(No Model.) 2 Sheets—Sheet 1.

H. M. THOMPSON.

AMALGAMATOR.

No. 282,131. Patented July 31, 1883.

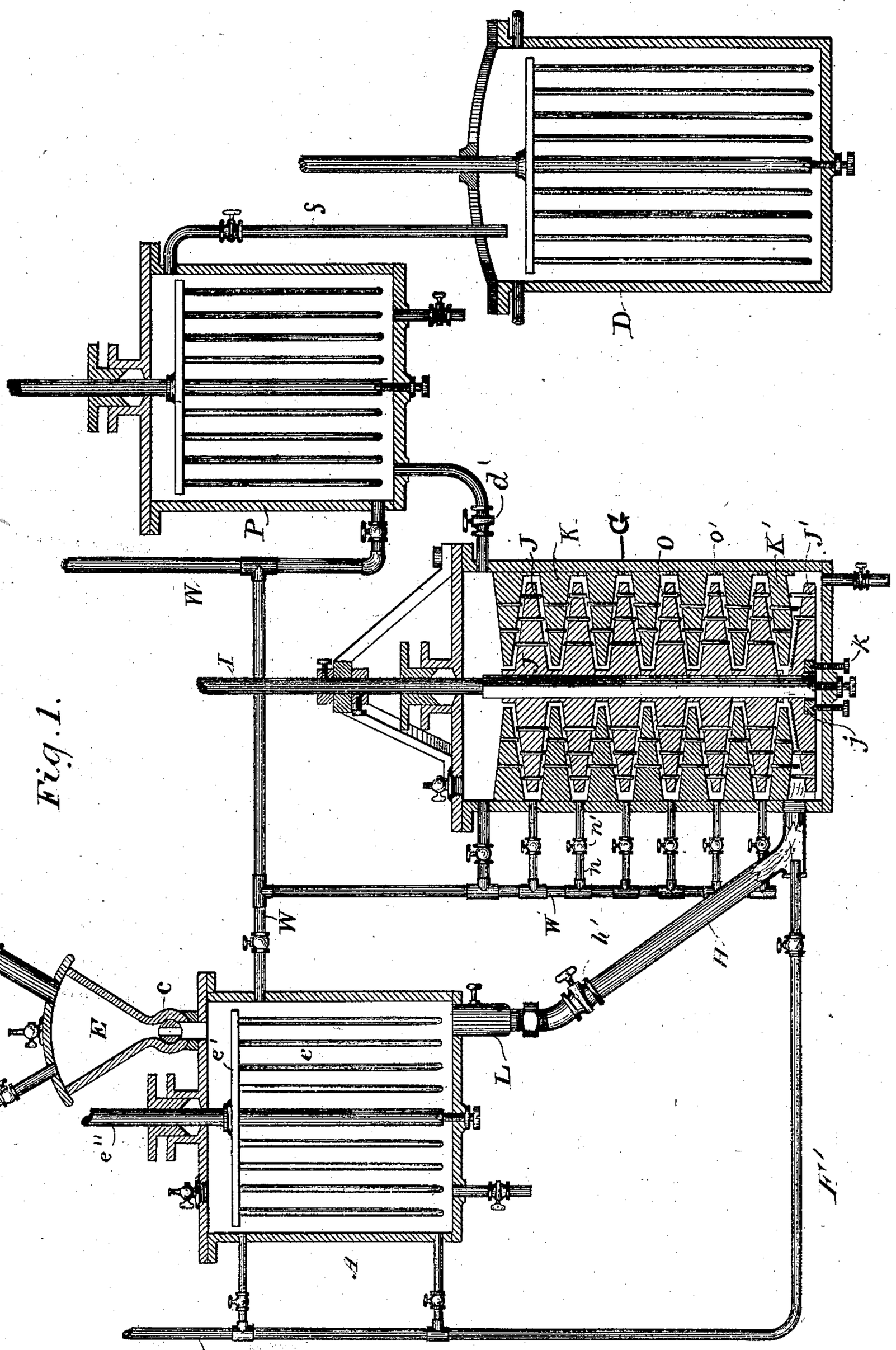

Fig. 1.

