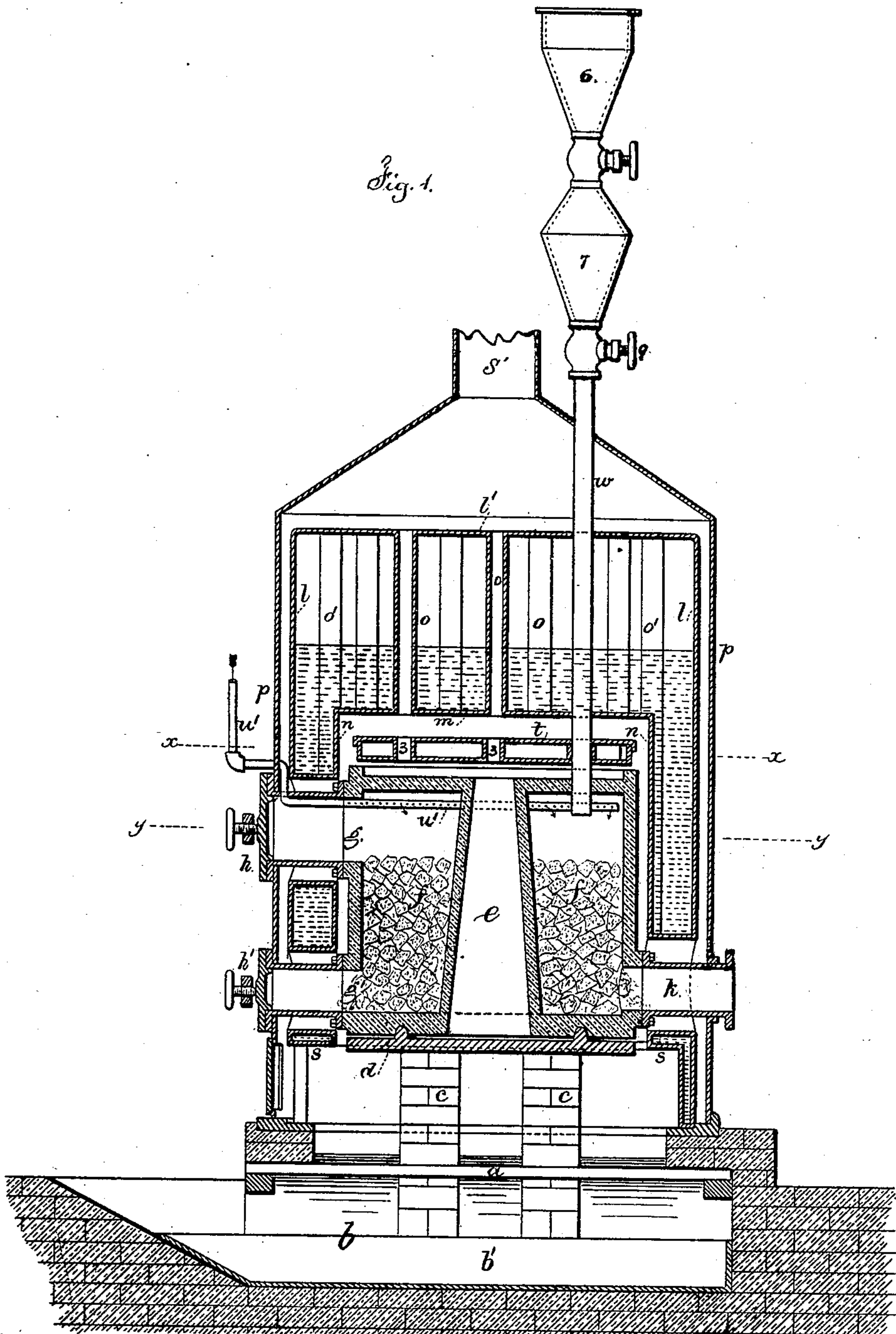


W. HARKNESS.  
Apparatus for the Manufacture of Heating and  
Illuminating Gases.  
No. 236,491. Patented Jan. 11, 1881.



Witnesses

Chas. H. Smith  
Geo. F. Pinckney

Inventor  
William Harkness.  
per Lemuel W. Serrell

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Fig. 2.

