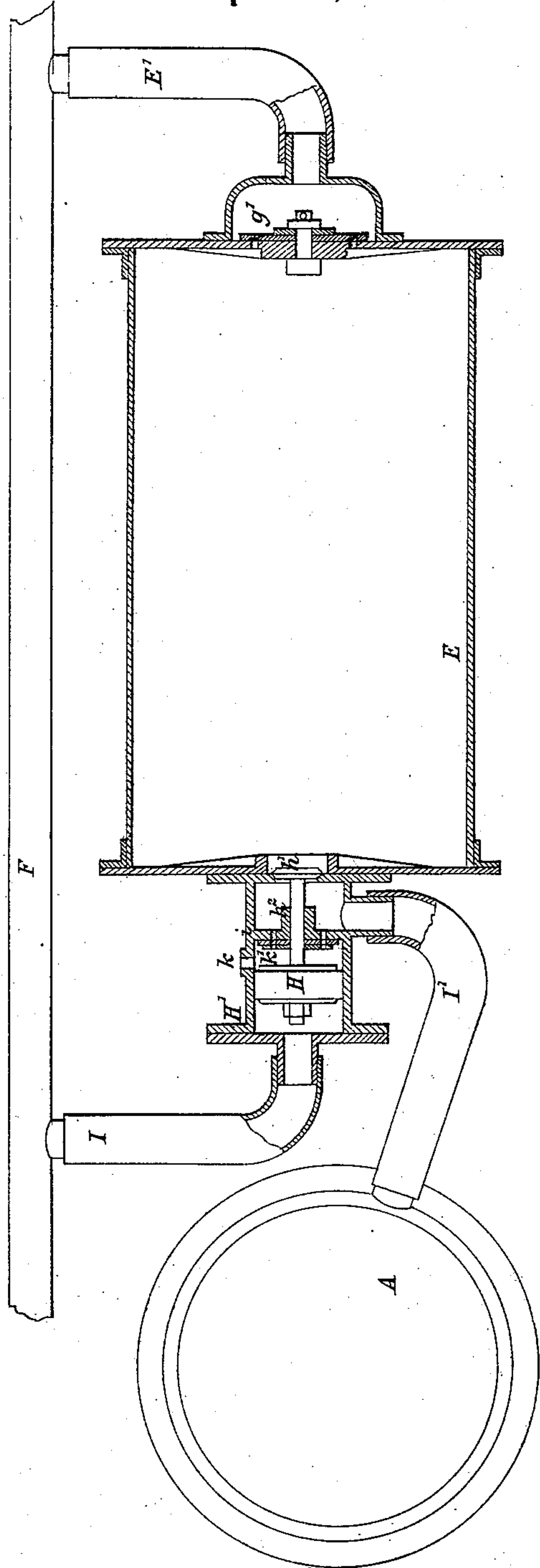
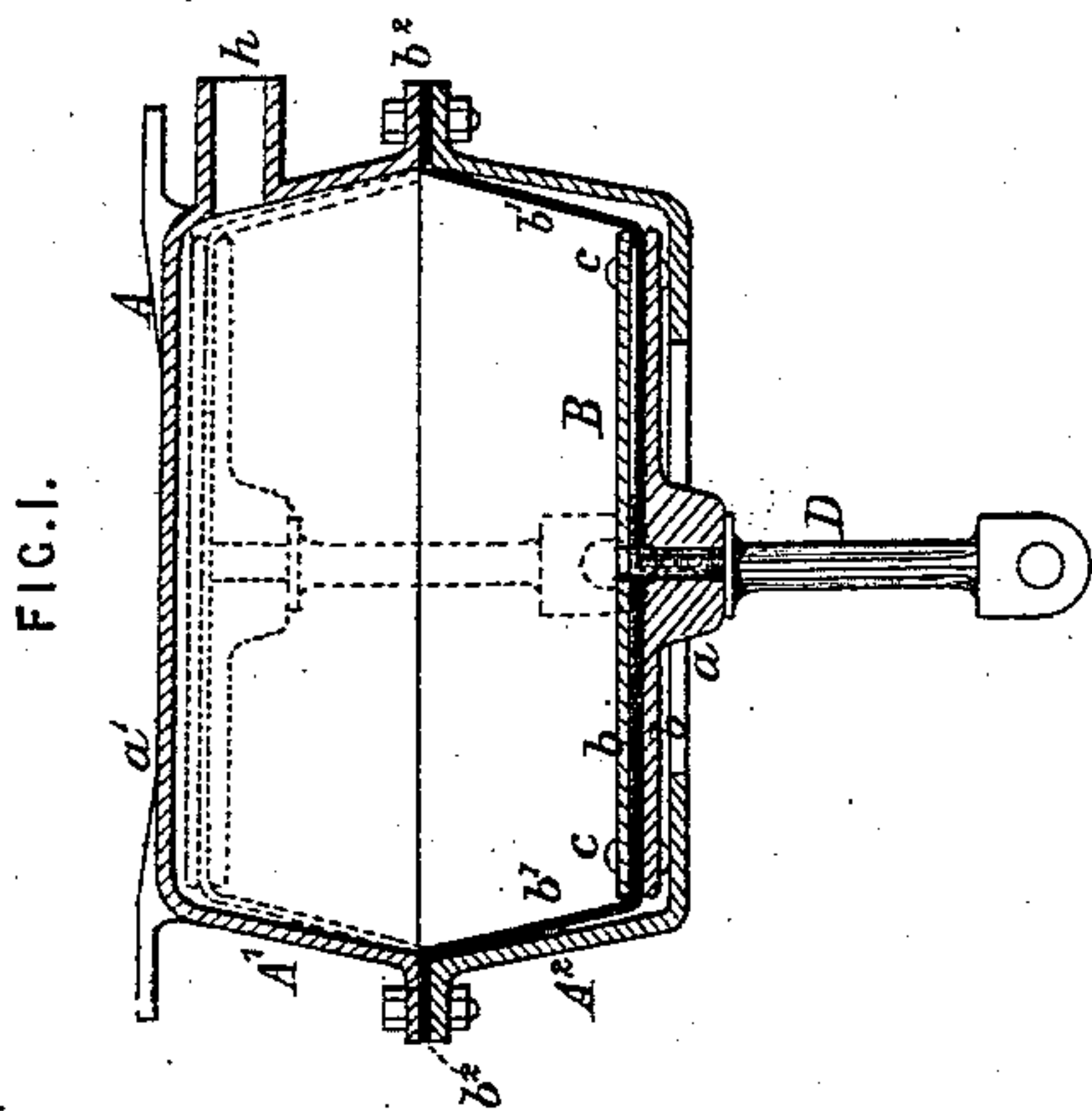
