduction of pressure in the portion of the main pipe from the engine to car two becomes 88.2. Then it closes and accelerator on car three opens until the reduction is 92.6, and so on.

The accelerator on the preceding coach is not brought into action, because the reduction of pressure that acts upon it is equal to the supplementary reduction only produced by it. It is for the coach No. 3 92.6—88.2=4.4. Between the forty-ninth and fiftieth cars this difference is maximum and equal to eight-hundred-and-seventy-five-twentieths equal 43.7 grams. By reference to page 5, lines 1 to 4, and it will be noted that each accelerator is only brought into play by a reduction of eighty grams.

The simultaneousness of application of all the brakes results from this fact that each accelerator can only bring into action the following, the preceding ones resting immovable. The accelerator on car n escapes such a quantity of air that may reduce the pressure in the portion of the main from the engine to the accelerator on car $(n+1)$ to the desired degree. Accelerator on car forty-eight escapes such a volume of air that the reduction in the main as far as car forty-nine would become 789.8. At this instant no one of the brake-valves enters into action, as we assume their action can only be brought out by a reduction of eighty grams; but as soon as the accelerator on car forty-nine plays it determines in the whole main the reduction of eight hundred and seventy-five grams, and then simultaneously all the brakes enter into action.

I claim.

1. A pressure-reducing accelerator consisting of a central spindle f screwed into the bottom of the perforated cylinder e which is connected to a perforated elastic diaphragm c said spindle carrying the exhaust-valve g which is kept on its seating by the spring p so long as the same pressure exists on both the faces of the diaphragm a cone-valve i slidably fitted on said spindle f and situated between two springs k and m one or other of which comes into action according to the position of the diaphragm c and the resulting action of which may be regulated by a screw o for the purpose of varying the duration of opening of the valve g and of obtaining an accelerator capable of increasing the reduction of pressure in a proper known ratio and adjustable at will, said accelerator coming into action with but a very slight reduction of pressure also regulatable, so as to do away with the effects of back pressure and the total exhausting of the main conduit and not offering any obstacle to the circulation of the air in this conduit, substantially as described.

2. In a railway-brake, the combination with the pressure-reducing accelerators and the engineer's valve of a pressure-reducing regulator interposed between the engineer's valve and the atmosphere for obtaining a determinate initial reduction of pressure in the main pipe, and means for controlling such initial reduction of pressure to correspond with the number of cars in the train, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

PAUL HALLOT.

Witnesses:

EDWARD P. MACLEAN,

A. FREY.