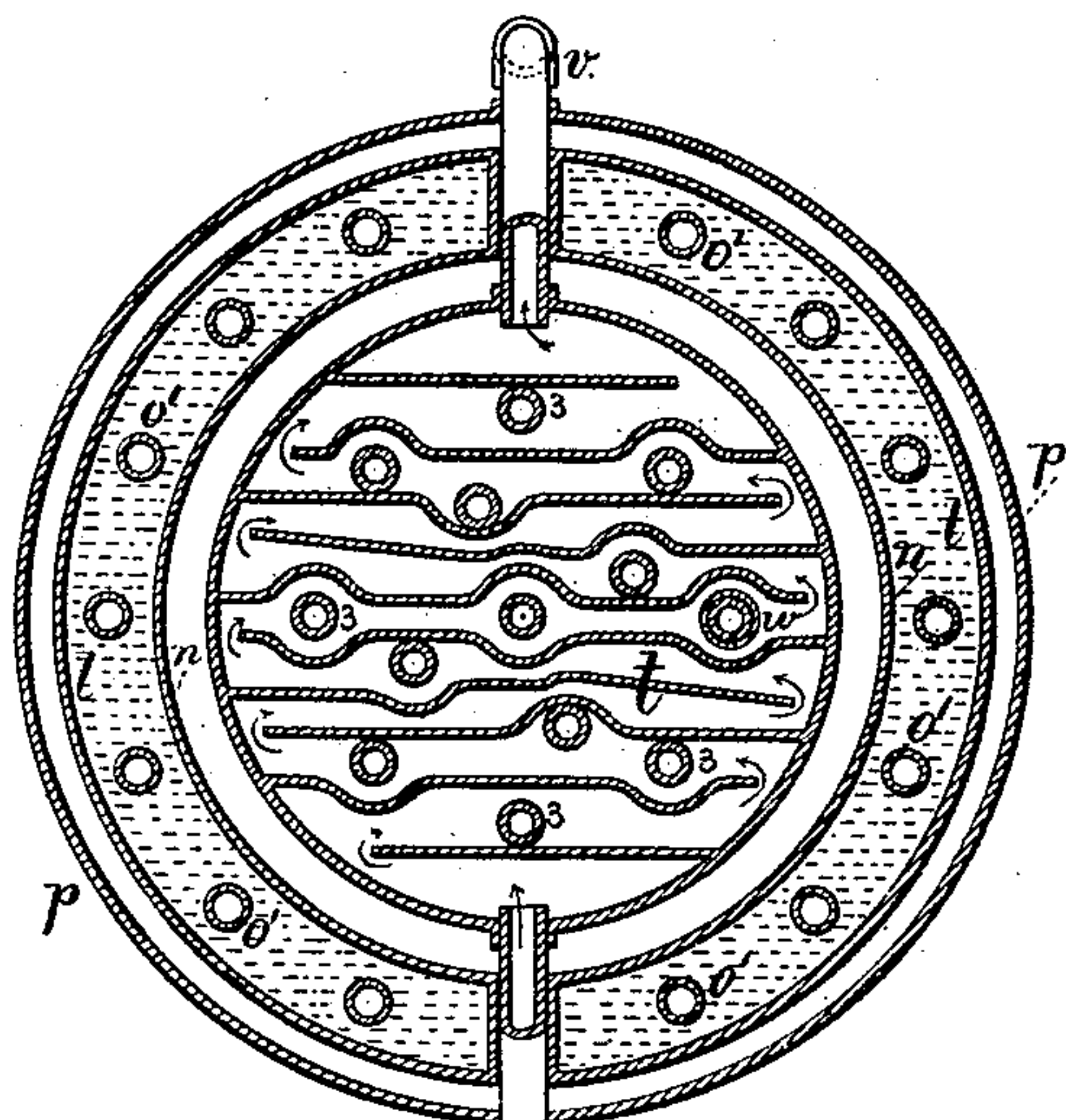


Fig. 3.