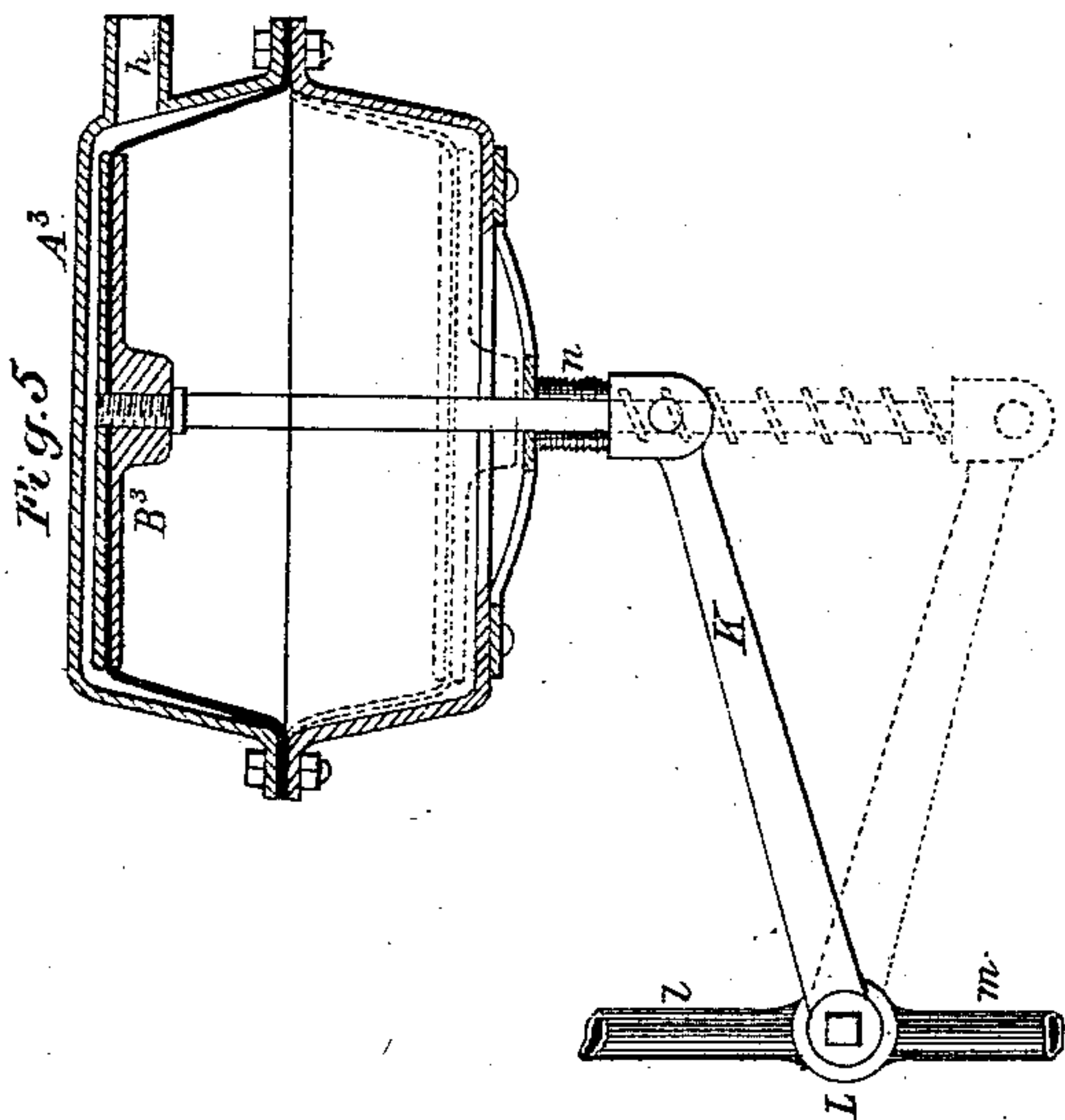


