3 Sheets, Sheet 1.

Robinson & Gresham,

Feed Water Injector.

No. 55,218. Patented May 29, 1866.

Fig 3.

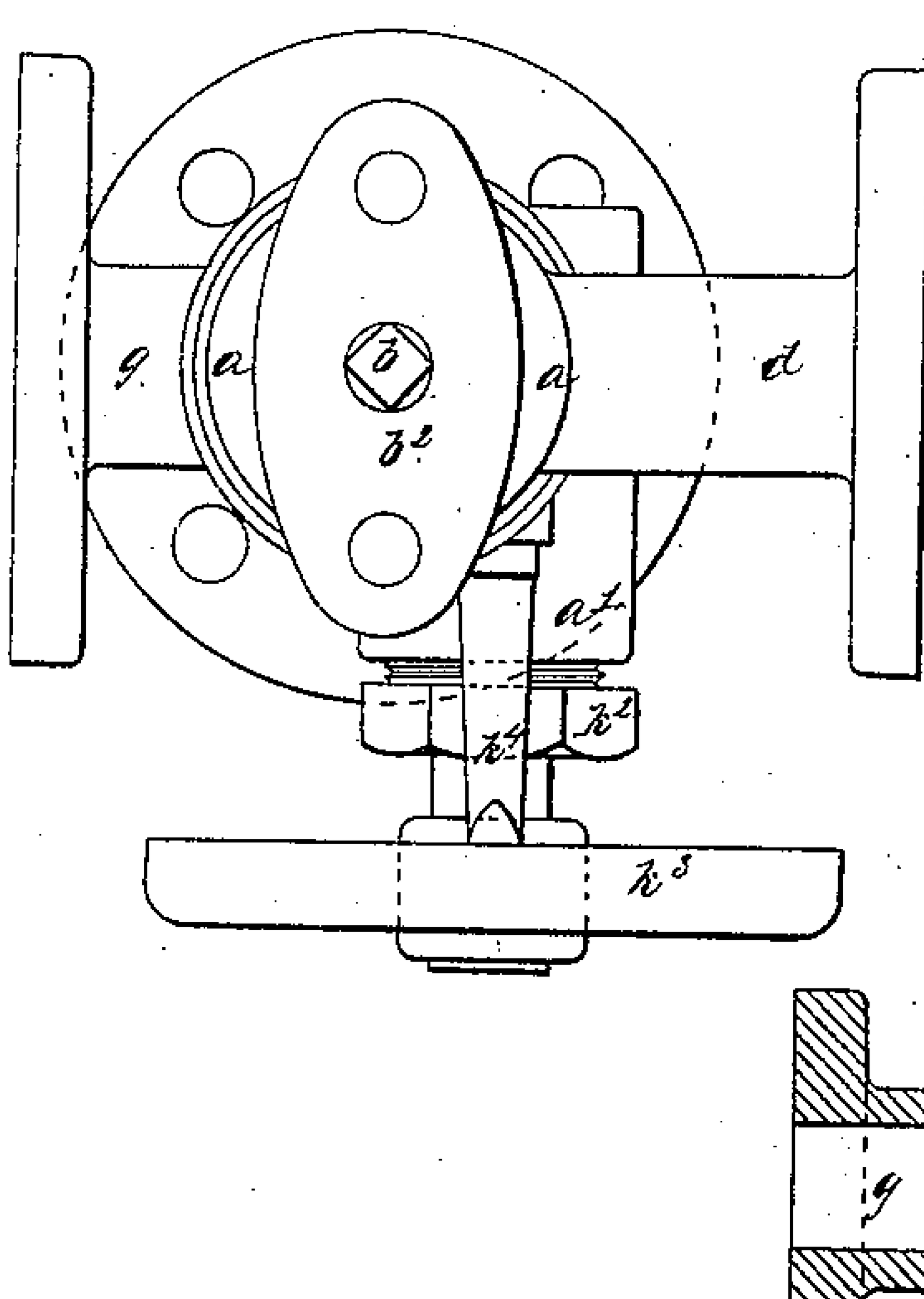


Fig 1.

