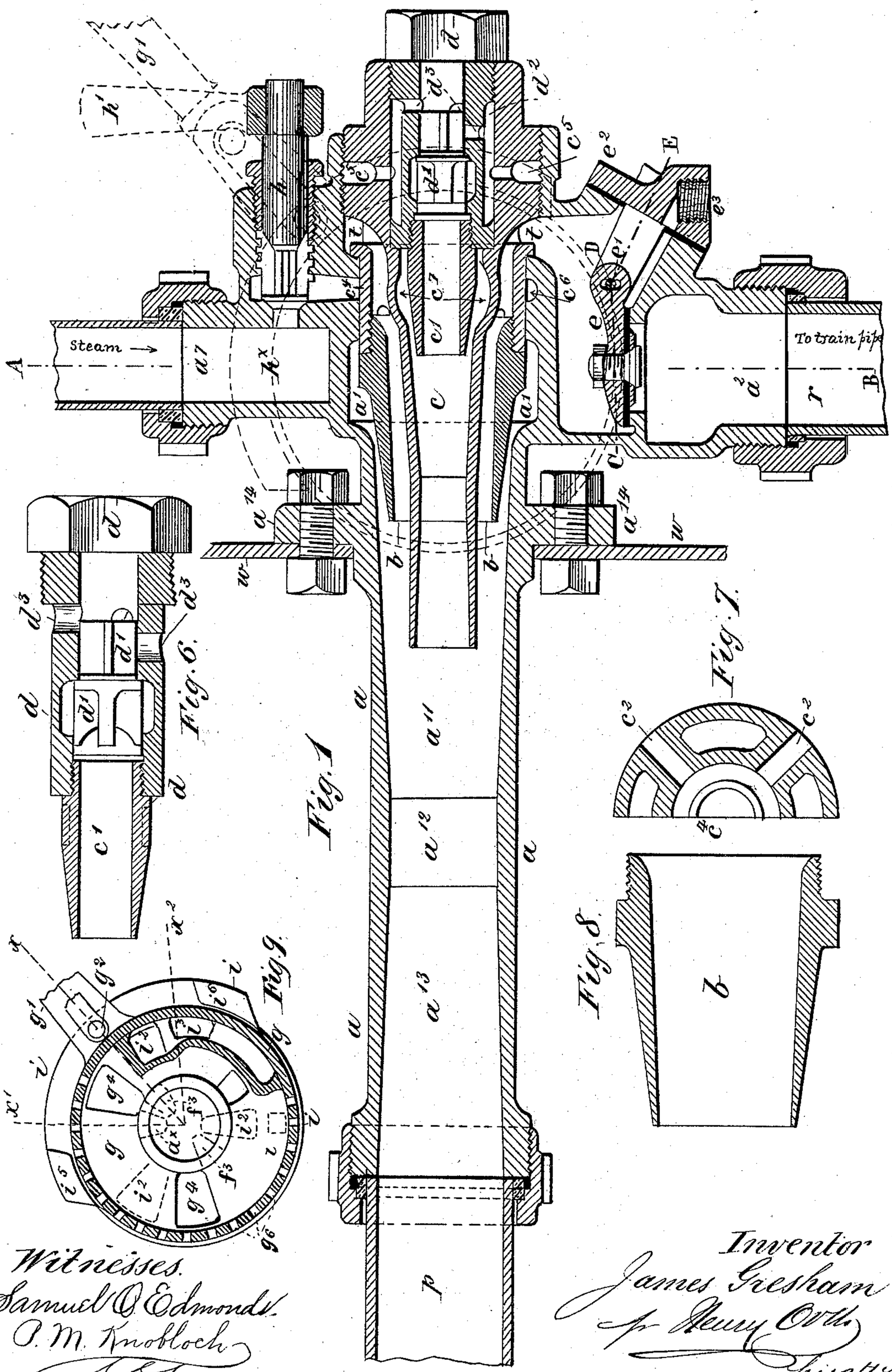
(Model.) 3 Sheets—Sheet 1.

J. GRESHAM.

EJECTOR FOR VACUUM BRAKES.

No. 312,991. Patented Feb. 24, 1885.



Witnesses.
Samuel O. Edmonds.
P. M. Knobloch

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James Gresham
Jr Henry Orth
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(Model.) 3 Sheets—Sheet 2.