J. & J. G. HARDY.
Railway-Brakes.

2 Sheets—Sheet 1.

No. 208,170.

Patented Sept. 17, 1878.



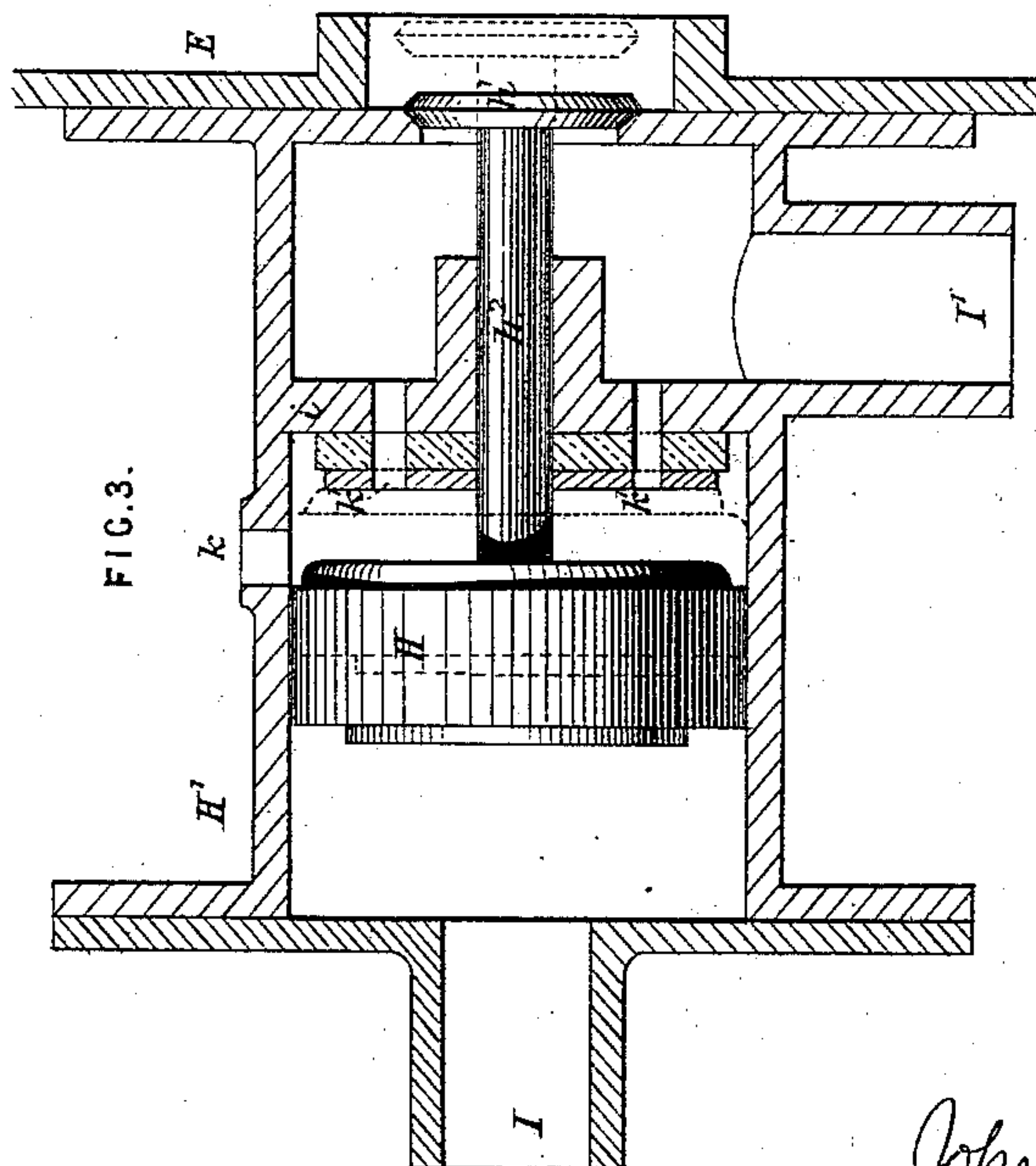
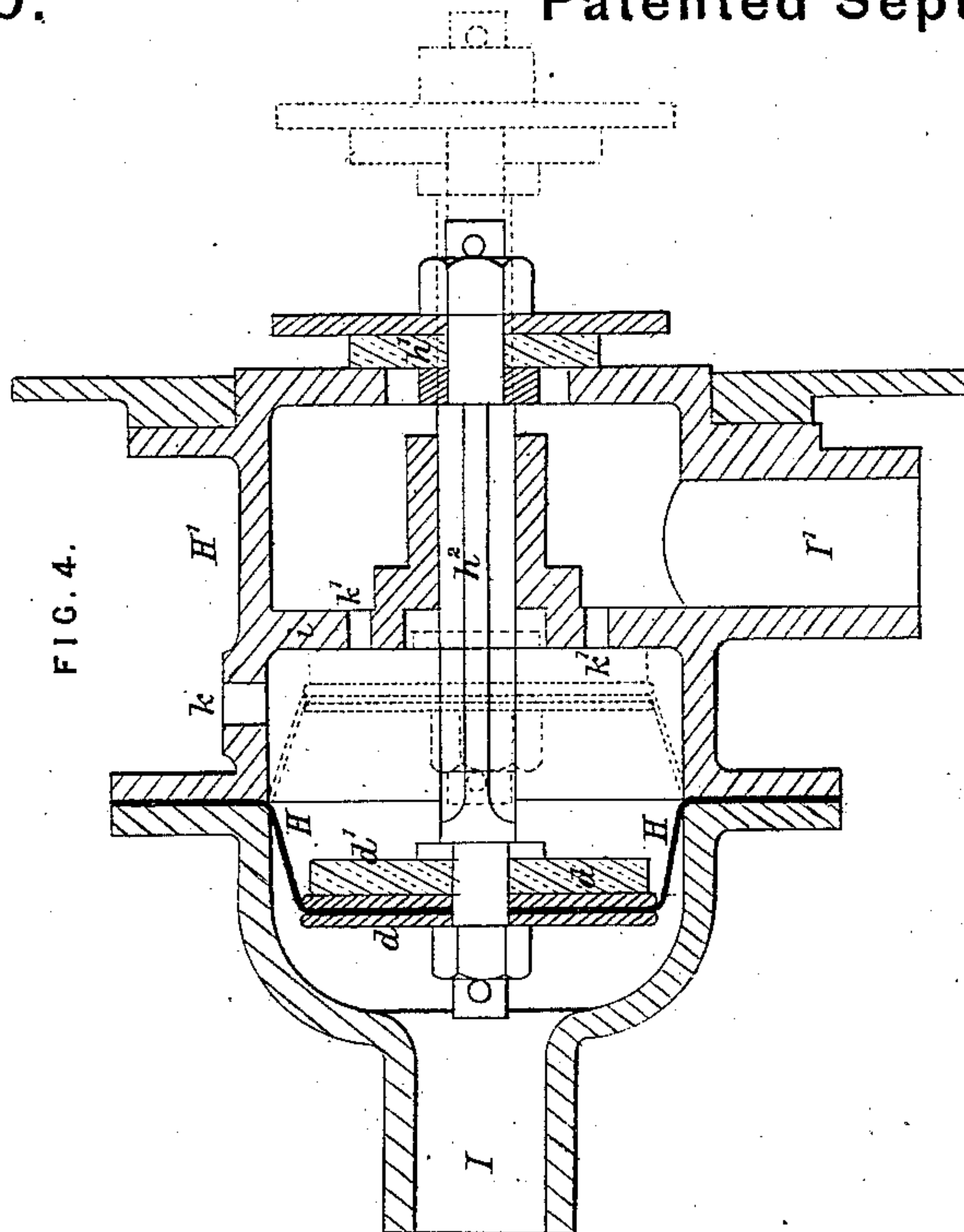
Witnesses
Harry A. Crawford,
Harry Smith