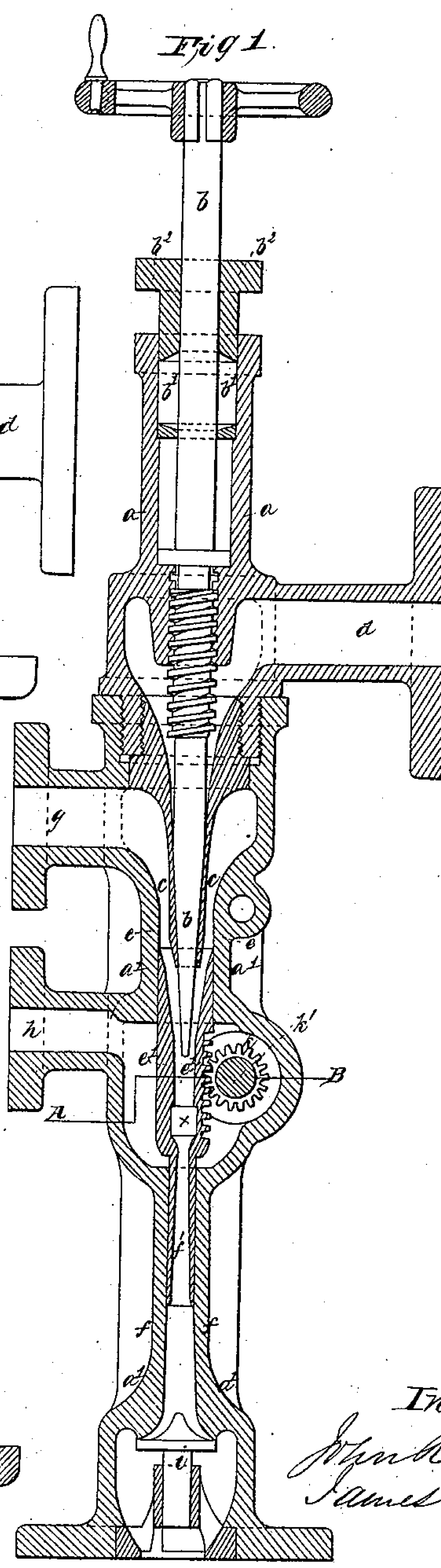
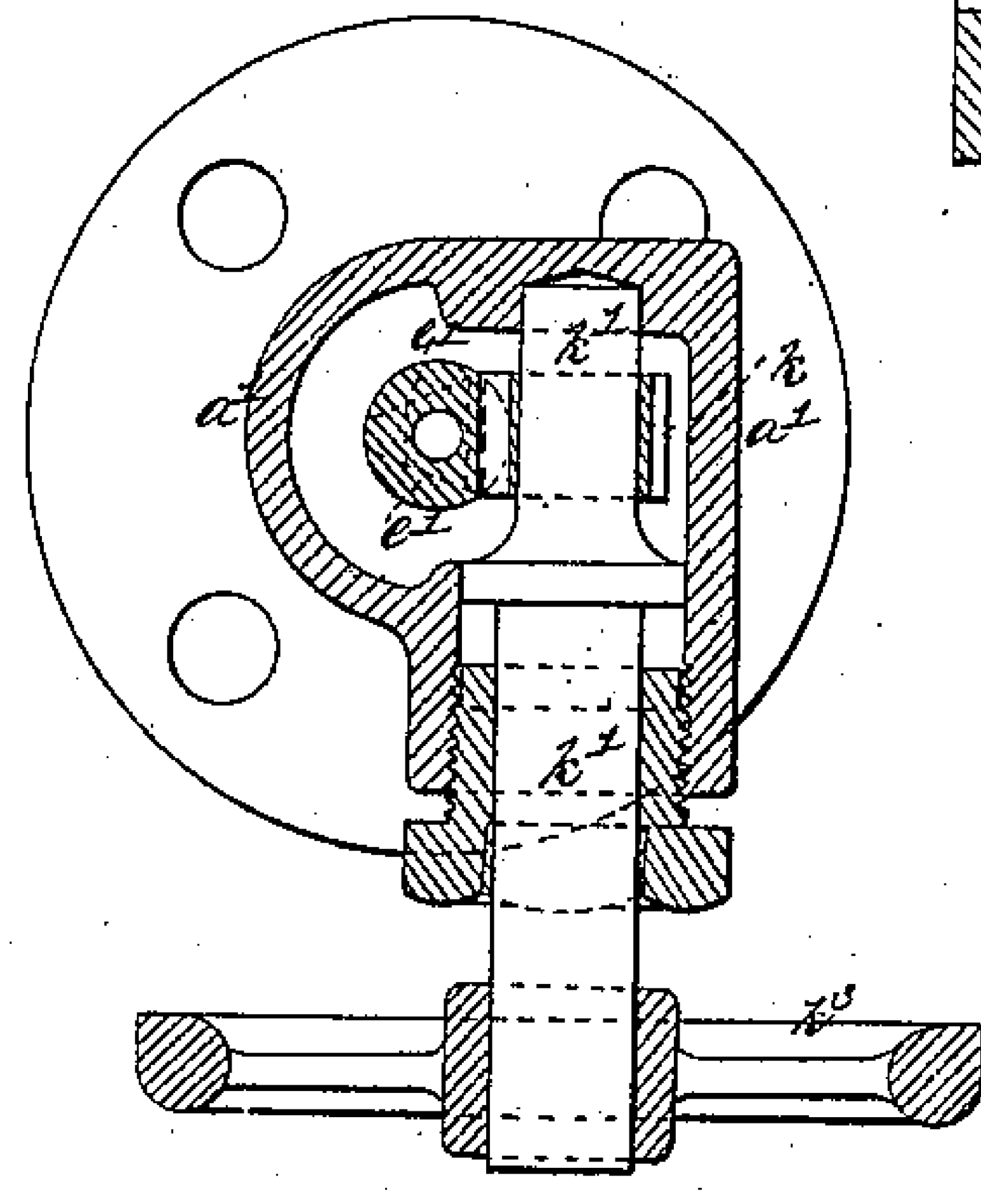