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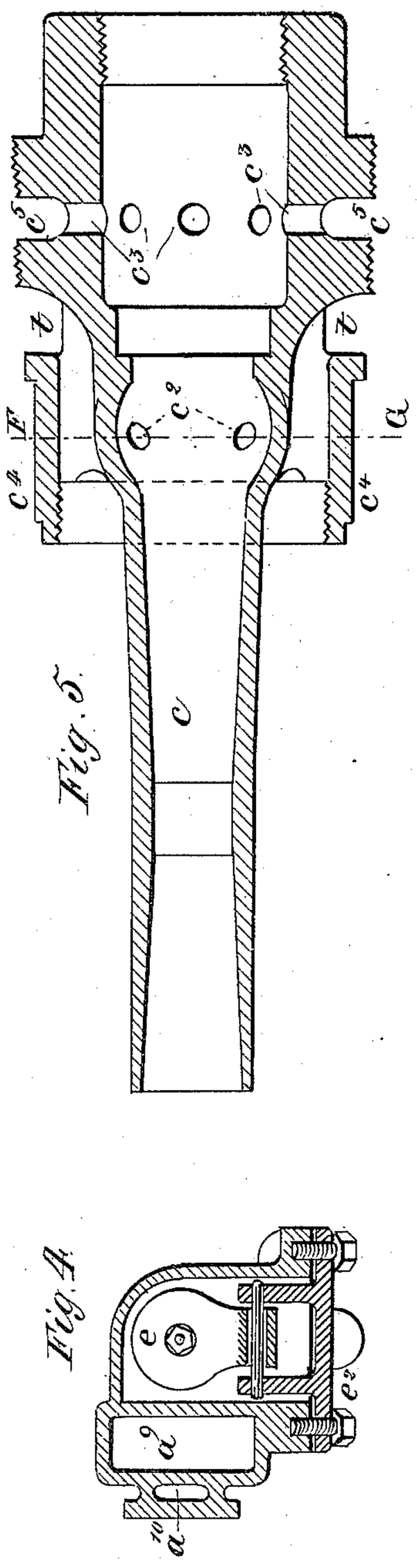

Fig. 5.

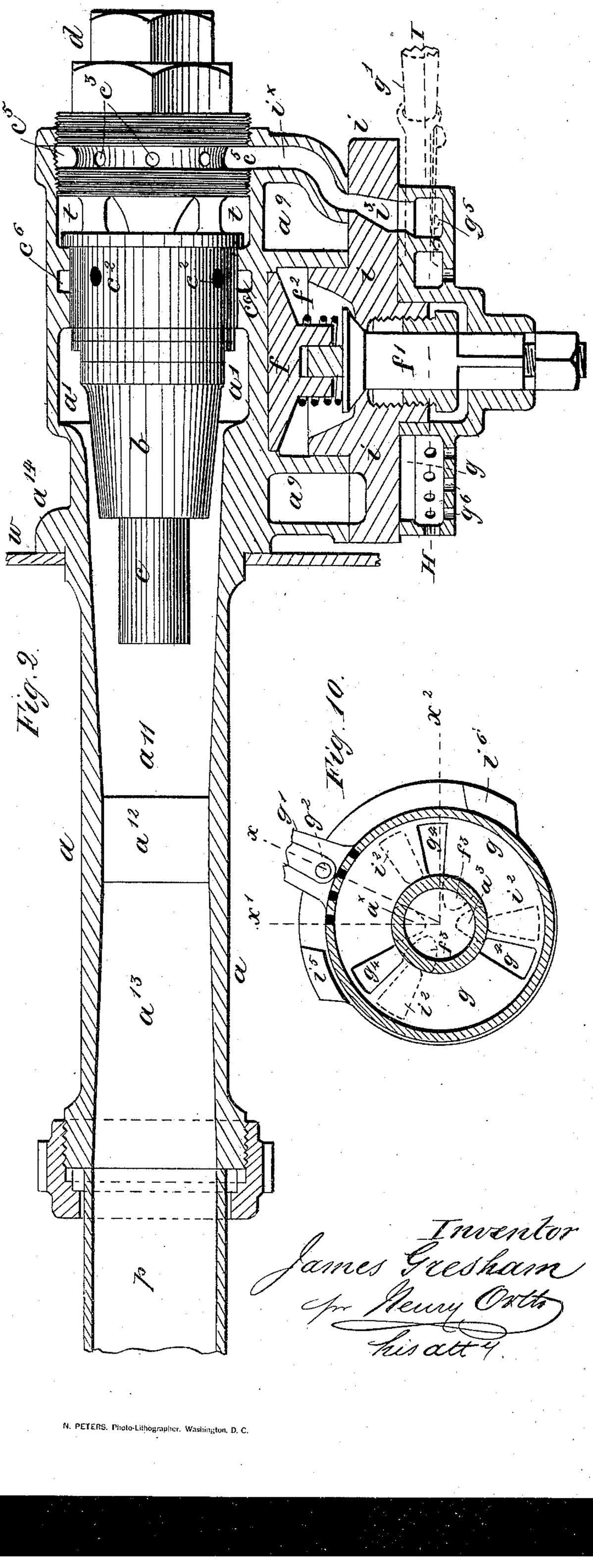

Fig. 2.