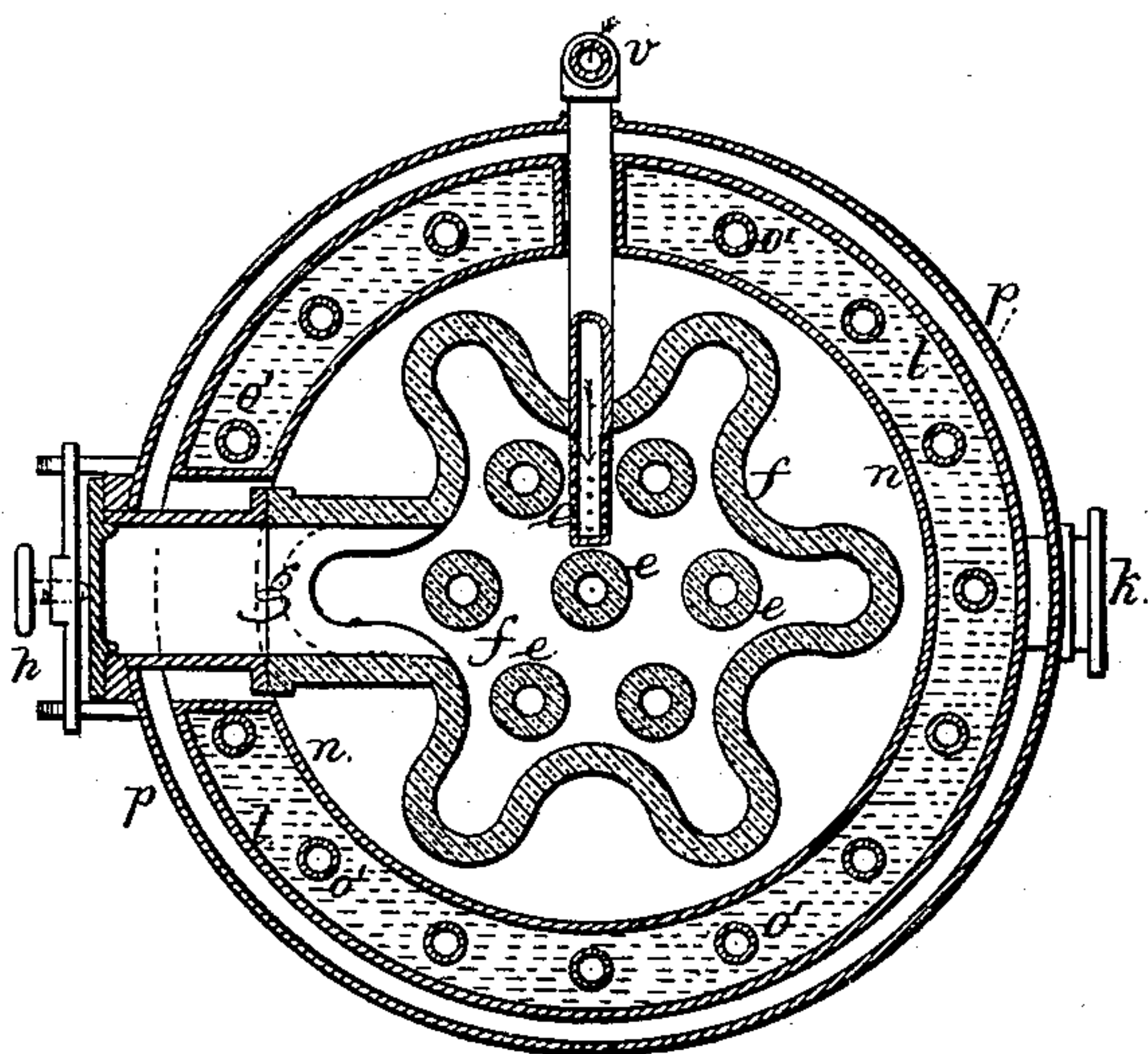
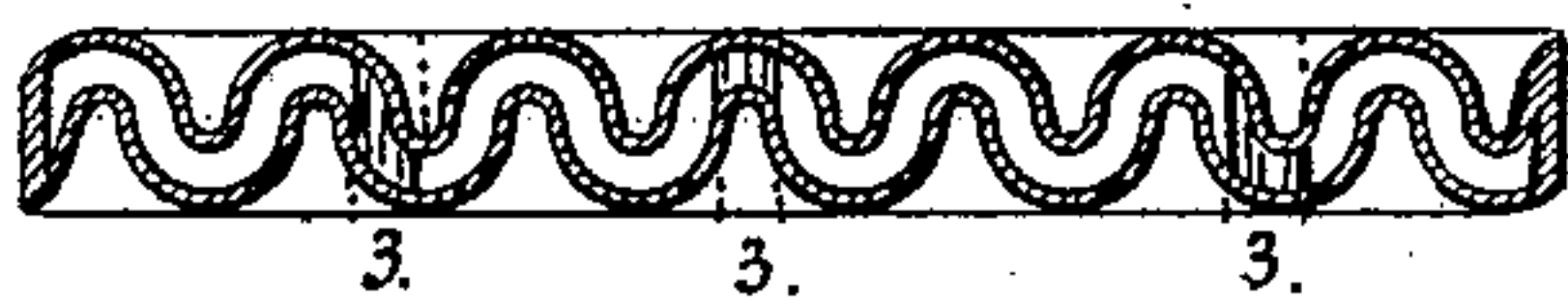