Fig 2.



Witnesses.

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W. Giffard

Inventors.

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3 Sheets. Sheet 2.

Robinson & Gresham,

Feed Water Injector.

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Fig 8.

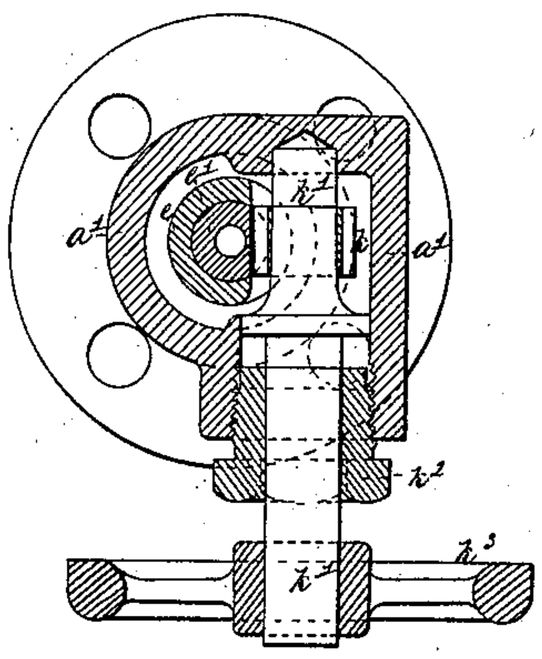


Fig 7.

