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R. HALDANE.

APPARATUS FOR THE DISTILLATION OF WOOD.

No. 297,517. Patented Apr. 22, 1884.

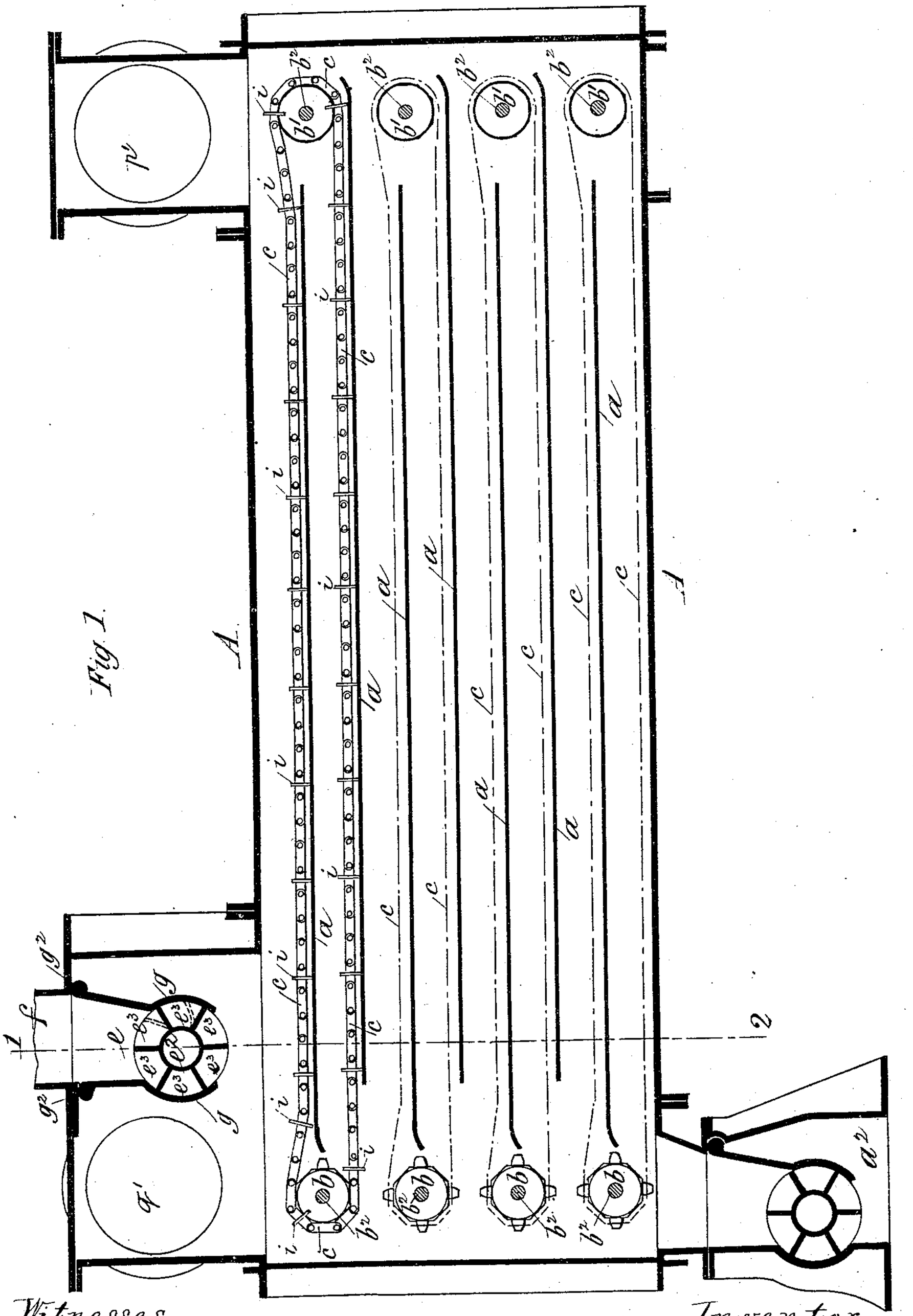

Fig. 1.