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(No Model.)

2 Sheets—Sheet 2.

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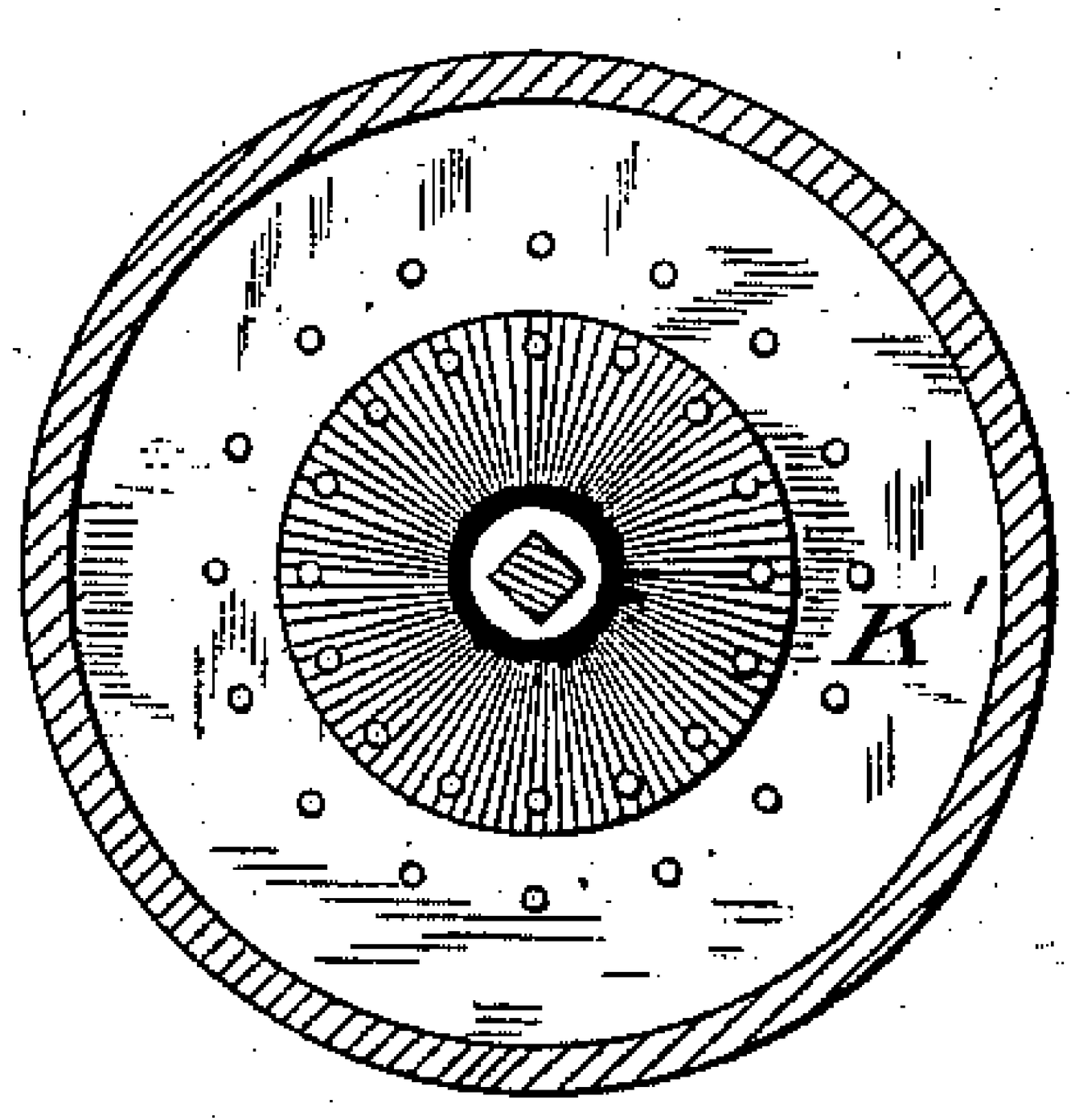
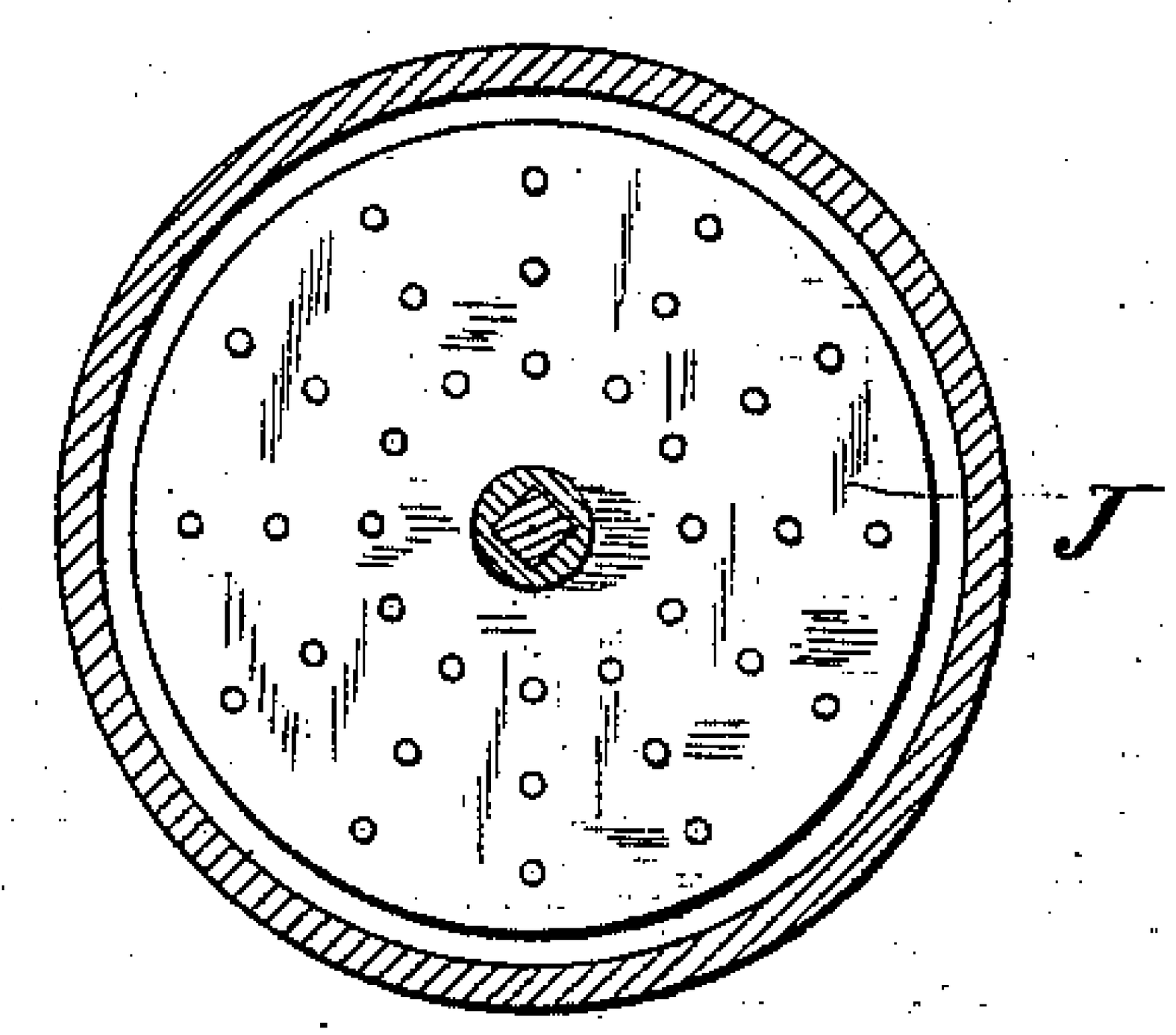
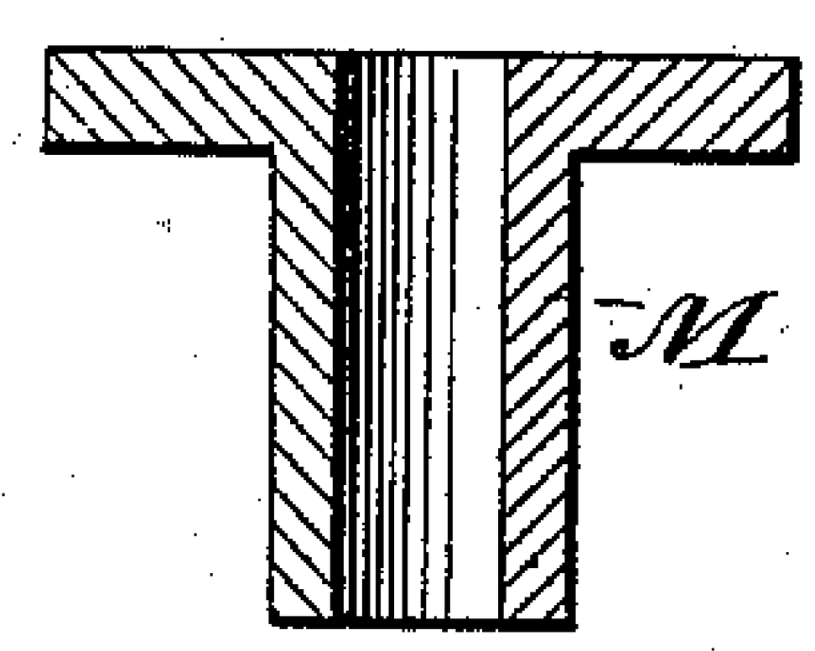
Fig, 3,



