E. S. G. REES.

CENTRIFUGAL PUMP, CONDENSER, AND COMPRESSOR.

APPLICATION FILED JUNE 24, 1910.

975,997.

Patented Nov. 15, 1910.

4 SHEETS—SHEET 1.

Fig. 1.

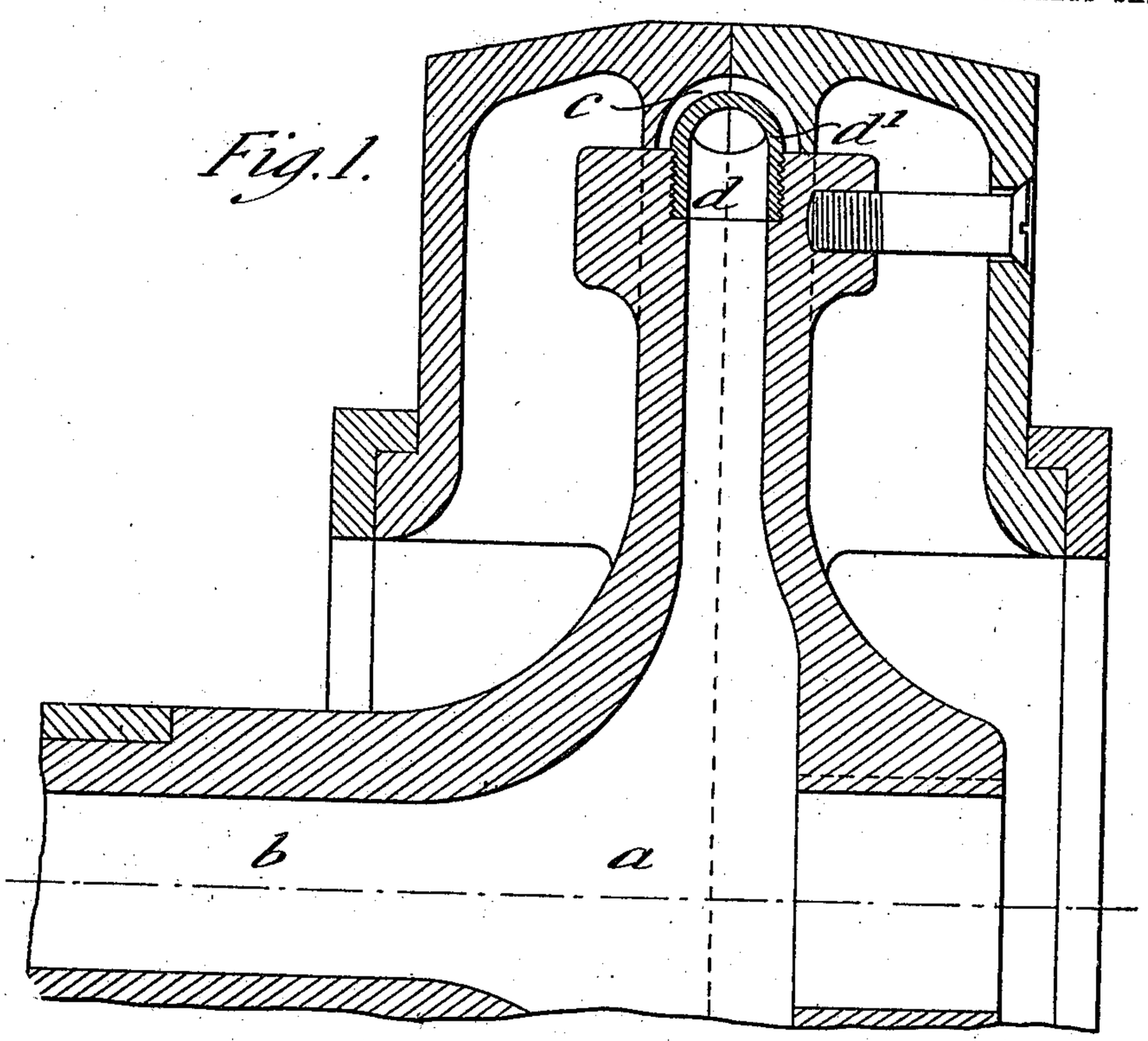
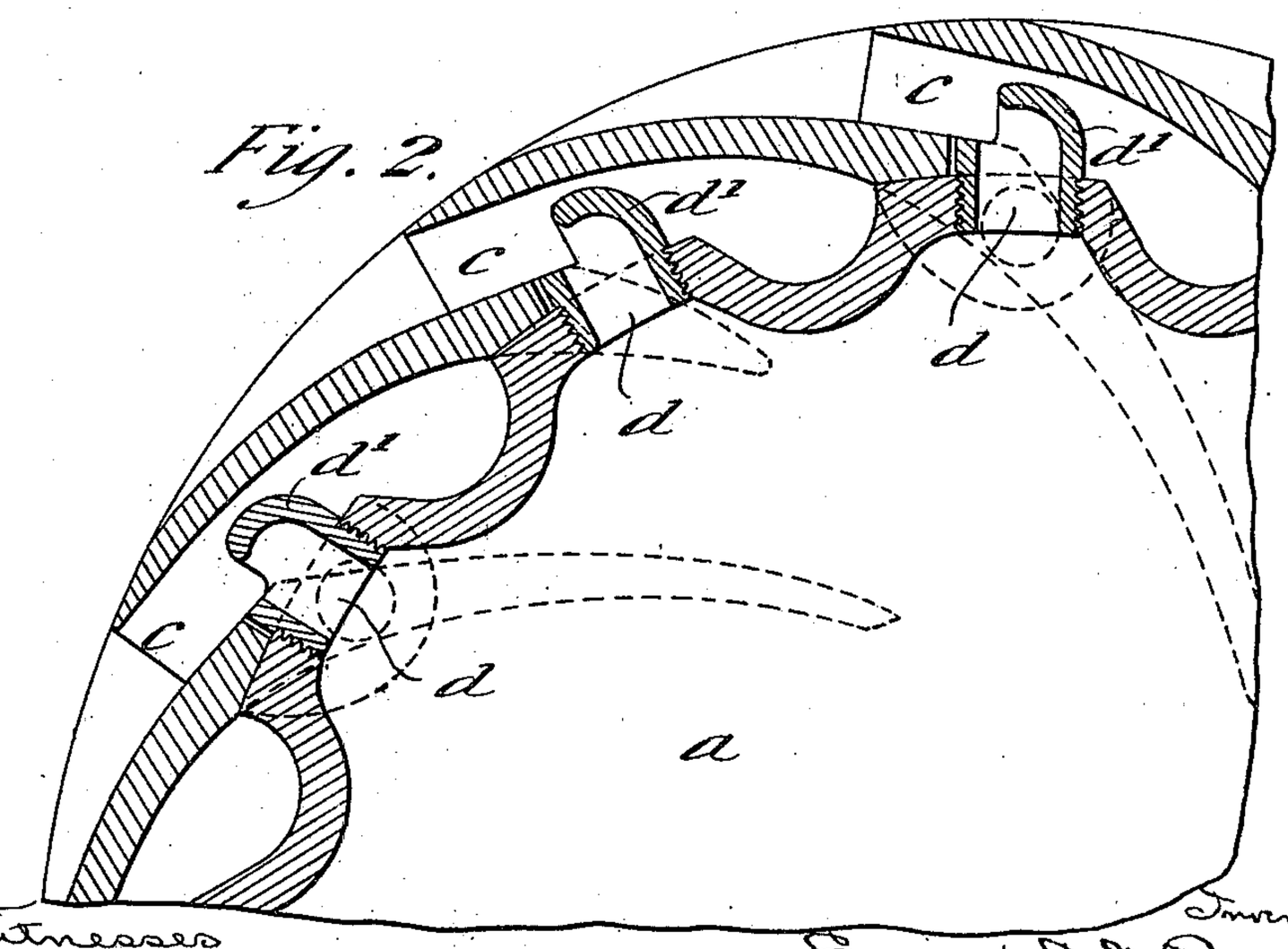