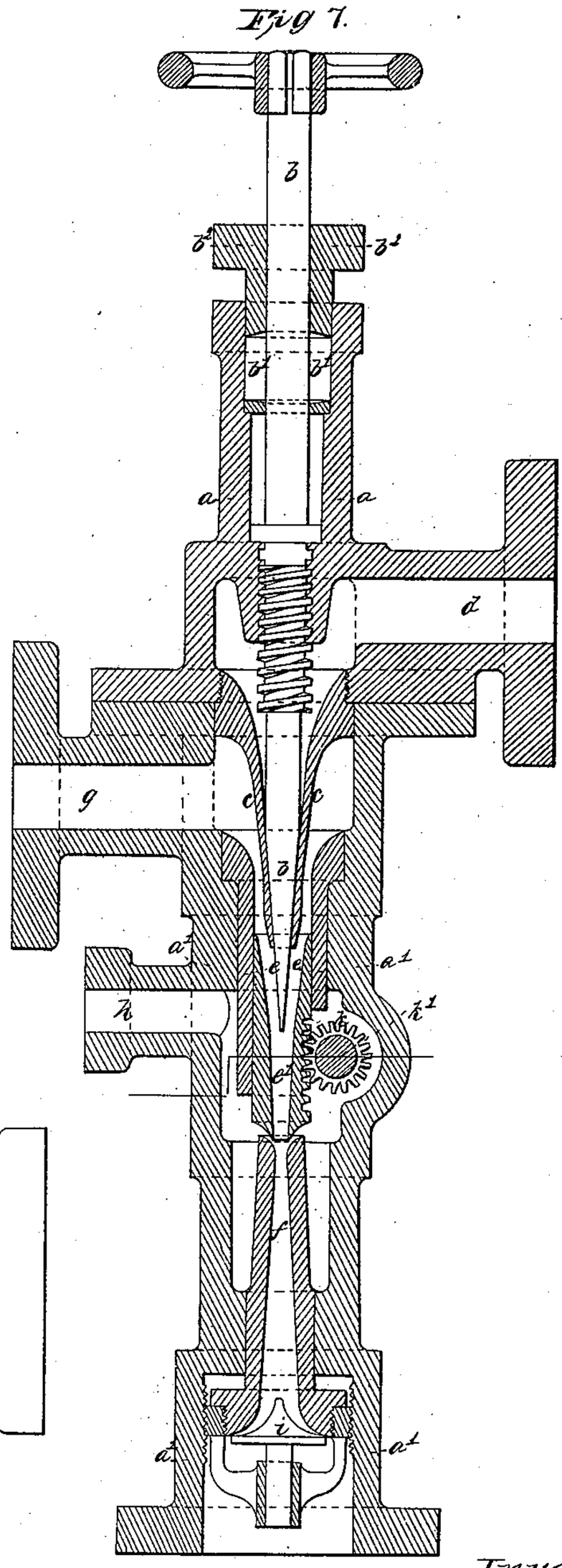
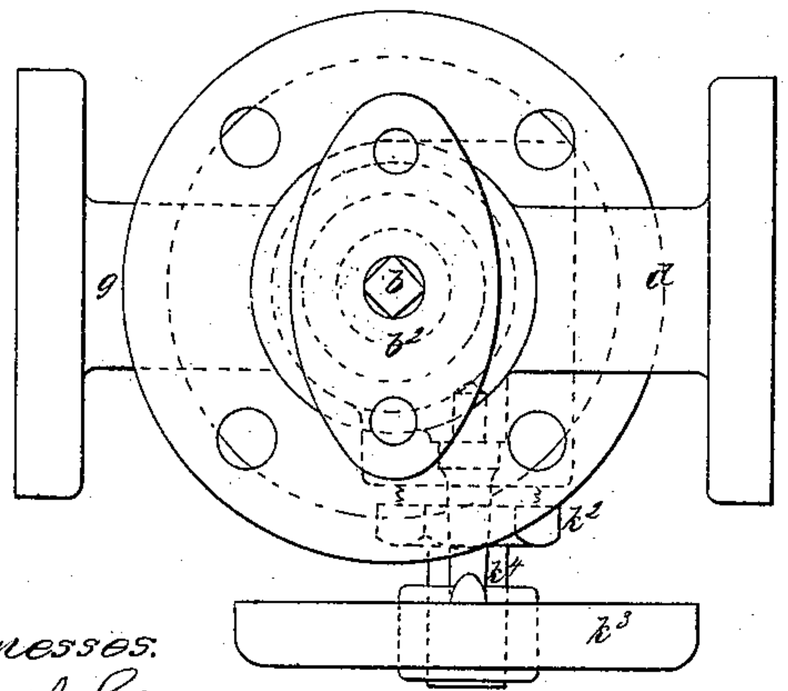


Fig 9.



Witnesses.
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3 Sheets. Sheet 3.

Robinson & Gresham,

Feed Water Injector.

No. 55,218. Patented May 29, 1866.

Fig 4.