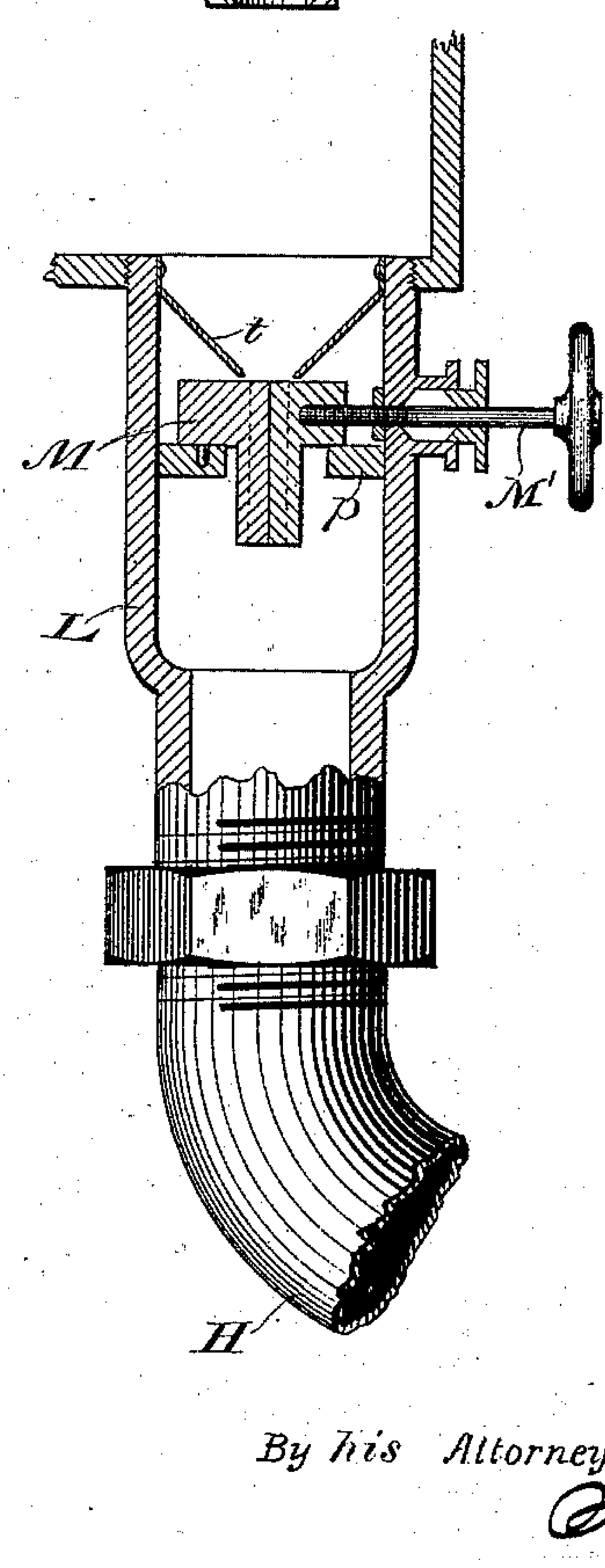
Fig, 4.