Fig. 2.



Witnesses

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4 SHEETS—SHEET 2.

Fig. 1.

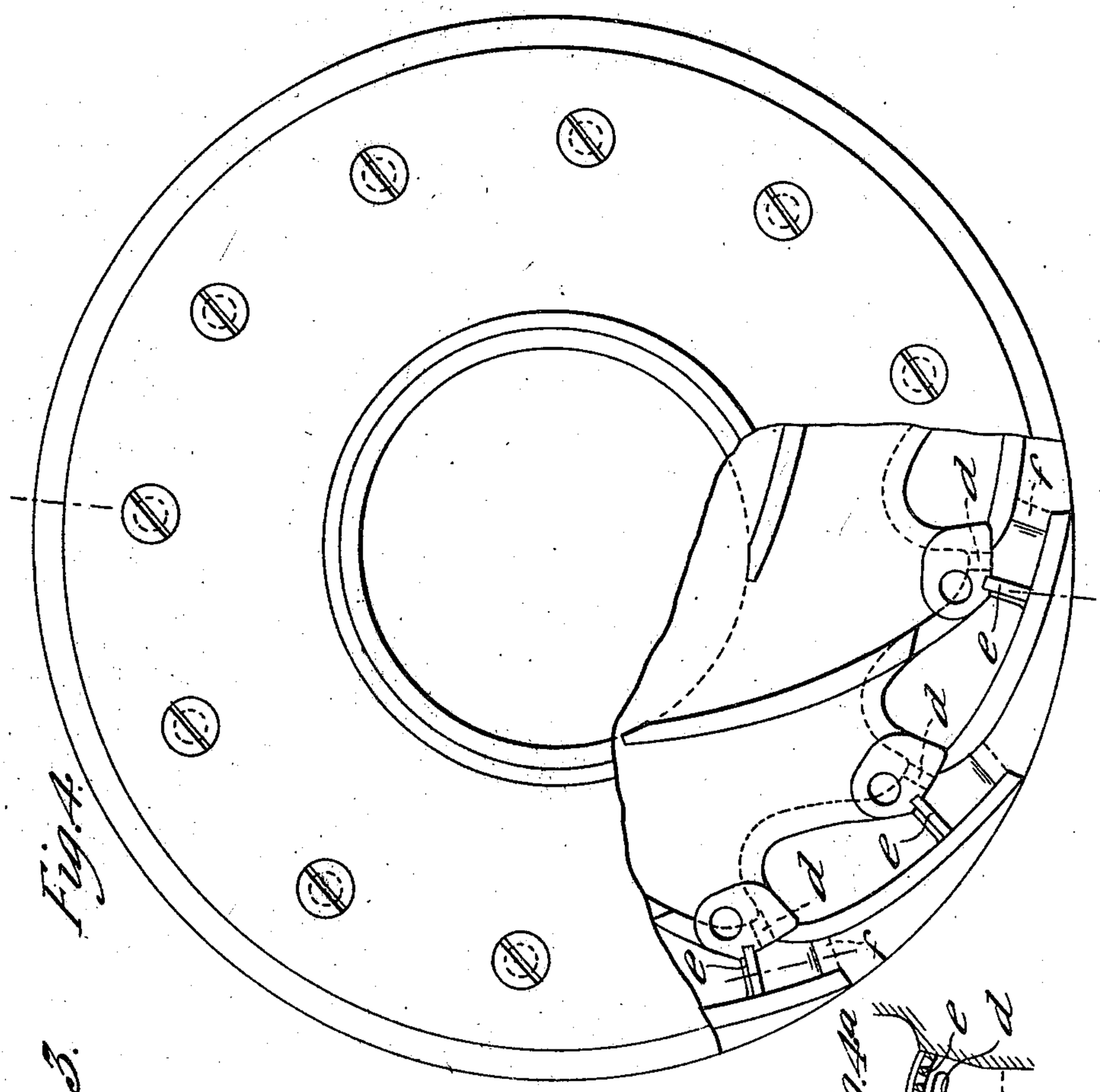


Fig. 3.

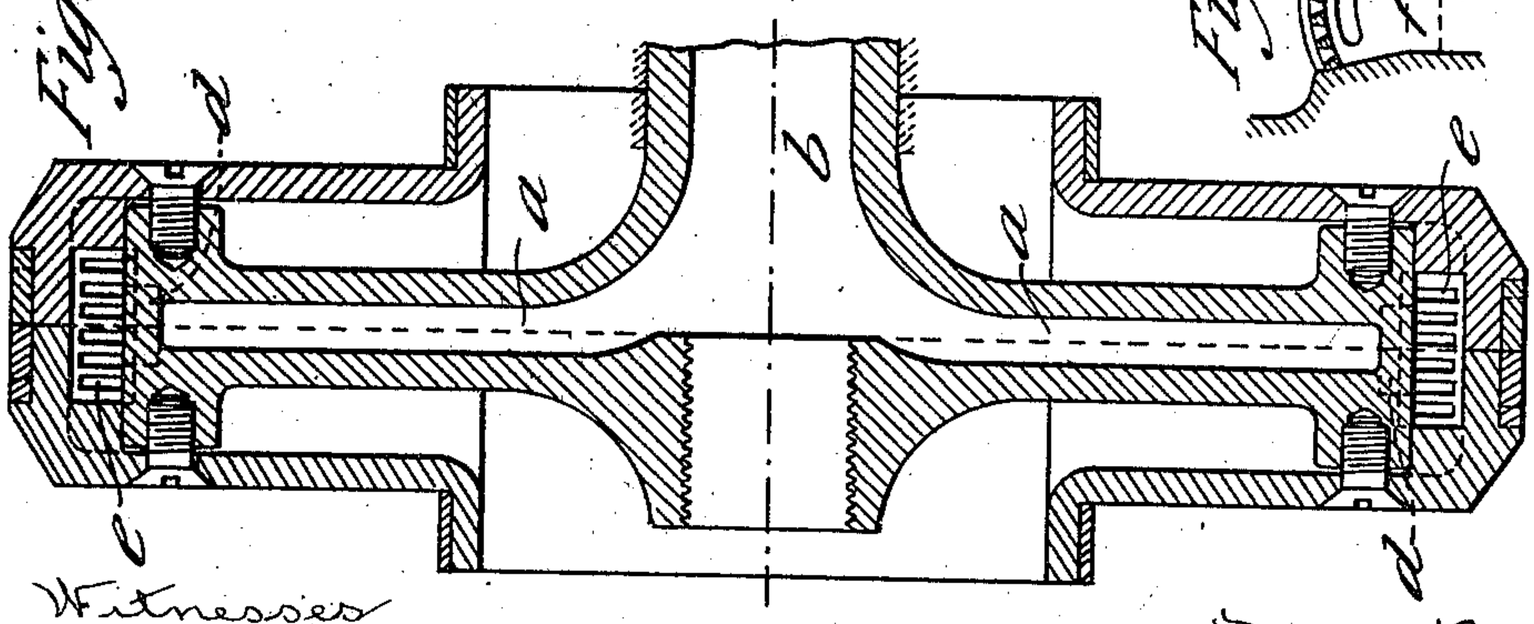
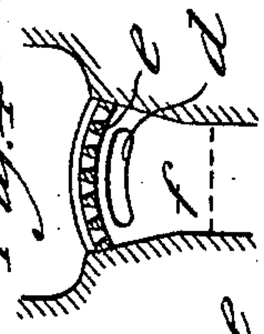


Fig. 4.



Witnesses

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4 SHEETS—SHEET 3.

Fig. 5.