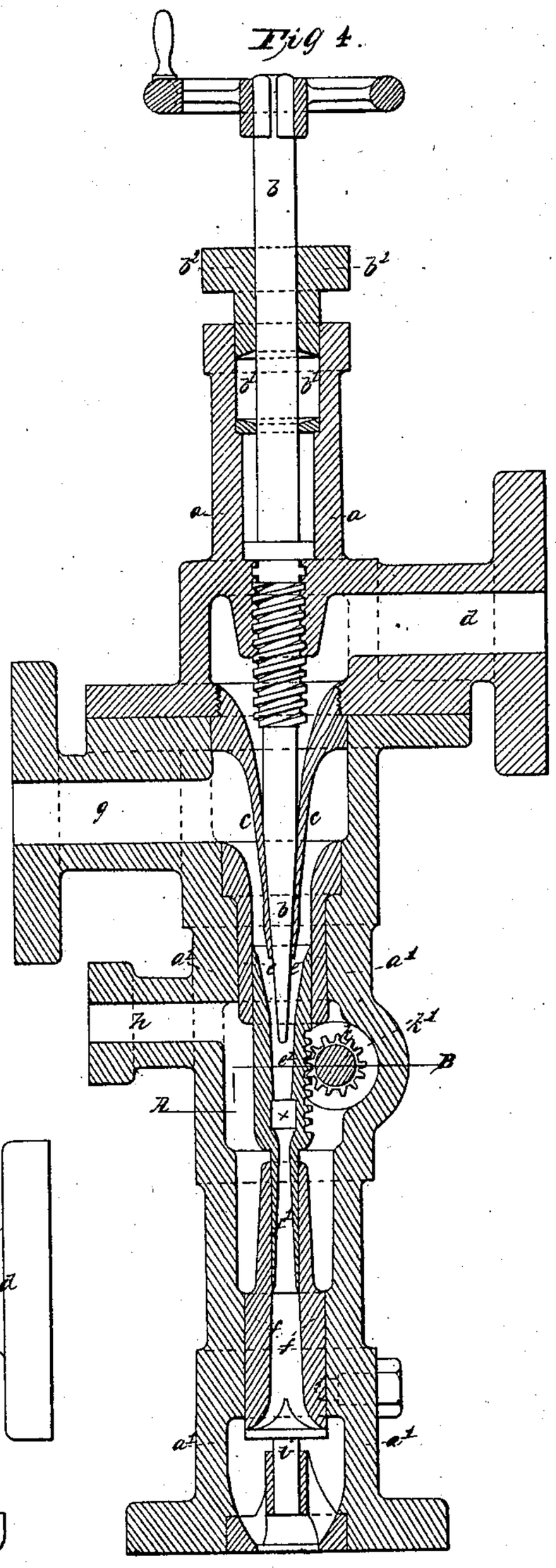


Fig 5.