Witnesses.
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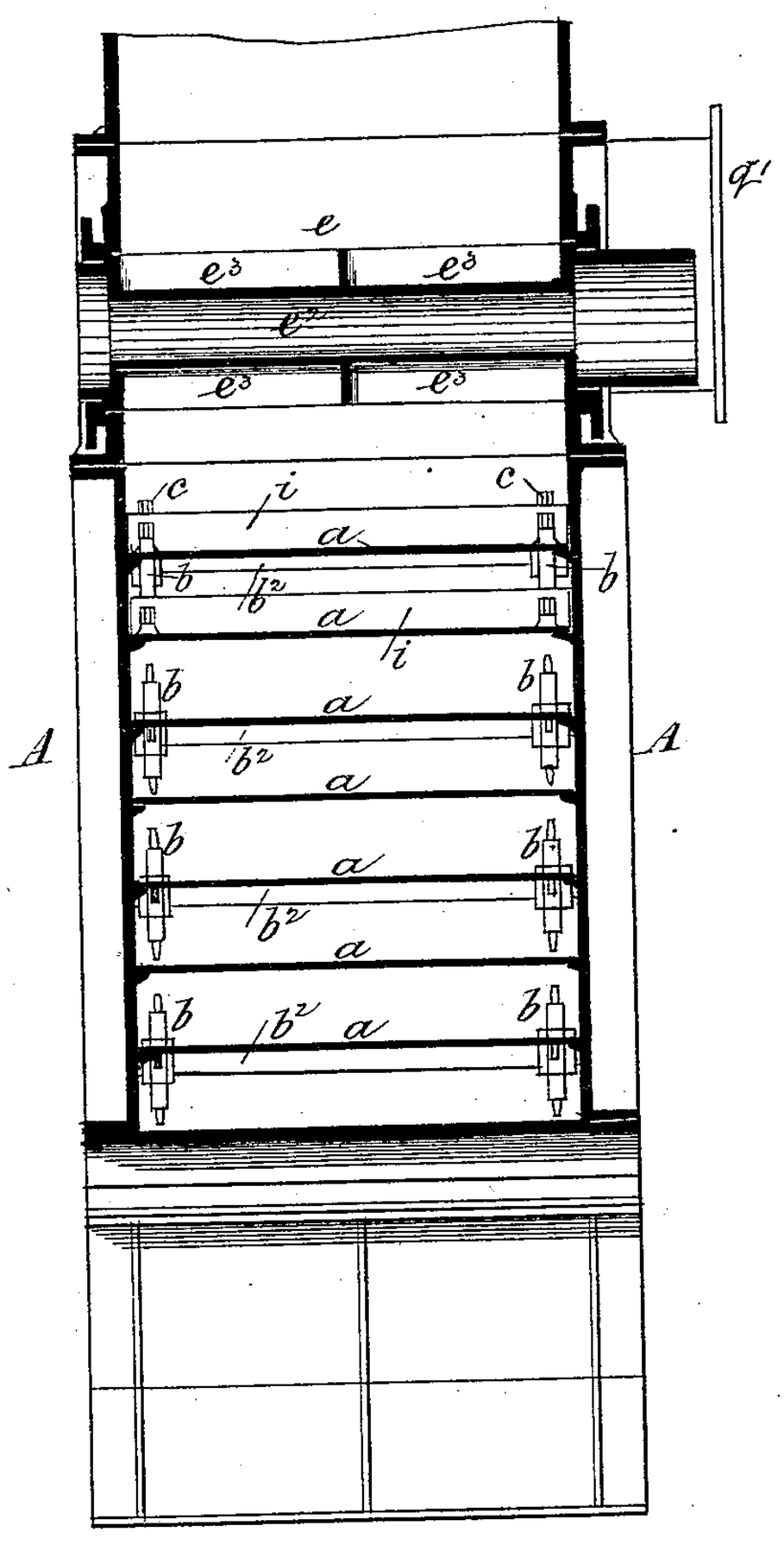
Fig. 2.



Witnesses.
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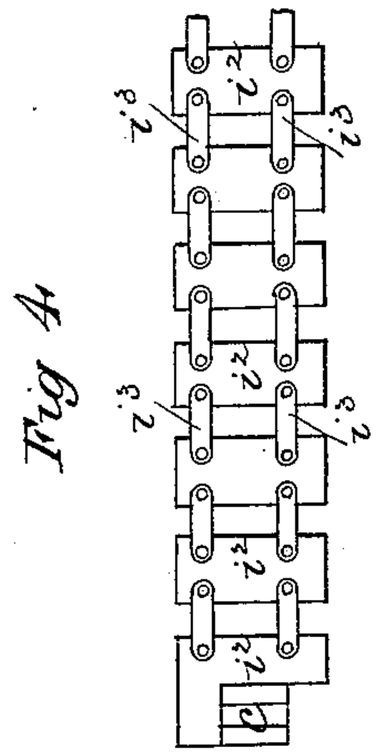

Fig 4

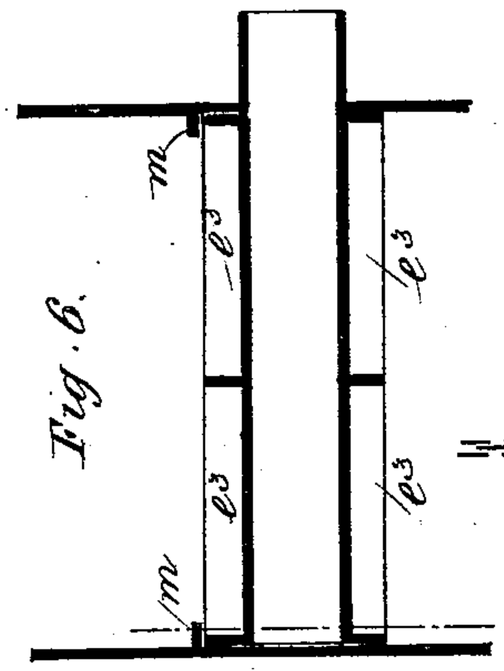

Fig. 6.