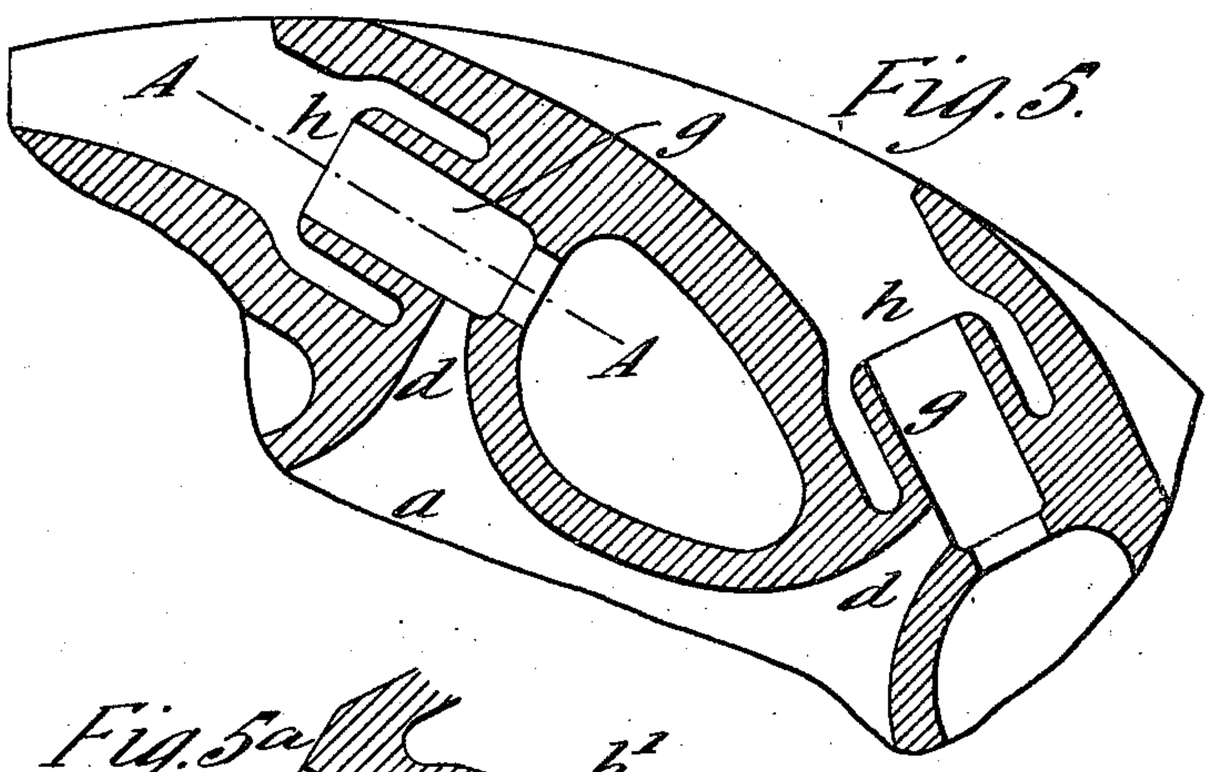


Fig. 5a

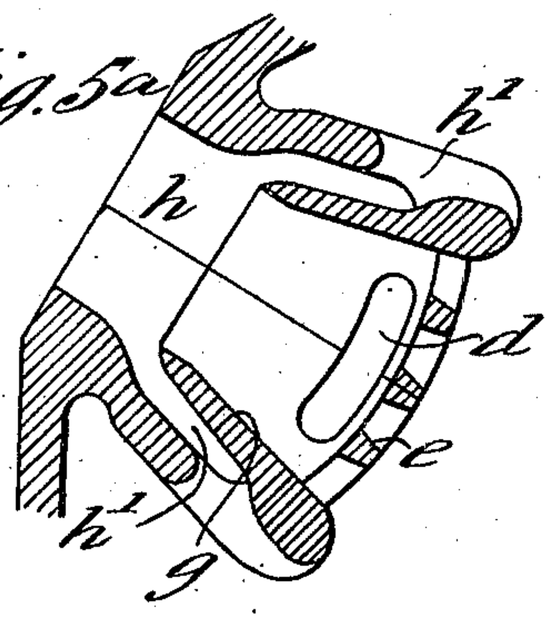


Fig. 6.