Inventors
John Hardy
and
John G. Hardy
by their Attorneys
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UNITED STATES PATENT OFFICE.

JOHN HARDY AND JOHN GEORGE HARDY, OF VIENNA, AUSTRIA.

IMPROVEMENT IN RAILWAY-BRAKES.

Specification forming part of Letters Patent No. 208,170, dated September 17, 1878; application filed June 27, 1878.

To all whom it may concern:

Be it known that we, JOHN HARDY and JOHN GEORGE HARDY, both of Vienna, in the Empire of Austria, have invented Improvements in Railway-Brakes, of which the following is a specification:

Our invention relates to that class of railway-brakes which are operated by the pressure of the atmosphere upon a piston working in a cylinder, from which, at the opposite side of such piston, the atmospheric resistance is removed by the production of a vacuum by means of an ejector air-pump or other suitable air-exhausting apparatus; and it consists, first, of a peculiar arrangement of apparatus whereby the brakes are applied automatically as soon as air is admitted, either voluntarily or accidentally, into the pipes connected with the said apparatus; secondly, in the provision of efficient means for automatically regulating the supply of steam to the air-ejectors of vacuum-brake apparatus.

And in order that the said invention may be fully understood, we shall now proceed more particularly to describe the same, and for that purpose shall refer to the several figures on the annexed sheet of drawings, the same letters of reference indicating corresponding parts in all the figures.

Figure 1 is a sectional detail view of a vacuum-cylinder with its piston, both of the construction and arrangement which it is preferred to adopt, but which in itself forms no part of the present invention, the same having been protected by certain prior Letters Patent granted to us dated 22d January, 1878, No. 199,540. Fig. 2 is a sectional plan of apparatus arranged in connection with the said cylinder for insuring the automatic action of the brakes on the admission of air to the exhaust-pipe. Fig. 3 is a sectional detail, drawn to a larger scale, of one of the valves hereinafter referred to; and Fig. 4 is a view in section, showing another kind of valve, which is not claimed separately as forming part of our present invention, but which may be used in place of Fig. 3. Fig. 5 is a sectional elevation of an apparatus for automatically regulating the supply of steam to the ejectors, according to the second part of the said invention.

In carrying out the first part of the said invention, there are employed, first, vacuum-cylinders A, the pistons B of which are connected to the brake-blocks by any suitable arrangement of levers and rods; secondly, an exhausted reservoir or reservoirs, E, hereinafter designated "vacuum-reservoirs," arranged in connection with the exhaust-pipe and with the vacuum-cylinders in such a manner that by the admission of air to such pipe, either accidentally or voluntarily, a communication shall be automatically established between the vacuum cylinder or cylinders and the vacuum reservoir or reservoirs at the same time that the communication between the latter and the exhaust-pipe is automatically closed, whereupon the vacuum cylinder or cylinders will be partially exhausted, and the brakes will be accordingly applied under the atmospheric pressure acting upon the exterior of their pistons.