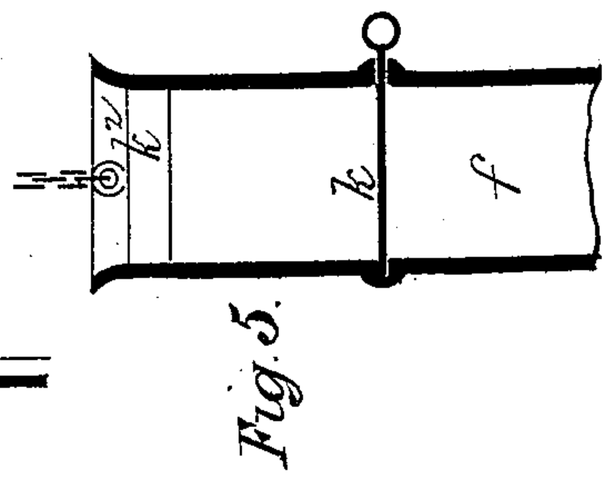

Fig. 5.

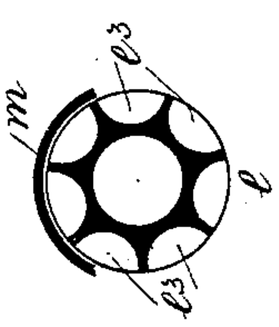

Fig. 7

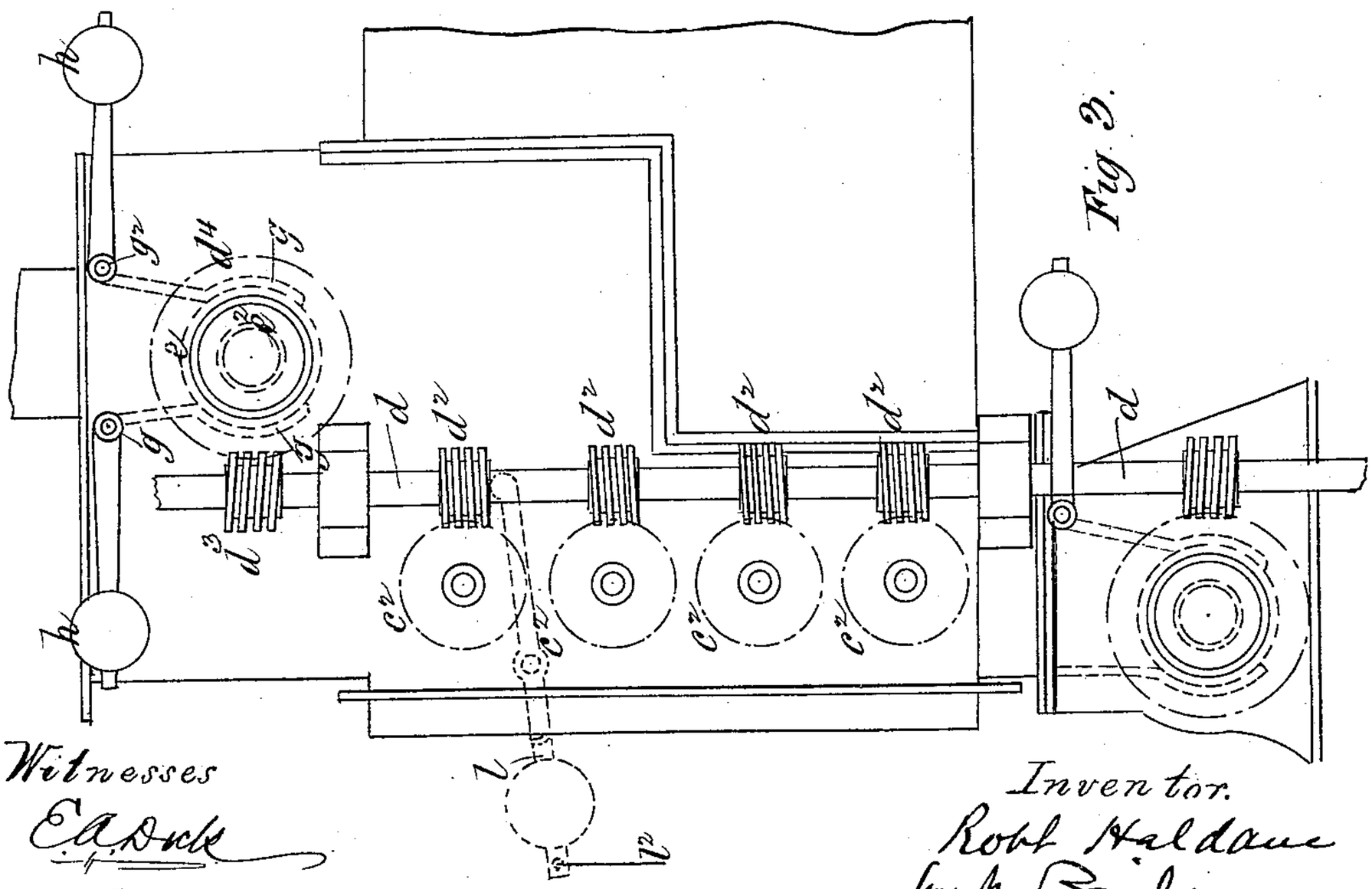

Fig. 3.

Witnesses