Fig. 4.

Fig. 10.

Witnesses—
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(Model.) 3 Sheets—Sheet 3.

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Fig. 11

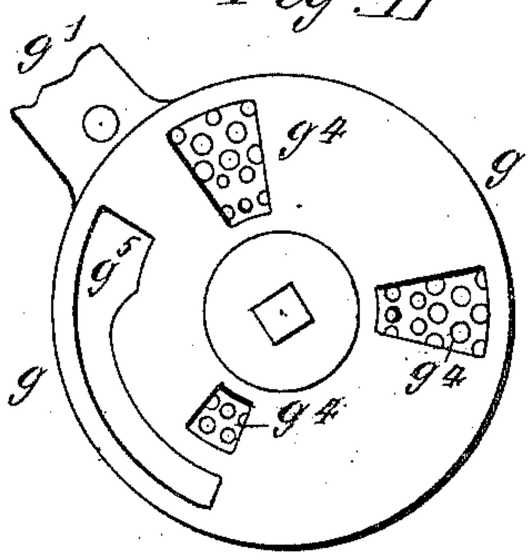


Fig. 12.

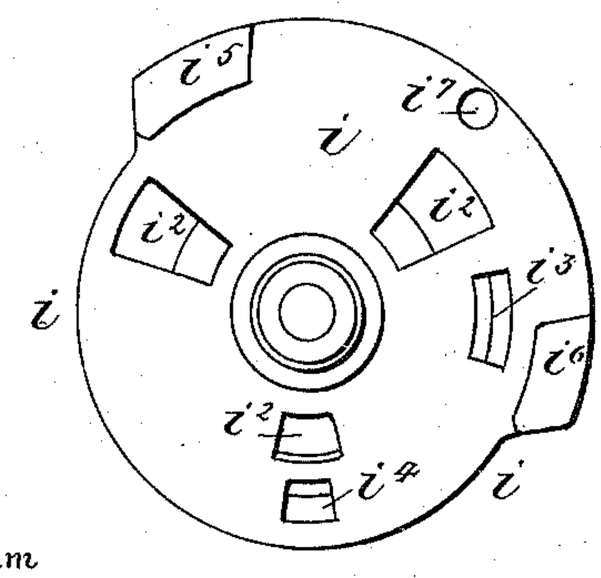


Fig. 3.