The vacuum-cylinders and their appurtenances, which may be of any suitable description, are preferably, as shown, of the construction described in the specification forming part of the said former Letters Patent. The cylinder A is formed of two truncated cones, A¹ A², of a flat shape at both ends, and meeting or united at their bases, such cylinder being constructed of open-work at its end a, and closed at its opposite end, a'.

The piston B may consist, as shown, of two rigid disks, b b, constituting the piston-head, which is, as nearly as possible, of the same diameter as the head of the cylinder A, but fits loosely within it, and is attached by the sack b¹, made of leather or other suitable material. The sack may be attached to the piston-head either by being interposed between the two disks which form the piston-head and secured by rivets c c, or in any other suitable manner, so as to form a closed connection with the piston-head at or near its circumference, and the exterior edge or circumference of the sack is secured at b² to the cylinder A at the point of junction of the bases of the truncated cones of which it is formed—that is to say, at or about midway between the extremities of the cylinder.

The piston B is connected to the brake le-

vers and rods by means of a rod, D, which may be arranged in any usual or suitable manner.

It will be obvious from an inspection of the drawing that, on exhausting the air from the interior of the cylinder A, (which operation is effected by the outlet *h* being placed in communication with the vacuum-reservoir E, as hereinafter explained,) the piston B will, by the pressure of the atmosphere acting upon its exterior surface, be forced into the cylinder and caused to assume the position indicated by dotted lines in Fig. 1, and the brakes will be applied.

With the vacuum-cylinders, constructed as hereinbefore described, are connected the vacuum-reservoirs and their accessories, which are interposed between the vacuum-cylinders and the exhaust-pipes, and are constructed and arranged in the manner next hereinafter explained.

The vacuum-reservoirs E, which are made, by preference, of a capacity about three times that of the corresponding vacuum-cylinders which they are intended to operate, are each provided with two valves, *g'* *h'*, respectively, at opposite ends thereof. The valve *g'* opens outward, and, through the intervention of a branch pipe, E', places the reservoir in communication with the exhaust-pipe F, leading from the ejector or other air-exhausting apparatus, so that, under the action of the said ejector or exhaust apparatus, a vacuum will be produced in the reservoir, while the valve *g'* will close should the pressure in the exhaust-pipe exceed that in the reservoir. The valve *h'*, which opens inward, is connected by a spindle, *h''*, with a packed piston-valve, H, (see Figs. 2 and 3,) of greater area, working in a valve-box, H', a partition, *i*, perforated at *k'*, being provided, in order to form a seating for the said piston-valve H when closed. The valve-box H' communicates at one end, through the intervention of a branch pipe, I, with the exhaust-pipe F, and at its opposite end, by means of the perforations *k'* and the branch pipe I', with the vacuum-cylinder A, and immediately, through an aperture, *k*, with the atmosphere.

The compound valve *h'* H is so arranged that in one position—videlicet, that indicated by dotted lines in Fig. 3—the valve H will close the communications at *k k'* between the vacuum-cylinder A, while the valve *h'* will open the communication between the vacuum-cylinder A and the vacuum-reservoir E, whereas in the other or normal position, which is indicated by full lines in the drawing, the communications at *k k'* between the atmosphere and the vacuum-cylinder will be open, while the valve *h'*, and consequently the communication between the cylinder and the exhausted reservoir, will be closed.

This automatic brake apparatus is operated in the following manner, one of the vacuum-reservoirs E and vacuum-cylinders A being

taken as an example of the operation of the whole:

Before starting the train a vacuum is produced in the exhaust-pipe F. The valve *g'*, at one end of the reservoir E, opens, allowing the reservoir to be exhausted until the desired vacuum is attained, and closes whenever the vacuum in the exhaust-pipe is less than that in the reservoir, thereby preserving the vacuum produced in such reservoir. In this condition of the reservoir the compound valve *h'* H will be in the position indicated by full lines in the drawings, the reservoir being closed at that end by the valve *h'*, while the valve H leaves open the apertures *k k'*, communicating between the atmosphere and the pipe I'. The vacuum-cylinder A will therefore now be in communication with the atmosphere and the brakes will be off the wheels. On the admission, however, of air to the exhaust-pipe F, either voluntarily under the action of an attendant opening an air-valve, or accidentally by the rupture of the exhaust-pipe, or from any other cause, the atmospheric pressure on the outer side of the valve H neutralizes or partially neutralizes the atmospheric pressure on the other or inner side, and the pressure of the air contained in the valve-box H', acting on the inner side of the valve *h'*, forces the valve *h'* into the reservoir E, and thus opens the communication between the vacuum-reservoir and the vacuum-cylinder. At the same time the valve *h'*, being connected with the valve H, draws the latter with it, thereby closing the apertures *k k'*, and cutting off the communication between the vacuum-cylinder A and the atmosphere.