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Fig. 8.

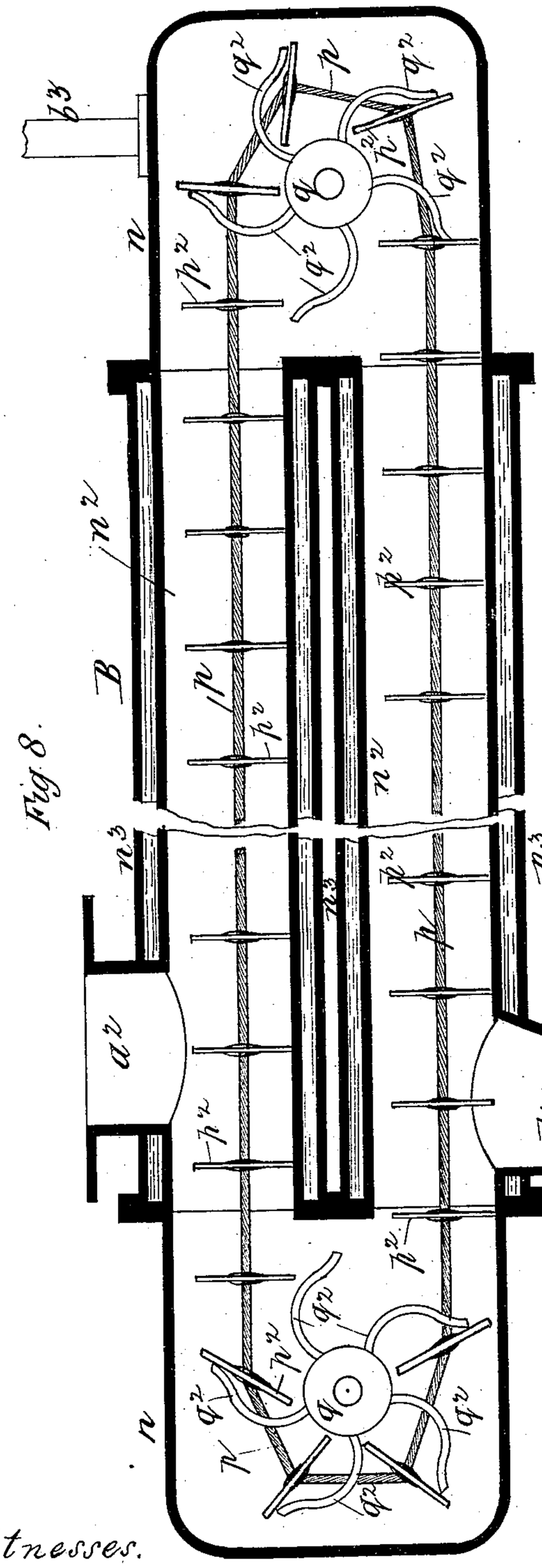


Fig. 10.

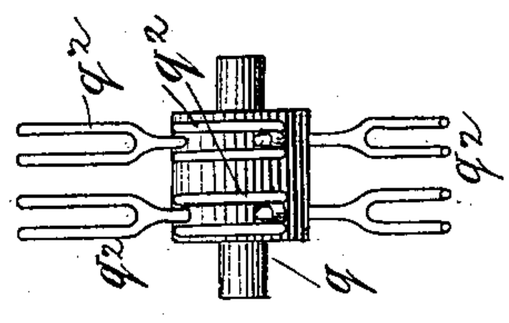


Fig. 9.