Fig, 5.



Fig, 2.



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UNITED STATES PATENT OFFICE.

HUGH M. THOMPSON, OF ST. LOUIS, MISSOURI.

AMALGAMATOR.

SPECIFICATION forming part of Letters Patent No. 282,131, dated July 31, 1883.

Application filed October 21, 1882. (No model.)

To all whom it may concern:

Be it known that I, HUGH M. THOMPSON, a citizen of the United States, residing at St. Louis city, in the State of Missouri, have invented certain new and useful Improvements in Amalgamators, of which the following is a specification, reference being had therein to the accompanying drawings.

The present invention relates to improvements in the amalgamators for amalgamating and separating the ores of precious metals, as described in Letters Patent No. 255,209, granted to me March 21, 1882, and also to certain novel features of construction and arrangement, as will be fully hereinafter described.

Figure 1 is a sectional side elevation of the several parts of my apparatus as arranged for use. Fig. 2 is a detail view of the adjustable feeding device. Fig. 3 is a view of one of the grinding-disks. Fig. 4 is a view of one of the mixing-disks; and Fig. 5 is a detail view, in section, of an undivided feeding-tube.

Similar letters denote like parts.

A represents a closed mixing-chamber, that is provided with rotating teeth or fingers *e*, a horizontal shaft or support, *e'*, and a vertical driving-shaft, *e''*, that is supported on suitable bearings, and provided with suitable driving pulleys or gearing. The chamber A is made of sufficient strength to allow superheated steam or any desired pressure to be injected into it from a suitable source of supply by way of pipe F and connections.

E is a charging-chamber and receiving-hopper of equal strength, and communicating with the chamber A through the cock C, which preferably has an expanding bore downwardly. The pulverized ore is fed into the charging-chamber through pipe F^2, from whence it will readily descend into the mixing-chamber, and be acted upon by the stirrers and the steam, air, or fluid that it is desired to mix therewith when the valve C is opened. The chambers E and A are provided with removable heads, and with ore, water, and steam supply pipes. By this arrangement, while a charge of ore is being operated upon in the mixing-chamber, the supply is accumulating in the hopper and ready to be quickly emptied into the said mixing-chamber, when desired, by simply opening valve C and closing the supply-pipe. An open hopper can be used, but it will require the pressure within the mixing-chamber to be reduced each time a fresh charge is inserted. The chamber G is a strong metallic cylinder also provided with removable heads, and it is located with its top disk about on a level with the bottom of the chamber A. The shaft I passes vertically through said chamber, and is supported, preferably, on an adjustable pivot at the bottom thereof. From said shaft extend the tapering disks J, which are formed thickest at their central part, where they are attached to the driving-shaft, gradually sloping from said shaft to their circumference. The disks J are rotated between an opposing series of stationary disks, K, which are also formed of metal and of opposite proportions to the rotating disks—*i. e.*, tapering or sloping from their circumference toward the center. I use one or more sets of these disks. They are separated by stud-pins or a suitable flange, *o'*, and are securely held from rotating in position by means of suitable grooves on their edges and key extending along the wall of the cylinder. Both sets of disks are provided with pins or projections O, that will pass between each other when the disks J are in motion and forcibly stir, mix, and agitate the contents of the chamber. In order to obtain and utilize the benefits to be derived from galvanic action, I cover one face of each disk with a coating of copper that may be applied in the form of a sheet or by electro deposition; or I omit the copper and connect the upper and lower of the disks to the positive and negative poles of a battery and pass a continuous current through the amalgamating-chamber and its contents; but the battery may be dispensed with when the action of the electric current is not found to be desirable. For the purpose of more thoroughly commingling the materials under treatment I construct the lower pair of disks, J' K', with roughened grinding-surfaces extending over a portion of their surface, the outer or remaining portion being provided with pins O, as are the rest of the disks. The disk K' is made somewhat thinner at its edge than the rest of the series in order to afford better entrance to the ore mixture to be treated. The disk J' is supported upon the collar *j*, which is