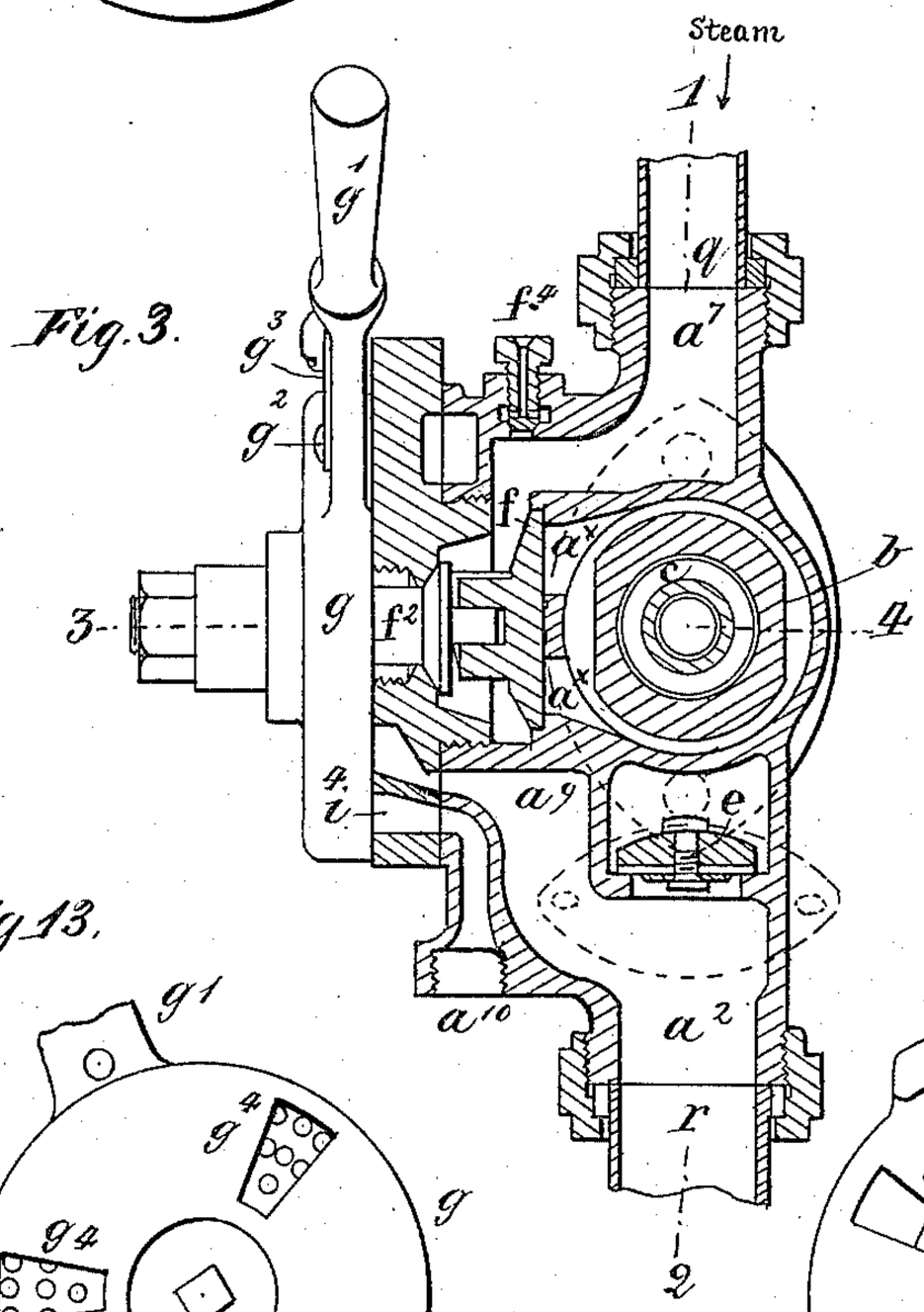


Fig 13.

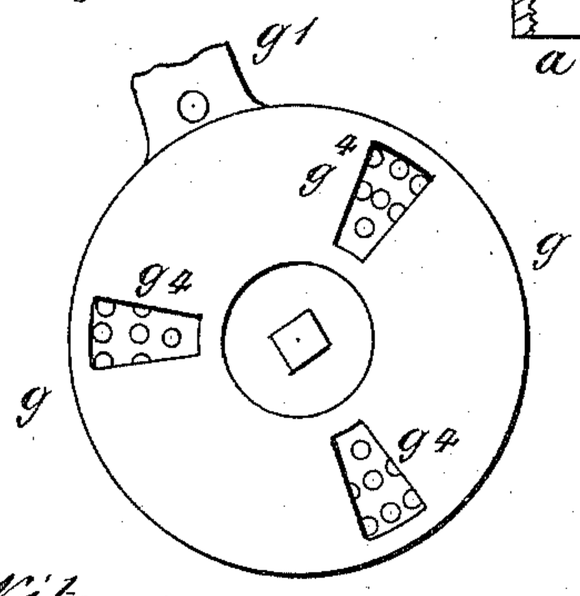
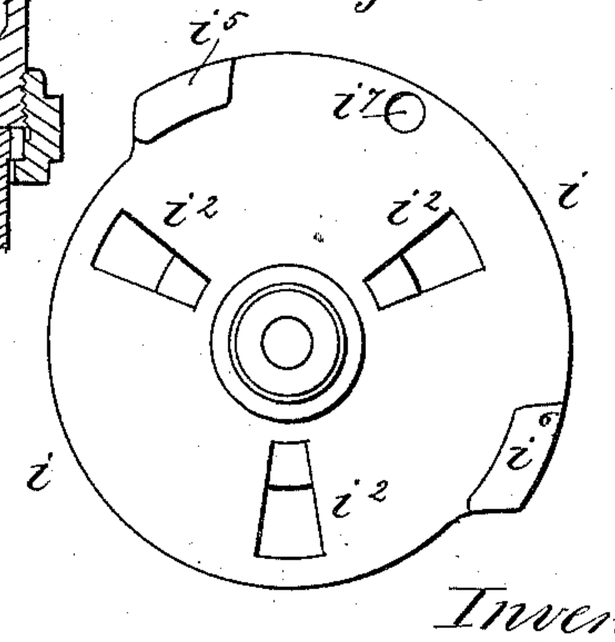


Fig 14.