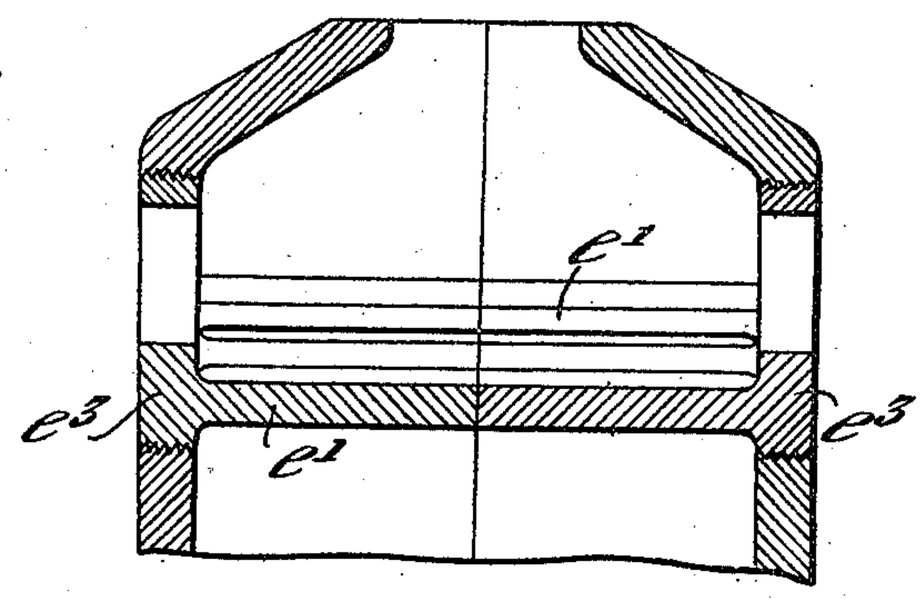
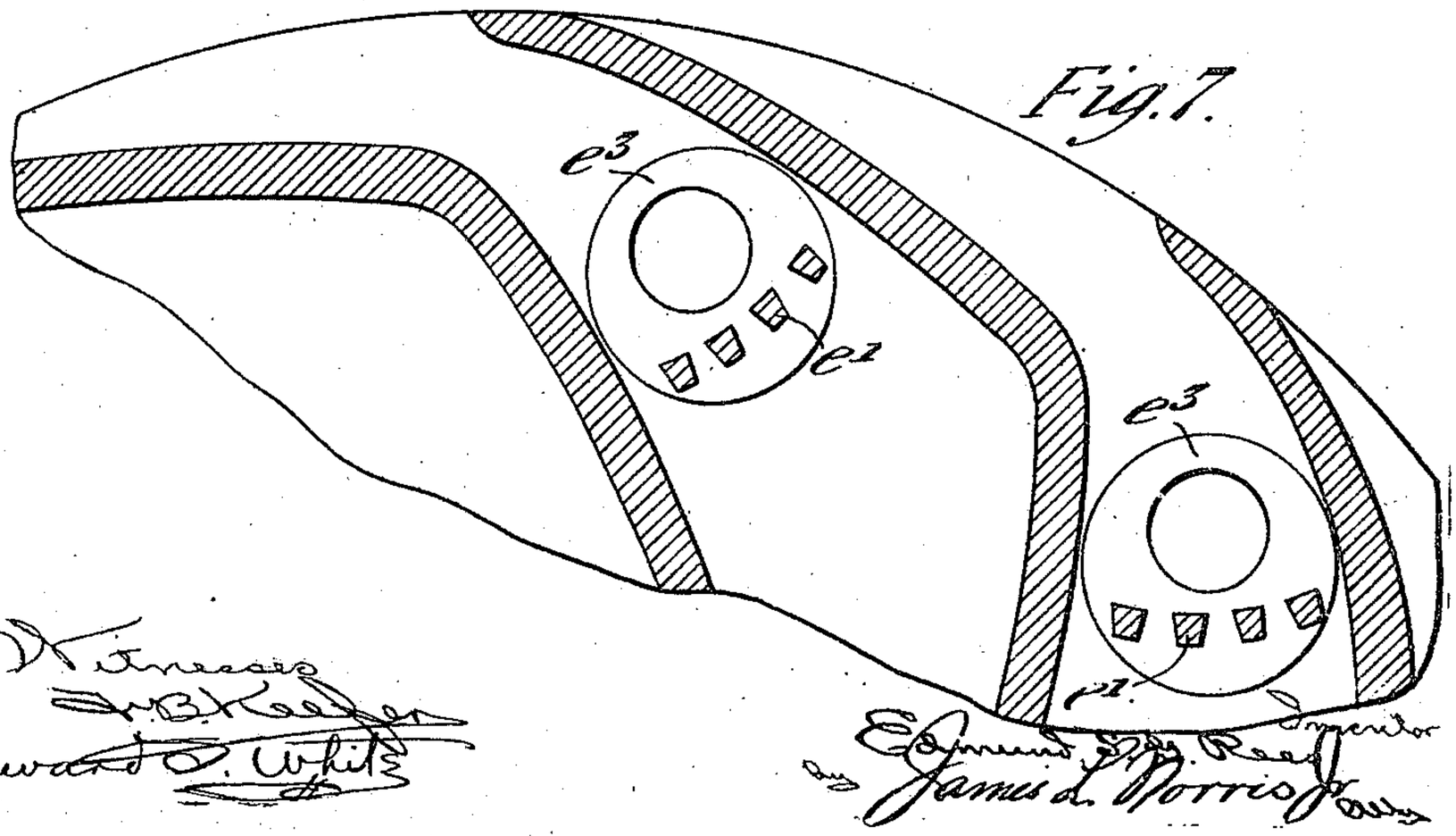


Fig. 7.



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4 SHEETS—SHEET 4.

Fig. 9.