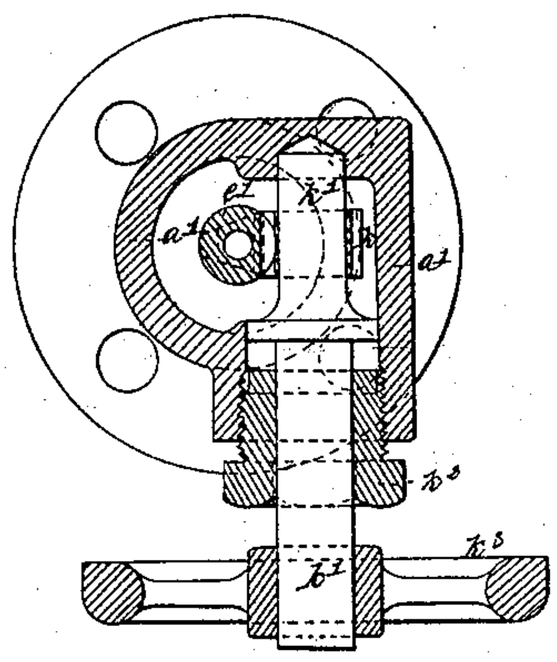
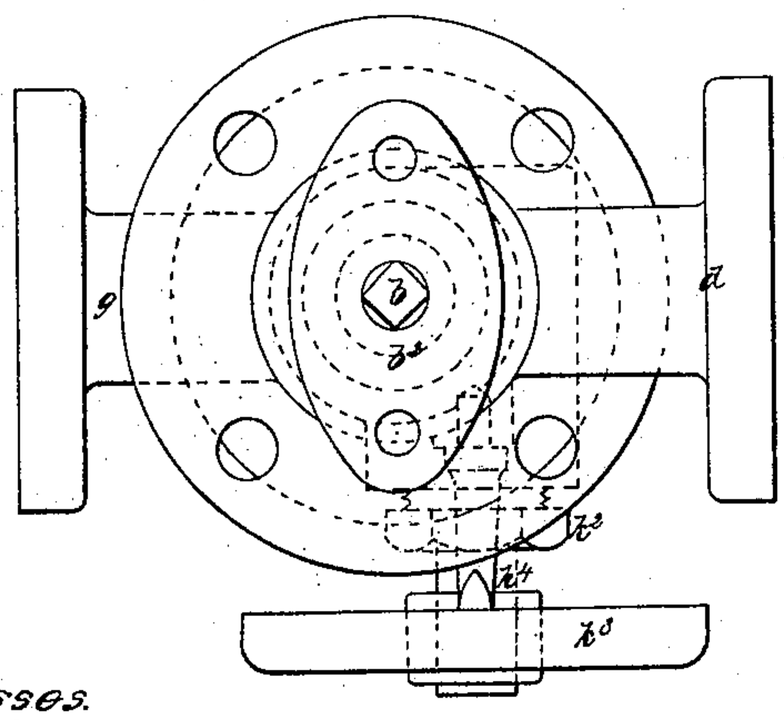


Fig 6.



Witnesses.
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W. Giffard.

Inventors.
John Robinson
Sam'l Gresham

UNITED STATES PATENT OFFICE.

JOHN ROBINSON AND JAMES GRESHAM, OF MANCHESTER, GREAT BRITAIN.

IMPROVEMENT IN FEED-WATER INJECTORS.

Specification forming part of Letters Patent No. **55,218**, dated May 29, 1866.

To all whom it may concern:

Be it known that we, JOHN ROBINSON and JAMES GRESHAM, of the city of Manchester, in the county of Lancaster, and United Kingdom of Great Britain and Ireland, have invented new and useful improvements in and applicable to that apparatus for raising and forcing fluids and feeding steam-boilers known as "Giffard's Injector;" and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying three sheets of drawings, which form a part of this specification, and to the letters of reference marked thereon.

Prior to the date of our invention, Giffard's injector had been constructed in various ways, so as to effect an adjustment of the annular spaces for steam and water, or other liquid. One method has been by moving the steam cone or nozzle forming the partition between the steam and liquid and the central cone-spindle, the combining cone or nozzle being fixed; and another method has been by connecting the combining cone or nozzle and the receiving cone or nozzle together, and arranging them with suitable packing, so that the larger end of the combining-nozzle could be adjusted to and from a fixed steam-nozzle to regulate the space for liquid, the steam being still adjusted by the central cone-spindle. By either of these methods, and by other methods hitherto used, internal packing has been necessary, which is liable to be burned or worn out, and it cannot be replaced without taking the apparatus to pieces at the cost of considerable trouble and inconvenience.

The object of our invention is to dispense with the necessity for internal packing, to simplify the construction, and render the apparatus more effective and less liable to get out of order.

Our invention consists in making the steam-nozzle fixed, and in adjusting the annular space for steam, as hitherto, and in combining therewith a peculiar arrangement for adjusting the annular space for liquid. There is one form of the internal bore for the combining and receiving nozzles in Giffard's injector which is found to give the best result; and the important feature of our invention may be considered to be the forming of these nozzles in two parts, one internal and the other external, but so arranged that when the two parts are together the form of the bore will approach as nearly as possible to the bore of these nozzles when they are each made in one piece. The external parts of the nozzles are fixed and the internal parts are movable, and the internal parts of the combining-nozzle, when the space for liquid is fully open, only extends a little past the small end of the steam-nozzle.