The vacuum-cylinder is thus exhausted or partially exhausted and the brakes are applied. In this position, which is indicated by dotted lines in Fig. 3, the parts will remain until the vacuum in the exhaust-pipe F and its branches is restored to such a degree that the pressure on the outer side of the valve H is reduced sufficiently to allow that on the inner side to produce the reverse action of the valve. When this takes place the valve H will return to the position indicated by full lines in the drawing, thereby closing the valves *h'* and placing the vacuum-cylinder A in communication with the atmosphere through the apertures *k k'*, when the brakes will consequently be removed from the wheels.

The relative dimensions of the valves *h'* H will be regulated by the degree of sensitiveness required in the apparatus—that is to say, by the minimum degree of pressure in the pipes at which it is desired that the brakes should be applied, as will be well understood by persons skilled in the arts.

With the view of diminishing friction the modification of valve shown in Fig. 4 may be advantageously adopted, in which a sack, H, having suitable rigid disks *d d* and a suitable washer, *d'*, is substituted for the rigid packed piston H, Figs. 2 and 3.

The dotted and full lines in Fig. 4 indicate the same respective positions of the valve as the corresponding lines in Fig. 3, and the operation of the two forms of apparatus is similar, the communication between the atmosphere and the vacuum-cylinder being either closed or open, according as the valve H is in contact with its seat *i*, closing the apertures *k'*, or is removed from its seat, leaving the said apertures open, while the valve *h*¹ is open or closed, as the case may be. The valve *h*¹ may also be modified in the manner shown in Fig. 4, or in any other suitable manner, so long as the proper proportion of its dimensions to those of the valve H is preserved.

The second part of the said invention, which is illustrated in Fig. 5 of the drawings, relates to means for automatically regulating the supply of steam to an air-ejector, so as to constantly maintain a vacuum in the exhaust-pipe and its connections; and it consists in the employment of a regulating vacuum-cylinder—such, for example, as that shown at A³, the piston B³ of which is connected by a lever-arm, K, with a cock, L, for controlling the ingress of steam proceeding from the boiler by a pipe, *l*, and its egress by the pipe *m*. This cock may either constitute the steam-valve for regulating the supply of steam to the ejector, or, as preferred, it may be employed to control the admission of steam to the slide or distributing valve of a small steam-cylinder, the piston of which is connected to and actuates the main steam-valve for regulating the supply of steam to the ejector. In either case, so long as a vacuum is maintained in the cylinder A³ the cock L will be closed, the piston B³ being in its highest position, as shown by the full lines in the drawing; but, should the vacuum be impaired, the piston B³ will descend under the action of a spring, *n*, either to its lowest position, as shown by the corresponding dotted lines, or to a position intermediate between its two extreme positions, according to the degree of deterioration of the vacuum, thereby

opening the steam-cock L and admitting steam to the ejector until the vacuum is restored to its required maximum, when the piston B³ will be again elevated by the atmospheric pressure overcoming the force of the spring *n*, and the cock L accordingly closed.

The vacuum-cylinder A³ is held out of action when the air-valve is opened by the engine-driver in order to apply the brakes, the air-valve being connected with a stop-cock arranged in the pipe communicating with such vacuum-cylinder, which stop-cock is closed by the act of opening the said air-valve.

Having now described and particularly ascertained the nature of the said invention and the manner in which the same is or may be used or carried into effect, we would observe, in conclusion, that what we consider to be novel and original, and therefore claim as our invention, is—

The combination of a vacuum-brake and the vacuum-pipe F with a vacuum-reservoir, communicating at one point through a valved passage with the said pipe, and at another point with the brake-cylinder and with the said pipe through passages provided with a compound valve, H *h*¹, all substantially as described.

In witness whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOHN HARDY.

JOHN GEORGE HARDY.

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