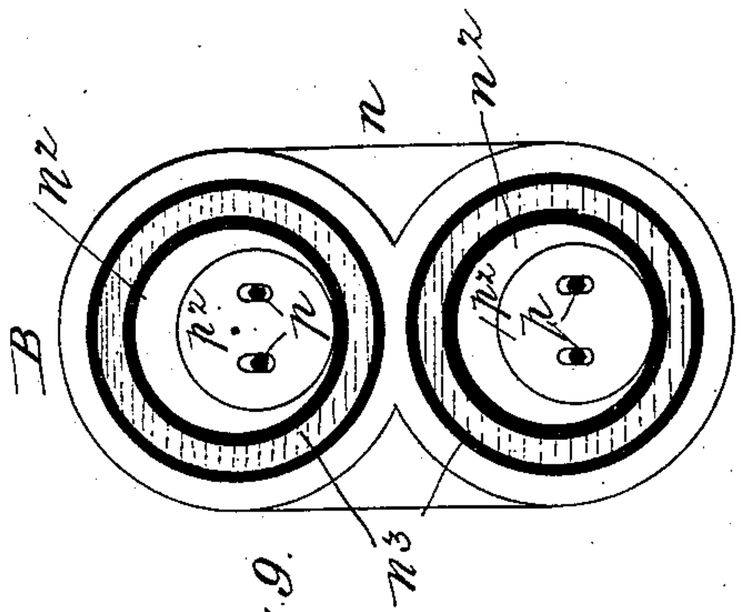
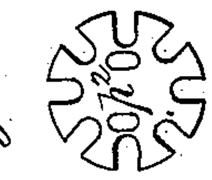


Fig. 11.



Witnesses.

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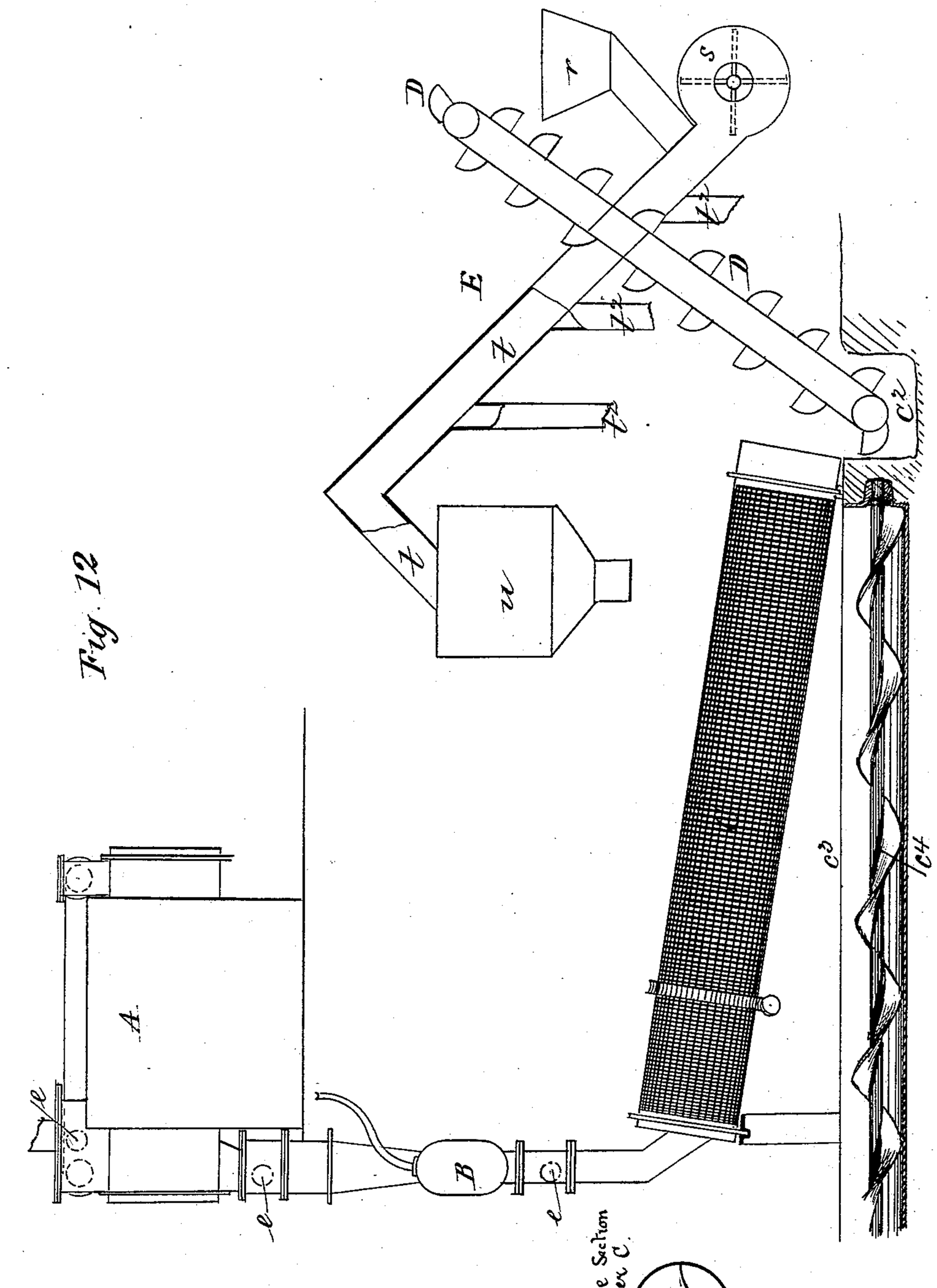