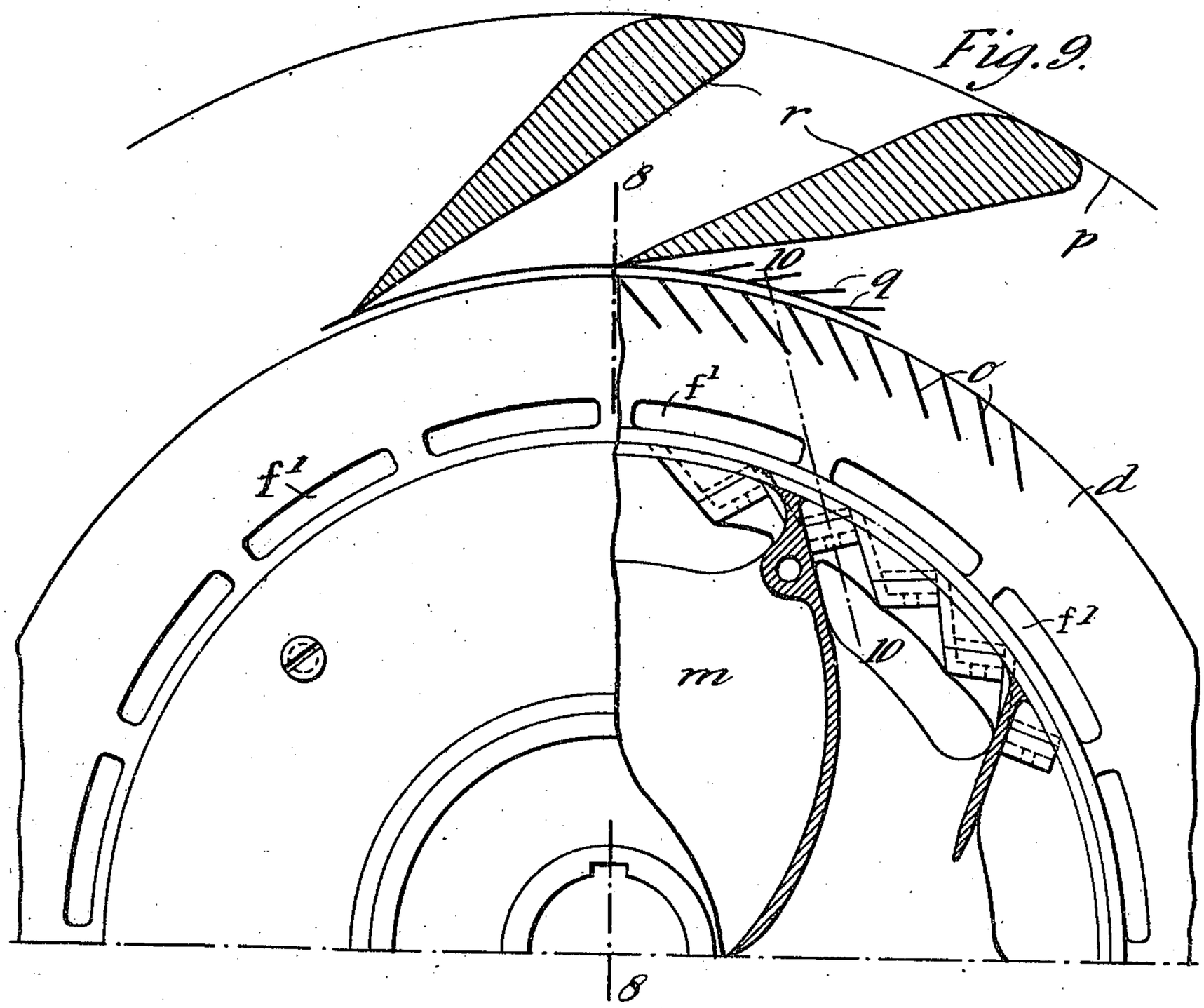


Fig. 8.

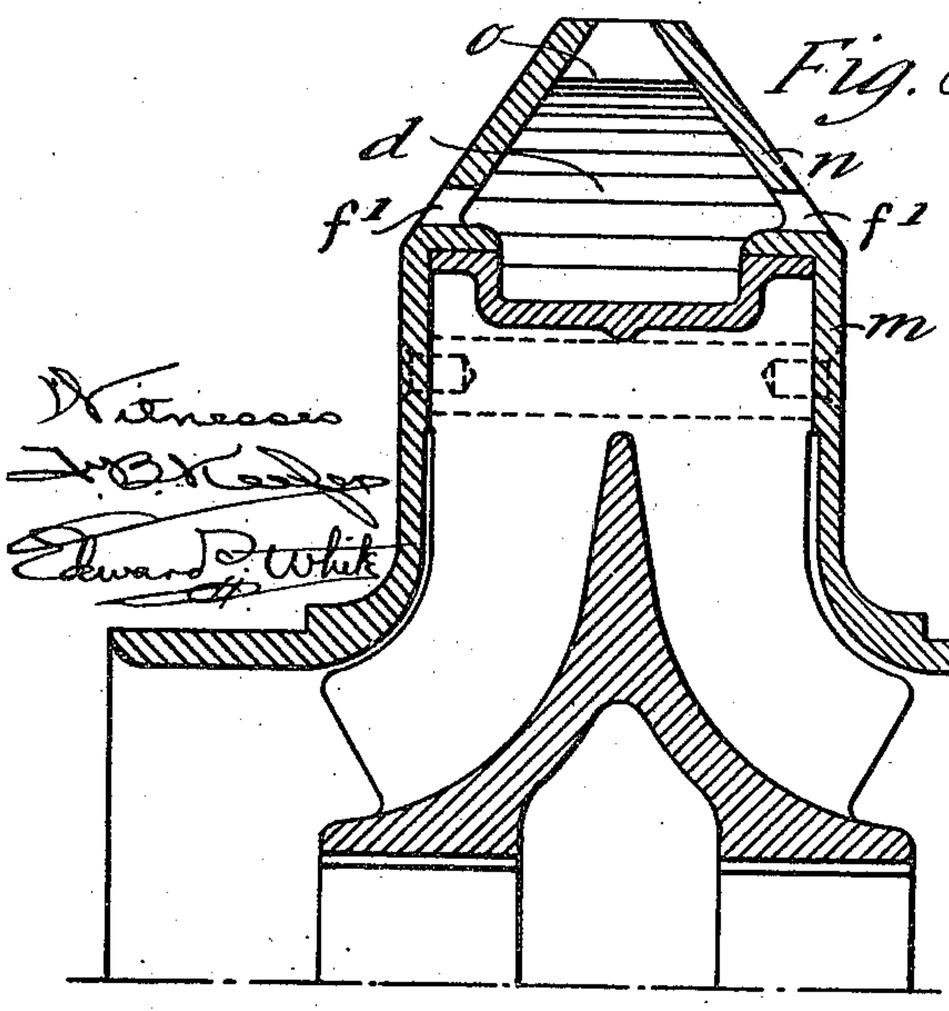
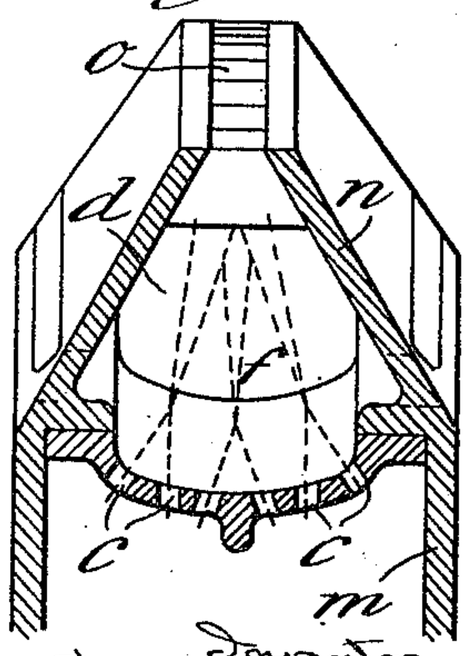