The point of our invention of most importance, by which we dispense with the necessity for packing and at the same time attain an easy fit, is in making the external diameters of the internal parts of the combining and receiving nozzles so small that at their ends they will be opposite that part of the passing current where it has attained its highest velocity, or where its velocity is not materially diminished; and by this arrangement the passing liquid has no tendency to escape between the internal and external parts of the combining and receiving nozzles, but rather to draw in air or fluid which may escape from the overflow-orifice by accident or an imperfect adjustment of the steam and water.

If the internal parts of the combining and receiving nozzles are made too large in diameter, or if they are made to extend to that part of the bore of the nozzles which is of large diameter, then the velocity of the passing fluid will be so far diminished that packing will be required to prevent its escape. The internal parts of the combining and receiving nozzles may be made in separate parts; but they are more simply made in one piece, with one or more orifices between them to allow for overflow, and these internal parts of the combining and receiving nozzles may be moved to adjust the space for liquid by a toothed rack and pinion.

The manner of carrying our invention into effect is illustrated by the accompanying three sheets of drawings.

Figure 1, Sheet 1, is a longitudinal section; Fig. 2, a cross-section at A B, Fig. 1; and Fig. 3, an end view.

The casing or body of the injector is formed in two parts. One part, *a*, contains the central cone-spindle *b*, its stuffing-box b^1, and gland b^2, and the steam-nozzle *c*, and the steam-pipe *d* leading to it. The other part of the

casing or body, a', of the injector contains the external parts e and f of the combining and receiving nozzles, the inlet-pipe g, for feed-water, and the outlet-pipe h, for overflow; and in this part of the injector the valve i is fitted to prevent the return of the water which has passed through the injector, and in this part is also fitted the piece forming the internal parts e' and f' of the combining and receiving nozzles, which piece has a toothed rack formed upon its exterior that gears with a toothed pinion, k, formed upon a short shaft, k^1, arranged in bearings, as shown in Fig. 2. The shaft k^1 being kept in position by a screw-nut, k^2, which also serves to put friction upon the shaft to prevent it from turning too easily, a leather collar being used between the screw-nut and the shoulder on the shaft. Upon the short shaft a hand-wheel, k^3, is fixed, which may be graduated upon its edge, and provided with a pointer k^4, so that the extent of opening for fluid may readily be known.

The angles of the larger end of the bore of the internal part e' of the combining-nozzle and the external part of the steam-nozzle c are made rather more obtuse than in the ordinary injector, so that a shorter range of movement in the internal part e' and f' is required to open and shut the space for liquid. A hole, x, is made at right angles to the part forming the internal nozzles to allow for overflow.

The injector represented by Figs. 1, 2, and 3 is supposed to be constructed entirely of brass.

Figs. 4, 5, and 6, Sheet 2, represent views of an injector corresponding respectively to Figs. 1, 2, and 3. This injector is supposed to be made with a cast-iron casing, a and a', and with brass nozzles. In other respects it is similar to that shown on Sheet 1.

Figs. 7, 8, and 9, Sheet 3, are views corresponding respectively to Figs. 4, 5, and 6 of another injector according to our invention, but more limited in its range of action. In this modification the receiving-nozzle f is formed in one piece, the internal part e' of the combining-nozzle being alone movable; consequently the space varies between the discharging-nozzle and receiving-nozzle. As the water-space is made to open and shut with a short movement, the variation of the space between the nozzles for small ranges of variation in the pressure of steam do not materially affect the working of the instrument.

The injector is adapted for a high or low pressure boiler, by screwing the receiving-nozzle f in or out to a greater or less extent when the injector is applied, and it will be seen that the receiving-nozzle f and valve i are specially arranged for this purpose.

In feeding hot water it may be desirable to close the space for overflow, which can be effected in this injector by forming one nozzle to enter the other as a valve, as shown, and by bringing the two nozzles in close contact by turning the hand-wheel.

The same letters and figures of reference denote the same and corresponding parts in each figure of the drawings.

We have now particularly described the nature of our invention, and the manner in which the same may be carried into effect, and claim as our invention—

Injectors where the internal nozzles e^1 and f^1 are actuated by a toothed rack and pinion, and are arranged and combined with the external nozzles e and f and the steam-nozzle c, substantially as hereinbefore set forth.

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

JOHN ROBINSON.
JAMES GRESHAM.

Witnesses:
PETER J. LIVSEY,
W. GIFFARD.