Witnesses
Samuel O. Edmonds.
P. M. Knobloch

Inventor
James Gresham
per Henry Orth
his atty

UNITED STATES PATENT OFFICE.

JAMES GRESHAM, OF MANCHESTER, COUNTY OF LANCASTER, ENGLAND.

EJECTOR FOR VACUUM-BRAKES.

SPECIFICATION forming part of Letters Patent No. 312,991, dated February 24, 1885.

Application filed June 30, 1884. (Model.) Patented in England November 23, 1881, No. 5,109; in France March 6, 1883, No. 154,136; in Belgium March 7, 1883, No. 60,676; in Italy March 14, 1883, No. 15,231, and in Austria-Hungary July 11, 1883, No. 9,791 and No. 29,725.

To all whom it may concern:

Be it known that I, JAMES GRESHAM, a citizen of Great Britain, residing at Manchester, in the county of Lancaster and Kingdom of Great Britain, have invented certain new and useful Improvements in Mechanism used in Actuating and Controlling Vacuum-Brakes, (for which I have obtained a British patent, No. 5,109, dated November 23, 1881, a French patent, No. 154,136, dated March 6, 1883, a Belgian patent, No. 60,676, dated March 7, 1883, an Italian patent, No. 15,231, dated March 14, 1883, and an Austro-Hungarian patent, No. 9,791, and No. 29,725, dated July 11, 1883;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention relates to and consists in an improved combination of ejector apparatus for producing the partial vacuum (hereinafter called the "vacuum") required for actuating vacuum-brakes for railway-trains with mechanism for bringing the ejectors into and out of action, and for admitting air to and excluding it from the pipes communicating with diaphragms, pistons, or other apparatus giving movement to the mechanism which applies and withdraws the brakes from the wheels of the train.

The object of my invention is to combine all the apparatus for actuating and controlling the brakes in one connected apparatus operated by one handle.

My improved mechanism is applicable for either simple or automatic vacuum-brakes. By "simple vacuum-brakes" is meant those in which the vacuum is formed in the pipe passing along the train, commonly termed the "train-pipe," when the brakes are to be applied to and in which the vacuum is destroyed in the train-pipe when the brakes are to be withdrawn from the wheels of the train; and by "automatic vacuum-brakes" is meant those in which a vacuum is maintained in the train-pipe when the brakes are withdrawn from the wheels, and in which the brakes are applied when such vacuum is destroyed by the severance of the train or otherwise, or by admitting air into the train-pipe when the brakes are to be applied.

For both the simple and automatic brakes a small ejector is used within a large ejector; but the small ejector in each case is proportioned in capacity to the work it has to perform.

For simple vacuum-brakes the large ejector is for forming the vacuum to apply the brakes, and the small ejector is in constant use for test purposes or as a "tell-tale," to show that the simple vacuum-brakes are in order, and this small ejector only requires to be of a capacity to produce a partial vacuum equal to a few ounces per square inch. The manner in which this small ejector acts as a tell-tale is described in specifications of English patents granted to me.

For automatic brakes the large ejector is for quickly forming a vacuum in the train-pipe, and the small ejector is in constant use (except as hereinafter explained) for maintaining the vacuum when formed by the large or the joint action of both ejectors. The small ejector has power enough to form the vacuum alone, as well as maintain it, but not to do it quickly enough. Small and large ejectors are used because there would be a waste of steam if the ejectors were not proportioned in capacity to the steam to be used and the work to be done.

Figure 1 is a longitudinal section in a line, 1 2, Fig. 3, with the disk-valve and handle shown in long and short dotted lines. Fig. 2 is a longitudinal section on the line 3 4, Fig. 3, but showing an outside view of the internal parts of the ejector, and the handle for operating the disk-valve (cut away by the section) is shown in peculiar dotted line. Fig. 3 is a section on the line A B, Fig. 1, and Fig. 4 a section on the line C D E, Fig. 1. Fig. 5 is a longitudinal section, on an enlarged scale, of an internal part of the ejectors which screws into the main casing. Fig. 6 is a longitudinal section of internal parts, that screw into the part

shown by Fig. 5. Fig. 7 is a half section on the line F G, Fig. 5, the other half of the section being a duplicate on the opposite side. Fig. 8 is a longitudinal section of the cone-nozzle that screws into the part shown by Fig. 5. Fig. 9 is a section on the line H I, Fig. 2, looking toward the seating of the disk-valve of the apparatus when used for automatic vacuum-brakes, and Fig. 10 is a similar view when used for simple vacuum-brakes. Fig. 11 is the face view of the disk-valve, and Fig. 12 the face view of the disk-valve seating for automatic brakes. Fig. 13 is the face view of the disk-valve, and Fig. 14 the face view of the disk-valve seating for the simple vacuum-brakes.