Fig. 10.



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by James L. Morris Jr
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UNITED STATES PATENT OFFICE.

EDMUND SCOTT GUSTAVE REES, OF WOLVERHAMPTON, ENGLAND.

CENTRIFUGAL PUMP, CONDENSER, AND COMPRESSOR.

975,997. Specification of Letters Patent. Patented Nov. 15, 1910.

Application filed June 24, 1910. Serial No. 568,727.

To all whom it may concern:

Be it known that I, EDMUND SCOTT GUSTAVE REES, a subject of the King of Great Britain, residing at The Rees Roturbo Manufacturing Company, Limited, of Wolverhampton, in the county of Stafford, England, managing director, have invented certain new and useful Improvements in Centrifugal Pumps, Condensers, and Compressors, of which the following is a specification.

This invention relates primarily to centrifugal apparatus for the exhaustion of spaces containing air or other non-condensible gases, or steam or other condensible gases, and in the latter case also for the condensing of such gases. This has been effected in apparatus of the class referred to by connecting the space to be exhausted with a chamber or chambers situated inside the casing of a centrifugal pump or turbine and having ducts communicating with a constricted outlet or outlets in the water circuit of the pump impeller or rotor which is preferably constructed with large capacity so as to constitute a fluid pressure reservoir operating as described in co-pending U. S. patent application No. 380347.

The object of the present invention is to secure a more efficient way of entraining the gas or vapor with the water passing through the constricted portions of the nozzles at or near the periphery of the rotary pressure drum. This is accomplished according to the present invention by spreading or subdividing the stream of water in such a way as to present a maximum of surface and permit the air or other gas to distribute itself over the whole surface in an efficient manner.

If the streams of water are flattened so as to present a fan-shaped or coned surface, such streams may be projected from the impeller across an intervening space into the fixed casing of the pump so as to entrap between successive jets columns of the gases or vapor filling or supplied to the intervening space. Or the gases are directly entrained in the sprayed or ruffled jets formed by the impinging streams.

In the accompanying drawings, Figure 1 is a part longitudinal section and Fig. 2 a part transverse section of an impeller or rotor embodying in one form the present invention; Fig. 3 is a longitudinal section and Fig. 4 a side elevation partly in section of a slightly modified construction; Fig. 4ª is a detail showing in section a feature of the modified construction; Fig. 5 is a part transverse section of an impeller showing a further modification, and Fig. 5ª is a section on line A—A of Fig. 5; Figs. 6 and 7 are a partial longitudinal section and partial transverse section respectively of a further modification; Fig. 8 is a part longitudinal section of an impeller embodying a further modification; Fig. 9 is a part side elevation, partly in section, of the same; and Fig. 10 is a section on line B—B of Fig. 9.

As shown in Figs. 1 and 2 the air or other gas or vapor enters an inner chamber *a* in the impeller through its hollow shaft *b* and this chamber communicates with the water nozzles *c* of the impeller through ducts or nipples *d*. The outlets of these nipples are formed as or provided with hoods *d'* projecting into the waterway from the inner edge of the nipple so as to spread the water into a semi-cylindrical or otherwise curved sheet or blanket over the end of the gas duct. Another method whereby the streams of water may be spread or flattened is to incline the nozzles of the pump impeller toward each other in groups of two or more so that the mutually inclined jets will strike each other and the water spread out into fan-shaped sheets. These sheets if projected across a space containing gas or vapor into suitably shaped ducts in a fixed casing entrain columns of gas or vapor between successive sheets and carry them into the ducts in the casing in the known manner.