Fig. 4.



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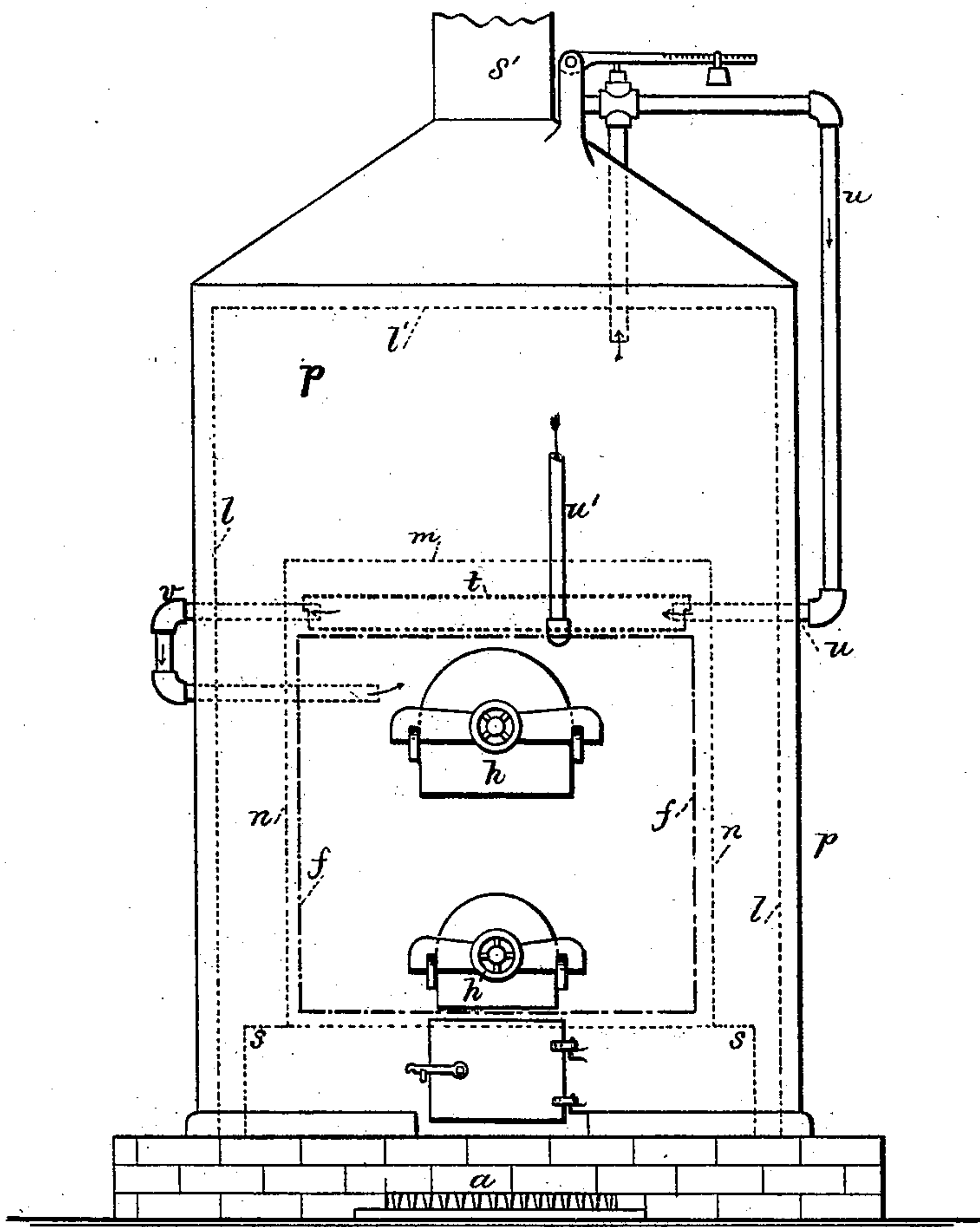
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Fig. 5.