Fig. 12

Witnesses.
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UNITED STATES PATENT OFFICE.

ROBERT HALDANE, OF GLASGOW, COUNTY OF LANARK, SCOTLAND.

APPARATUS FOR THE DISTILLATION OF WOOD.

SPECIFICATION forming part of Letters Patent No. 297,517, dated April 22, 1884.

Application filed September 24, 1881. (No model.) Patented in England April 8, 1880, No. 1,435.

To all whom it may concern:

Be it known that I, ROBERT HALDANE, of Glasgow, in the county of Lanark, Scotland, drysalter and manufacturing chemist, have invented improvements in retorts for obtaining products from the destructive distillation of sawdust, shavings, and other small wood, (for which I have received Letters Patent in England No. 1,435, dated April 8, 1880,) of which the following is a specification.

According to my said invention the destructive distillation is effected in a retort having a longitudinal shelf or division, or with several such shelves or divisions extending along the retort and forming two or more chambers therein, scrapers being caused by an endless chain or endless chains to travel along the bottoms of the chambers first in one direction and then in the other twice or a greater number of times along the length of the retort. The hopper by which the wood is fed into the retort is provided with a feeding wheel or roller having flutings or recesses in its periphery, forming feeders for receiving the wood and feeding it to the retort, the said wheel or roller having a weighted flap or flaps bearing upon its periphery to prevent the escape of gas from the retort through the hopper. From the retort the distilled gases pass by outlets to the condensers, and the charred wood is passed from the retort by a wheel or roller, (like that in the feed-hopper *f*,) into a cooler consisting of a long chamber or chambers, or tube or tubes, (which may be surrounded by a water-casing,) through which chambers or tubes the charred wood is passed along by scrapers, or a screw or the like, the said charred wood being passed by a feed wheel or roller like that before described, either at once into a winnowing-machine, or first into an intermediate revolving perforated or reticulated cylinder, to be further cooled, and from this cylinder into the winnowing-machine.

In the drawings, Figure 1 represents a longitudinal section of a retort constructed according to my invention. Fig. 2 is a transverse section of the same, taken on the line 1 2, Fig. 1. Fig. 3 is a side elevation of that end of the machine at which the driving mechanism is situated. The retort here shown is furnished with seven shelves forming eight chambers, along the bottoms of which the wood being treated is traversed alternately in reverse directions from end to end of the retort; but it is to be understood that but one shelf or other number of shelves may be employed, as may be desired.

The retort A has in its interior shelves, *a a a*, extending from side to side thereof, but with a space between each of their ends and the ends of the retort, the said shelves at the ends at which they receive the wood under treatment from the shelf above being extended beyond the said shelf above for receiving the said wood. Sprocket-wheels *b b* and pulleys *b'* are carried upon shafts b^2, mounted in bearings at either end of the said shelves. Over these sprocket-wheels pass chains *c c*, as shown in Fig. 1 at the two upper shelves, but indicated by the dot and pick lines in the lower shelves. The shafts b^2 of the sprocket-wheels *b* at the driving end of the machine are extended to the outside of the retort, to carry worm-wheels, (indicated by the dot and pick circles at c^2 c^2 at Fig. 3,) with which worm-wheels gear worms d^2 d^2, upon a shaft, *d*, which also carries a worm, d^3, gearing with a worm-wheel (indicated by the dot and pick circle at d^4) upon the shaft e^2, upon which is formed the feeding wheel or roller *e*, which has recesses or box-like receptacles e^3, for receiving the wood from the hopper *f* and feeding it to the retort.