a is the main external casing, which may be secured by bolts passing through a flange, a^{14}, to any convenient part of the locomotive, a pipe, *p*, being connected by a union-coupling with the casing *a*, to convey the steam and air to the smoke-box or blast-pipe of the locomotive. In some cases the casing is or may be secured to the fire-box end plate, *w*, of the locomotive-boiler, part of the casing passing inside the boiler, and the pipe *p* from it thus goes through the boiler to the smoke-box or blast-pipe. This arrangement, with a long pipe between the ejector and the smoke-box, deadens the noise caused by the ejectors when working. The part a^{11} is the contracting-cone, where the steam and air combine. a^{12} is a parallel part, and a^{13} is the expanding cone, of the large ejector. The casing has a branch, a^7, to which the steam-supply pipe *q* is connected by a union-joint. The casing has also another branch, a^2, to which a pipe, *r*, communicating with the train-pipe, is connected. This branch a^2 has a seating formed in it for a valve, *e*, faced with leather or india-rubber, secured to the valve by a screw, this valve being hinged or jointed on a pin, *e'*, carried in the two arms of a lid, e^2, which is secured to and made to cover a hole air-tight in the casing, through which the valve is inserted. (See Figs. 1, 3, and 4.)

In the cover a screw-tapped hole, e^3, is made, in which the end of a small pipe is screwed, and the outlet end of this small pipe is in any convenient position, and has a small hole constantly open to allow any moisture formed in the ejectors to drain away. The valve *e* acts to prevent air passing from the ejectors to the train-pipe, but allows air to pass from the train-pipe to the large ejector.

From the chamber of the valve *e* there is a passage leading to an annular cavity, *t*, formed around the part *c*, and between it and the interior of the casing.

The part *c* (shown by Fig. 5) is mainly the casing in which the cones for the small ejector are formed; but on the exterior of the part *c* there is a cylindrical part, c^4, connnected with the part *c* by hollow radiating ribs (see Fig. 7,) leaving spaces between them, by which the air can pass from the cavity *t* to the cone *b*, which is screwed into the cylindrical part c^4, as shown best in Fig. 1. This cone *b* has two flats formed upon it on opposite sides, (seen best in Fig. 3,) for a screw-key to screw it in and unscrew it from the part c^4. There is an annular space left between the exterior of the cone *b* and the interior of the casing *a*, for steam to pass which comes from the cavity *a'*, formed in the casing around the cone *b*. This cavity *a'* communicates with ports in a disk-valve seating (see Fig. 3) formed in the casing and the space outside this disk-valve *f* communicates with the branch for the steam-pipe a^7, as seen best in Fig. 3. The disk-valve *f* is partly sunk and fitted in and ground to the seating, so as to partly rotate, and there are two ports, $a^\times$, in the seating and two corresponding ports in the disk-valve, (hereinafter referred to,) so that when the latter is moved to one position the ports come opposite and steam can pass, and when moved into another position the ports in the seating are covered, and the steam is shut off from the large ejector. The screw-plug f^4, Fig. 3, is for oiling the valve *f*.

Into the interior of the part *c* the central part, *d*, is screwed for the small ejector. This part *d* is tubular, closed at one end, and formed with a screw-head, and it is prepared in its interior with a seating for a small cone-valve, *d'*, having ordinary guiding-wings on both sides, and when the valve is in its place the cone-nozzle *c'* is screwed in, as shown. When the part *d* is screwed in its place, it fits air and steam tight where it comes in contact with the interior of the part *c*. There is space formed in the interior of the part *c* which forms an annular cavity, d^2, round the exterior of the part *d*, and small holes d^3 are formed through the sides of the part *d*, so as to allow air to pass from the cavity d^2 on the exterior to the interior of the part *d* above the small valve *d'*. The internal annular cavity d^2 communicates by small holes c^3 with a groove, c^5, round the exterior of the part *c*, thus forming an annular cavity between it and the interior of the casing *a*, and this cavity communicates by a passage, $i^\times$, with the valve-seating for the air-disk valve, as shown best in Fig. 2, hereinafter further referred to. The part *c* where its exterior comes in contact with the interior of the casing *a* fits air and steam tight, and there is an annular cavity, c^6, in the interior of the casing round the cylindrical part c^4; and there are holes c^2 in the ribs, connecting the cylindrical part c^4 and the interior part, to allow the steam to pass to a cavity, c^7, to supply steam to the exterior of the nozzle *c'* for the small ejector, which escapes through a small annular space left between the exterior of the nozzle and the interior of the part *c*. The annular cavity c^6 is connected by a passage with the steam-branch a^7, (see Fig. 1,) a seating being formed in the casing for a valve, $h^\times$, that has a stem that can slide freely in a hole in the axis of a spindle, *h*, that screws into the casing, a packing-gland being formed