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# UNITED STATES PATENT OFFICE.

WILLIAM HARKNESS, OF NEW YORK, N. Y.

APPARATUS FOR THE MANUFACTURE OF HEATING AND ILLUMINATING GASES.

SPECIFICATION forming part of Letters Patent No. 236,491, dated January 11, 1881.

Application filed February 2, 1880.

*To all whom it may concern:*

Be it known that I, WILLIAM HARKNESS, of the city, county, and State of New York, have invented an Improvement in Apparatus for the Manufacture of Heating and Illuminating Gases, of which the following is a specification.

I make use of a gas-generator containing pumice-stone or porous material, such as pieces of fire-brick, placed directly over a fire, so as to become highly heated. There is a superheating device above the generator, in which steam is highly heated, and over and around the generator is a steam-boiler. By this construction the entire heat from the fire is utilized, the steam from the boiler is used for any desired purpose, and the required amount of steam for the gas-making operation is supplied into the generator, together with carbonaceous material in the proper proportion, either in the form of a liquid hydrocarbon or coal-dust, the superheated steam and the carbonaceous material act upon each other, the steam is decomposed in the presence of the heat, the oxygen combining with the carbon and the hydrogen mingling with the hydrocarbon and carbonic-oxide gases, and the mingled gases, passing down through the highly heated pumice or similar material, are converted into fixed gases adapted to be burned. If the proportion of carbonaceous material to steam is small a heating-gas will be formed that possesses but small illuminating power, and if the proportion of carbonaceous material is increased illuminating-gas of any desired brilliancy will be made. This apparatus is adapted to continuous operation, and the process of manufacturing the gas does not have to be suspended periodically for the reheating of the generator containing porous materials.

In the drawings, Figure 1 is a vertical section of the gas-making apparatus and boiler, and Fig. 2 is a sectional plan of the same at the line *x x*. Fig. 3 is a section of the boiler at the line *y y*, but the generator is of a different sectional shape to that shown in Fig. 1. Fig. 4 is a modification of the superheating device, and Fig. 5 is an elevation of the apparatus.

The grate-bars *a* are above a suitable ash-

pit, *b*, at the bottom of which it is preferable to employ a water-pan, *b'*, as usual in furnaces, in order that the vapors of the water may pass through the fire upon the grate-bars and promote combustion.

The piers *c c* on the walls of the ash-pit support the tile *d*, and above this is the generator *f*, of fire-clay or other suitable material, through which are one or more flues, *e*. I have shown in Fig. 1 a single central and tapering vertical flue, and in the plan, Fig. 3, several of these vertical flues, and there is a space between the tile and the bottom of the generator, so that the heated products of combustion pass up around the generator and through the vertical flues thereof, and the generator is, by preference, corrugated vertically, so as to increase the heating-surface and lessen the risk of breakage by contraction or expansion. This generator has the mouth or necks *g g'*, with doors *h h'*, that can be removed, but which are closed air-tight when in use, and the interior of the generator is partially filled with pumice or other porous material, such as fire-brick. The pipe *k*, from the lower part of the generator, conveys the gas that is made therein to any suitable holder.

There is a steam-boiler that surrounds and forms a case to the generator, such boiler being composed of the outer cylinder, *l*, tube-sheet *m*, interior case, *n*, and vertical flues *o o*, between the flue-sheet *m* and the top of the boiler *l'*, and other flues, *o'*, that pass upward from the offset at *s* through the top *l'* of the boiler, and *p* is the exterior case to confine the heat, and from this the pipe *s'* connects to any suitable chimney.