The shaft *d* is driven by a steam-engine or other suitable motor by means of gearing connected with the said shaft. The said feeding wheel or roller *e* revolves between flaps *g g*, hinged at g^2 g^2, and extending from side to side of the hopper, and over such portion of the periphery of the feeding-wheel that each flap covers at least a portion equal to one of the recesses e^3 of the said wheel. These flaps *g g* may be kept in contact with the feeding wheel or roller by their own weight, or by means of weighted levers *h h*, mounted upon the fulcrums or hinges of the said flaps, pressing the said flaps against either side of the said feeding wheel or roller, or by other equivalent means. Thus these flaps prevent the escape of gas, or tend greatly to prevent such escape, and at the same time are capable of yielding, to allow any obstructive matter to pass clear.

One of the flaps may be hinged, if desired, the other being stationary and situated close to the periphery of the wheel or roller. The chains *c* have affixed to them and extending from side to side of the shelves and the bottom of the retort, and in contact with the upper surfaces or floors thereof, scrapers *i*, some of which are shown in Figs. 1 and 2. These scrapers may be rigid scrapers fixed between horns cast at suitable intervals upon some of the links of the chain; or they may consist of chains or a series of plates, i^2, connected by links i^3, as shown with regard to a portion of such a scraper in Fig. 4, this latter arrangement allowing of the yielding of the scrapers on encountering any obstacle; or other equivalent arrangement of scrapers or propellers may be adopted.

The hopper *f*, by which the wood is fed to the retort, is or may be provided with a sliding valve, *k*, as shown separately in Fig. 5, for charging wood into the retort in such a manner as to prevent the escape of gas from the retort. The wood being placed in the upper part of the hopper above the valve *k*, an upper cover, k^2, is placed thereupon, the said cover k^2 fitting closely into the said hopper. On the valve *k* being withdrawn, the wood falls upon the feeding wheel or roller *e*, the cover k^2 descending with the wood till the said cover arrives just above the valve *k*, which may now be closed and the cover k^2 removed to leave the upper part of the hopper clear for a fresh charge of wood; or other mode of feeding may be adopted—for example, there may be an elevator employed for continuously feeding the wood into the hopper, or an air-blast may be used to elevate the wood and at the same time winnow it. For actuating the shaft *d*, for driving the chains *c* and feeding-wheel *e*, I prefer to use steam of low pressure, so that no injurious effect is caused in the event of pieces of wood obstructing the scrapers, and an ordinary reduction-valve may be employed to keep the steam at the requisite pressure, or a weighted lever, *l*, may be employed to press up each of the worms into position against stops on the worm-shaft, as shown with regard to one worm by dotted lines in Fig. 3, so that in the event of any worm-wheel coming to a standstill by the clogging of the scrapers, the worm will run down upon the worm-shaft, and a connection, l^2, with the steam-inlet will shut off steam and stop the engine.

In order to prevent the clogging of the feeding wheel or roller by the entry of wood between its end and the sides of the retort at the lower part of the hopper, the ends of the said wheel may be housed in the sides of the retort, as shown in Fig. 2, or there may be a saddle-piece, *m*, on either side projecting to a slight extent over the ends of the feeding-wheel, as shown in the diagrams Figs. 6 and 7, where the wheel *e* is shown as having its recesses or receptacles of a different form from that in Fig. 1, it being understood that such recesses or receptacles may be of any suitable shape. For example, they may be bucket-shaped, as shown in dotted lines with regard to two receptacles in Fig. 1.

When in operation the machine is fed at the hopper *f* with the small wood to be treated, which falls into the receptacles e^3 of the feeding-wheel *e*, which, as it slowly rotates, discharges the wood onto the top shelf *a*, along which it is caused to travel by the slow forward movement of the scrapers until it arrives at the end of the said shelf, from which it falls onto the second shelf *a*, along which it is caused to travel in like manner in the reverse direction, and from which it falls upon the third shelf *a*, and is by the second series of scrapers urged along this and falls therefrom, and so on from shelf to shelf, until it falls onto the bottom of the retort, along which it is traversed until it eventually falls in a charred condition by the outlet *n*, which is provided with a wheel or roller similar to the feeding wheel or roller *e* above. The gases evolved during the process are carried off at gas-outlets, as at *p'* and *q'*, (or at other place,) and conducted by the condenser-pipes, to be dealt with in the ordinary manner. The retort is set in brick or other setting, provided with furnaces and flues for effecting the heating of the retort in a manner essentially similar to that ordinarily adopted for heating retorts. From the retort A the charred wood is fed through the passage a^2, (Figs. 1 and 8,) provided with a feed-wheel, into the cooler B. (Shown in longitudinal section in Fig. 8, and in transverse section in Fig. 9.) It consists of two end chambers, *n n*, connected by two tubes, n^2, endless wire ropes or chains *p*, carrying scrapers p^2, fixed to the ropes or chains by collars or pins or other fastenings, the holes in the scrapers through which the ropes pass being preferably slotted to give play to the scrapers. The said ropes or chains, with the scrapers, pass continuously through these tubes and end chambers, the said ropes or chains being caused to travel by the wheels *q* in each chamber furnished with carriers q^2 with forked ends, between which forked ends the wire rope or chain passes, the carriers bearing upon the scrapers and causing them to traverse along the tubes n^2. One of the wheels *q* is shown separately in side elevation in Fig. 10. The tubes n^2 may be surrounded by jackets n^3, through which water may circulate to facilitate the cooling. The charred wood is caused to travel by the scrapers along through the upper tube, n^2, and when it reaches the end thereof it drops to the lower tube, along which the scrapers cause it to pass until it is discharged through the passage b^2, provided with a wheel similar to the wheel *e*, Fig. 1, as shown.