round the spindle h to keep it steam-tight. By means of a handle, h', on the end of the spindle h, it can be screwed in or out. When screwed in, the valve $h^{\times}$ is shut and steam cannot pass; but when screwed outward the steam can pass to the small ejector. In ordinary working this valve $h^{\times}$ is constantly open to supply steam to the small ejector. The casing is formed with passages or cavities a^9, covered by a disk having ports in it. This disk i has an inner central boss screwed on its exterior, which screws into a boss formed in the casing, (see Figs. 2 and 3,) and when screwed tight an air and steam joint is formed between the disk i and casing. The inner side of the disk i is formed with a cone-seating for a spindle, f', with a cone upon it, and on the inner end of the spindle a flat part is formed to fit easily a slot in the disk-valve f for steam. A helical spring, f^2, is placed round the boss of the valve f, and between it and the shoulder at the inner side or back of the cone on the spindle f' to keep the steam-disk valve f against its seating. The spindle f' passes through a boss in the disk-seating i, which boss also acts as a packing-gland; and the disk-valve g has a cavity that fits on the exterior of the boss, and the boss of the disk-valve g has a square hole to fit squares formed upon the outer end of the spindle f', and is secured by a screw, as shown. (See Figs. 2 and 3.) The disk-valve g has a handle, g', by which it is oscillated, along with the spindle f', which thus gives motion at the same time to the disk-valve f for supplying to and shutting steam from the large ejector. The handle g' has a flat steel spring, g^3, secured to it by a screw; and the end of the spring has a pin, g^2, riveted in it, which passes through a hole in the handle g', the end of the pin being cone-pointed, so that when the handle is moved from one extreme position to another the cone-pointed pin g^2 will enter or pass over, as required, a hole, i^7, in the face of the disk-seating. The object of this arrangement is to enable the operator to feel when the handle g' is in what is termed the "running position," and to hold it in that position when required. There are also projections i^5 and i^6 in the disk-seating which limit the two extreme movements of the handle. The disk-valve g is formed by two disks connected at their edges with a cavity or space between them, (see Fig. 2,) and through the inner disk there are port-holes which correspond with ports in the disk-seating, and there is also a cavity-port in the disk. The outside disk of the disk-valve is perforated with small holes g^6, to admit air freely into the cavity between the two disks of the disk-valve.

In Fig. 9 the handle g' (for automatic vacuum-brakes) is shown in the running position x—that is, in the position when the train is traveling and the brakes are not acting on the wheels. In this position of the handle the steam-ports f^3 in the disk-valve for steam are not opposite the ports $a^{\times}$ in the casing, consequently no steam is passing to the large ejector. The three ports g^4 in the disk-valve g are not (when the handle g is in the position x) opposite the three ports i^2 in the seating, which communicate with the cavity or passage a^9 in the casing, and through said cavity or passage with the train-pipe, as shown in Fig. 3. Consequently no air is admitted to the train-pipe. The cavity-port g^5 corresponds and communicates with one of the ports i^2, and with the ports i^3 and i^4 in the disk-seating i, one of which, i^3, communicates with the passage $i^{\times}$ leading to the small ejector, the other, i^4, with a passage, a^{10}, to which a pipe is coupled leading to the upper side of the sacks or cylinders on the locomotive and tender, to keep those brakes applied if those of the train should leak off.

In the position x, in which the handle g' is shown, the cavity-port g^5 is in communication with the port i^3 and the nearest of the ports i^2, but not with the port i^4. Therefore, the small ejector is then acting to draw air from the train-pipe through the passage a^9, cavity-port g^5, port i^3, and passage $i^{\times}$. In the position x of the handle g' the port i^4 is closed.