Above the generator and within the chamber of the steam-boiler there is a superheater, *t*, that is hollow and provided with flue-tubes *3 3*, that pass vertically through the same. This superheater may have vertical partitions passing alternately from opposite sides, so as to make a zigzag passage for the steam as it passes from the supply-pipe *u* to the exit-pipe *v*; but I prefer and use corrugated top and bottom plates for the superheater, as seen in Fig. 4, so as to present a large surface that heats the steam that passes through the heater. Steam from the boiler in a regulated quantity is allowed to flow through the pipe *u* and su-



perheater to the exit-pipe *v*, and thence into the generator *f*, and the end of the pipe *v* is, by preference, perforated, so that the steam is distributed through the upper part of the generator, and it comes into contact with hydrocarbon vapors.

I make use of a suitable pipe to supply carbonaceous material into the generator *f*. If the carbonaceous material is in a liquid form, such as petroleum, the liquid is allowed to run in a regulated quantity through the pipe *w'*, and discharge within the generator through the holes in such pipe, and I remark that the liquid hydrocarbon may be introduced in the form of vapor through this pipe from any suitable vessel in which such hydrocarbon is vaporized. If coal-dust, either bituminous or anthracite, is employed, the funnels 6 and 7 are, by preference, used on the pipe *w*, and cocks or slides are used to close the funnel 7 after it is full, and then the said coal-dust is allowed to run gradually into the generator through the cock or slide 9. Solid and fluid hydrocarbons or vapors may both be supplied into the generator.

The operation of this apparatus is as follows: The heat vaporizes the hydrocarbon, and the steam, coming into contact therewith in the presence of a high temperature, is decomposed, the oxygen of the steam combining with a sufficient quantity of carbon to form carbonic oxide, while the liberated hydrogen mingles with the hydrocarbon vapors, and they pass down through the incandescent pumice-stone, and become intimately combined or fixed, so as to be adapted to illuminating or heating purposes. The quality of the gas will vary according to the proportion of carbonaceous material to the steam, and illuminating-gas will be formed by a larger proportion of carbonaceous material than that employed in making a heating-gas that is only slightly luminous.

This apparatus is very compact and economical, because the heat is confined and the surplus used for generating steam, the boiler being the case for confining the heat to the gas-generator.

I am aware that in gas-making apparatus a retort has been used containing pumice-stone or similar materials; also that steam-boilers have been used with and surrounding the gas-making retort, and that the steam has been superheated and introduced into the retort.

In my apparatus the superheater is surrounded by the products of combustion, so as

to become highly heated, the boiler incloses the gas generator and superheater, and, having the offsets and vertical flues, the heat is economized, and the steam and hydrocarbon vapors entering the top part of the generator from opposite directions become intimately mixed and pass downwardly to the hottest portion of the generator, so as to be thoroughly converted into combustible gases.

I claim as my invention—

1. The combination, in a gas-making apparatus, of a vertical generator, a fire-chamber below the same, a broad superheating-vessel above the generator, a vertical tubular steam-boiler surrounding and inclosing both the generator and the superheater, tubes for supplying steam and carbonaceous material into the upper part of the generator, and porous material, such as pumice-stone, within the generator to promote the gas-making operation, substantially as set forth.

2. A generator having one or more vertical flues through it, and mouth-pieces with lids, in combination with the grate-bars and fire-chamber beneath the generator, a pipe supplying steam into the generator, apparatus for supplying carbonaceous material in a regulated quantity, and porous material, such as pumice-stone, within the generator, and through which the vapors and gases pass, for the purposes and substantially as set forth.

3. The generator *f*, having corrugated walls, vertical flues *e*, and mouth-pieces *g g'*, with lids *h h'*, in combination with the hoppers 6 and 7, for supplying coal-dust, and the grate for fuel below the generator, substantially as set forth.

4. The combination, with the gas-generator, of a superheater having top and bottom plates that are corrugated, and vertical pipes passing through the plates, substantially as set forth.

5. The combination, with the gas generator and superheater, of a tubular steam-boiler having inner and outer cases surrounding the gas-generator, and a tube-sheet above the superheater, whereby the products of combustion, after acting upon the gas generator and superheater, pass up through the vertical boiler-tubes, as set forth.

Signed by me this 28th day of January, A. D. 1880.

WILLIAM HARKNESS.

Witnesses:

WILLIAM G. MOTT,  
CHAS. H. SMITH.