In the modified construction of Figs. 3 and 4, a comb or grid *e* is substituted for the hood *d'*; Fig. 4ª is a detail showing the grid in section. The bars of these grids split up or laminate the stream of water in front of the gas ducts *d* so as to induce or freely permit the entrainment of the gas between the divided streams. Such combs or grids may be plane or curved or bent transversely and the passages between the teeth may be arranged to give any desired relative inclination of the divided streams so that they may for example impinge against each other at a suitable point or points in the vacuum chamber *f* and break up or spray the individual streams or form flattened sheets with ruffled surfaces. The total space between the bars of the grid may be such that this point will be the most constricted part of the water nozzle or the comb or grid may be placed either at or near the most constricted part of

the nozzle or other suitable position in the water channel. For example, as shown in Figs. 5 and 5ª the grids *e* are placed at the inner ends of tubes *g*, with which the gas chamber *a* communicates by ducts *d* and which discharge the mixed gas and water into supplementary jets *h* which are supplied through ducts *h'* from the water chamber of the impeller.

In the construction shown in Figs. 6 and 7 which is more particularly intended for large impellers, the grid is on the rear or inner side of lateral ducts or holes in the wall of the impeller connecting the gas or air space, which in this case is external to the impeller, with the water nozzles. In this case the grids are preferably made in two halves *e' e'* each extending partly across the waterway and having a screwed nipple e^3 by which it is screwed into the gas inlet duct or through the wall of the waterway so as to form the gas duct. The part of the water channel in each of these constructions into which the air or gas is admitted may be enlarged in area and the gas entrained in the water simply by projecting the water at a high velocity through a grid placed in front of this enlarged area, or as explained above the streams may be projected across an intervening space between the impeller and the fixed casing into which it delivers and the air trapped between successive sheets of water formed by causing these streams to impinge against each other in pairs.

In the construction shown in Figs. 8, 9 and 10, the impeller *m*, which is preferably formed with an internal fluid reservoir of very great capacity compared with the area of its discharge outlets or nozzles *c*, which are formed in the periphery of the impeller, and which are mutually inclined in pairs so that the impinging streams form fan-like sheets of water or spray, is provided with a hood *n* integral therewith or suitably attached, which hood is furnished at its periphery with short transverse blades *o* designed to exhaust the space within the hood. This space *f* is in communication through the apertures *f'* with the apparatus or space from which the gases are to be extracted and these gases are entrained within the hood by means of the fan-like sheets of water or spray caused by the impinging of the streams issuing from the nozzles *c*.

In the preferred arrangement of mutually inclined jets, the directions of the several resultant sheets of water obtained by mutually inclining the transverse row of nozzles *c* in pairs, are arranged to be themselves mutually inclined toward a common point within the hood, so that these resultant streams or sheets of liquid combine to form a single sheet of sprayed water of very great area and of such length circumferentially that the series of sheets obtained in this manner occupy the full periphery of the hood which, therefore, especially toward its periphery, will practically be completely occupied by a mass of finely divided spray which is projected toward the openings between the blades *o* and the periphery of the hood. This mass of spray together with the entrained air or other gas, is ejected into the surrounding fixed casing *p* which, in order to insure against leakage back into the hood, may have a series of reversely inclined vanes *q* (Fig. 9) spaced around the inner periphery of the fixed casing in conjunction with the usual expanding channel or channels which may be formed, for example, as shown in Fig. 9 by cut-waters *r*, the edges of which latter preferably approximate very closely to the periphery of the hood, or may consist of a single expanding channel as in the well known evolute type of fixed casing.

Instead of the water issuing from the nozzles in impinging streams so as to be converted into flat sheets, the nozzles may be parallel and the streams issuing from them may be subdivided, as by means of a grid, into a very large number of jets which would have practically the same result as the mutually inclined streams, namely of filling the interior of the hood with a mass of rain or sprayed water which is projected toward the openings between the vanes and the periphery of the hood.

Having thus described my invention and the best means I know of carrying the same into practical effect, I claim:—

1. A centrifugal vacuum pump, condenser or compressor comprising an impeller having peripheral discharge nozzles mutually inclined to cause the issuing streams to form fan-like sheets of water or spray, substantially as described.

2. A centrifugal vacuum pump, condenser or compressor comprising an impeller having peripheral discharge nozzles and a hood rotating with the impeller and encircling the space into which the nozzles discharge.

3. A centrifugal vacuum pump, condenser or compressor comprising an impeller having peripheral discharge nozzles and a hood rotating with the impeller and encircling the space into which the nozzles discharge, the periphery of the hood being fitted with short transverse vanes adapted to act as an extractor, substantially as described.

4. A centrifugal vacuum pump, condenser or compressor comprising an impeller having peripheral discharge nozzles arranged in transverse rows mutually inclined in pairs and a hood rotating with the impeller and encircling the space into which the nozzles discharge.

5. A centrifugal vacuum pump, condenser or compressor comprising an impeller having peripheral discharge nozzles arranged

in transverse rows mutually inclined in pairs and a hood rotating with the impeller and encircling the space into which the nozzles discharge, the periphery of the hood being fitted with short transverse vanes, substantially as described.

6. A centrifugal vacuum pump, condenser or compressor comprising an impeller having peripheral discharge nozzles arranged in transverse rows mutually inclined in pairs and a hood rotating with the impeller and encircling the space into which the nozzles discharge, the periphery of the hood being fitted with short transverse vanes, and a fixed casing into which the fluids are discharged from the impeller, said casing having a series of vanes opposed to the vanes fitted in the hood, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDMUND SCOTT GUSTAVE REES. [L. S.]

Witnesses:
ARTHUR EATON,
THOMAS GEORGE PRICE.