b^3 is an outlet for gas from the cooler to a chamber, to be condensed or otherwise treated, or to the retort-furnace or other place to be burned.

The scrapers p^2 may be either plain at their

edges, as in Figs. 8 and 9, or they may be serrated, as shown in Fig. 11. The tubes n^2 may be of other shape in cross-section than that shown. For example, they may be D-shaped or oval, or they may be replaced by a chamber containing a shelf or shelves like the retort Figs. 1 and 2.

An arrangement of tubes like that Figs. 8 and 9 may be employed as a retort in place of the arrangement Figs. 1 and 2, if desired, the water-casing, of course, being omitted and the flame of the furnace which heats the retort playing around the tubes. In this case it is evident that the two tubes would be the equivalent of a retort like that Figs. 1 and 2, with but one shelf therein. From the cooler B the charred wood is passed either at once (or through an intermediate perforated or reticulated cylinder) into a winnowing-machine, which may be like those used for winnowing grain.

Fig. 12 is a diagram representing the order in which the apparatus communicate with each other.

A represents the retort described with reference to Figs. 1, 2, and 3; and B is the cooler described with reference to Figs. 8 and 9.

The dotted circles at *e* represent the positions of receiving and feeding wheels like that marked *e*, described with reference to Figs. 1 and 2. These wheels may be driven by any suitable means. The wheel at the exit from the retort is shown in Fig. 3 as being driven by an additional worm on the shaft *d*.

E is the winnowing-machine having a hopper, *r*, into which the charred wood is fed or received either directly from the cooler B or after having passed through a rotating perforated or reticulated cylinder (represented at C) to be oxidized and further cooled, being received therefrom into a pit, C^2, from which it is passed by an elevator, D, into the hopper *r* of the winnowing-machine. Where the hopper of the winnowing-machine is at a lower level than the cylinder C, the elevator D may, of course, be dispensed with. The cylinder C, if used, may be rotated in any convenient way, and may be furnished with internal shelves or lifters, which may be screw-shaped if the cylinder be set horizontally. The small charcoal which falls through the openings in the cylinder are received into the trough c^3 and carried to any suitable place by a screw, c^4, or by a creeper, or otherwise. The blast of the fan *s* of the winnowing-machine drives the charcoal up the shaft *t*, foreign substances falling therefrom down the chutes t^2 t^2, the charcoal entering the receiver *u*, from which it is received in sacks or other receptacles. Other equivalent means for creating a blast may be used in place of the fan *s*.

I claim—

1. The combination, with the retort A, having shelf or shelves *a*, chain or chains *c*, scrapers *i*, feed-wheel *e*, operating mechanism for said chain and wheel, and outlets for conducting off the distilled gases, of the cooler B, communicating with the said retort through a passage, a^2, controlled by a feed-wheel, and formed or provided with chambers *n*, tubes n^2, ropes or chains *p*, scrapers p^2, driving-wheels q q^2, operating mechanism therefor, water-casing n^3, and controlled discharge-outlet b^2, as and for the purpose hereinbefore set forth.

2. The cooler B, consisting of the combination of the chambers *n*, tubes n^2, ropes or chains *p*, scrapers p^2, driving-wheels q q^2, discharge-wheel *e*, and casing n^3, for the purpose described.

3. In apparatus for obtaining products from the destructive distillation of sawdust, shavings, and other small wood, the combination of the retort A, the cooler B, and the winnowing-machine E, constructed, arranged, and communicating with one another substantially as hereinbefore described, whereby the material fed into the retort is conducted successively through said retort, cooler, and winnowing-machine, from which latter it is finally discharged in the condition of charcoal, as and for the purposes hereinbefore specified.

4. The combination of the retort A, cooler B, cylinder C, winnowing-machine E, and means, substantially as hereinbefore described, whereby the material fed into the retort is conveyed successively through said retort, cooler, cylinder, and winnowing-machine, as and for the purposes set forth.

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

ROBERT HALDANE. [L. S.]

Witnesses:

ROBERT ADAM GUNN,

JAMES SMITH BEGG,

Both of 115 *St. Vincent Street, Glasgow.*