When the handle g' is in the position x^2, to apply the brakes, the steam-ports f^3 are shut, the ports g^4 and i^2 to admit air into the train-pipe are open, the communication between the cavity-port g^5 and one of the ports i^2 is closed; but it is open to the port i^4, communicating with the top side of the sack or cylinder of the engine or tender brakes, the small ejector thus acting to keep those brakes against the wheels of the engine and tender.

When the handle g' is in the position x', to take the brakes off quickly the air-ports g^4 and i^2 are closed, and the steam-ports f^3 and $a^{\times}$ to the large ejector are open, and both the large and small ejector are then acting together to take off the brakes from the wheels, the port i^4 being then closed, and the cavity-port g^5 is then in communication with one of the ports i^2. The cavity-port g^5 is in every position of the handle g' in communication with the small ejector through the port i^3, so that it is either exhausting air from the train-pipe or from the upper side of the sacks or cylinders for the engine or tender. The same handle g', disk-valves g and f, and arrangement of ports and passages which are used for automatic brakes will also answer for simple vacuum-brakes, the passage a^{10} being closed, and the handle g' moved in the reverse directions for applying and removing the brakes; but when the apparatus is intended to be used for actuating and controlling simple vacuum-brakes only the ports are more simple when arranged as shown in Figs. 10, 13, and 14, as the cavity port g^5 and connected ports and passages are not then required.

In the running position x of the handle g', Fig. 10, the small ejector for test or tell-tale purposes, which is constantly working, being

supplied by steam by the valve $h^{\times}$, the air-ports g^4 and i^2 are closed, and there is only a small partial test-vacuum formed in the train-pipe. Consequently the brakes are all withdrawn from the wheels of the train.

When the handle, Fig. 10, is in the position x^2 to apply the brakes, the air-ports g^4 and i^2 closed, and the steam-ports f^3 and $a^{\times}$ to the large ejector are open, and a strong vacuum is formed in the train-pipes to apply the brakes.

When the handle is in the position x', Fig. 10, to take off the brakes, the steam-ports f^3 and $a^{\times}$ to the large ejector are shut, and the air-ports g^4 and i^2 are open to admit air freely to take off the brakes.

For the last-described arrangement the passage $i^{\times}$ is dispensed with, and the cavity c^5 is made to communicate directly with the cavity a^9.

Having thus described my invention, what I claim as new is—

1. The combination of a small and large ejector with steam and air valves, the steam-valve for the large ejector and air-valve for the train-pipe being both simultaneously actuated by the same handle, substantially as and for the purpose specified.

2. The combination of a small ejector within a large ejector having steam-valves, with a disk-valve for steam for the large ejector and a disk-valve for air to the train-pipe, both actuated by the same handle, substantially as and for the purpose specified.

3. In apparatus for actuating and controlling vacuum-brakes, the combination of the following parts: a small ejector within a large ejector, a valve for controlling steam to the small ejector, a disk-valve for controlling steam to the large ejector, and a disk-valve for controlling air to the train-pipe, the disk-valves for steam and air being connected and actuated by the same handle, substantially as and for the purpose specified.

4. In an apparatus for actuating and controlling vacuum-brakes, the combination of a combined injector and ejector with a steam-valve for the ejector and an air-valve for controlling air to the train-pipe, both operated simultaneously by the same handle.

5. The combination, substantially as described, of the injector-casing, the air-branch a^2, the large ejector and the small ejector arranged therein, the valve e, and the lid e^2, having a passage, e^3, formed therein leading to the valve-chamber, for the purpose specified.

6. The combination, substantially as described, with the casing a, steam-branch a^7, the air-branch a^2, the large ejector c, and the small ejector c', of the disk-valve f, the valve-seat i, disk-valve g, and suitable communication between said valves and the ejectors, and the handle g', said valves being arranged for simultaneous operation by means of said handle, for the purpose set forth.

7. The combination, with the casing a, its air and steam branches a^2 a^7, and the ejectors c c', of the valves e and f, the disk-valve g, and valve-seat i, interposed between said valves f and g, and the handle g', said parts being arranged and constructed for co-operation as described, for the purpose specified.

8. The combination, with the casing a, its air and steam branches a^2 a^7, the ejectors c c', and the valve d', of the valves h, f, and g, and the valve-seat i, interposed between valves f and g, and a lever for operating the latter valves simultaneously, substantially as and for the purpose specified.

In testimony whereof I affix my signature in the presence of two witnesses.

JAMES GRESHAM.

Witnesses:
PETER J. LIVSEY,
JAMES WOOD.