adjusted vertically by the set-screws *k*, the driving-shaft being square or provided with suitable key. The said disk may move vertically thereon without interfering with the remainder of the series that are fixed above it to the same shaft, I. All of the stationary disks have a central opening somewhat larger in diameter than the vertical shaft I, and the rotating disks are sufficiently smaller in diameter than the diameter of the chamber to allow the contents thereof to pass upward or downward over the edges of the rotating disks and between the stationary disks and the vertical driving-shaft, thus forming a continuous zigzag passage through the chamber, the two sets of disks being held a suitable distance apart by the stud-pins or flanges and their attachment to the vertical driving-shaft, which is attained by alternately placing the rotating and stationary disks on the said shaft, securing the rotating ones thereto in the desired positions, and then inserting the combined sets in the chamber and securing the stationary ones thereto by suitable keys or bolts, they being separated vertically by the pins or flange *o'*, as described.

The mixing and amalgamating chambers are connected by the pipe H, which leads from the bottom of the elevated chamber A to a point at or near the bottom of chamber G, between the lower pair of disks. The bore of this pipe may be enlarged toward its lower end, and thereby lessen the danger of choking; and it is preferably provided with suitable cut-off, *h'*.

L represents an adjustable feeding device for regulating the passage of the contents of the mixing-chamber to the amalgamating-chamber, and it is constructed of a short removable section of pipe, L, provided with the internal slotted bearing or shoulder, *p*, upon which rests the feeding-tube M, which may be of the size found best suited to the variety of ore being treated and the capacity of the amalgamating-chamber. In order to provide for variation of the feed-opening without removing the section L or any of the parts, I use a nipple or feeding-tube, M, that is divided longitudinally, and I secure one half thereof to its supporting-flange *p* by a suitable pin, and provide the other half with an internally-screw-threaded aperture, in which works the screw-stem M', which passes out through the pipe and suitable stuffing-box, and is provided with hand-wheel or key. By means of this screw-stem the portions of the feed-tube can at any time be quickly separated and any impediment readily dislodged, and, if desired, the size of the opening permanently enlarged. The chute or guide *t* serves to prevent the entrance of sand and grit behind the flange and bearings of the feed-tube. The undivided feeding-tube M, made with one or more small holes in it, may be inserted in the top of a plain pipe flush with the bottom of the mixing-chamber; but I prefer to use a short removable section, as described.

F' represents a continuation of the steam-pipe, and it enters the ore-pipe H near its lower end, and about opposite the grinding-disks it is provided with suitable cut-off, and is used to assist in forcing the ore mixture between the first pair of disks, should it be found necessary to do so.

P represents a washer, formed of a closed cylinder, which contains a vertical shaft and suitable stirring fingers or teeth. It is kept filled with water, and is connected to the top or upper portion of the amalgamating-chamber by the pipe *d'*, provided with suitable stop-cock. The discharge-pipe *f* leads from the top of the washing-chamber to a second washer or trap, D, that is also provided with stirring devices and suitable water-pipes, if desired.

The mixing, amalgamating, and closed washing chambers are supplied with water by the pipe W, from which the water under pressure can be conveyed to the interiors of the cylinders, when required. The amalgamating-chamber is further provided with the downward-extending water-pipe W', and the branches *n*, provided with suitable cocks, *n'*, which branches are arranged to deliver the water between the sets of disks, and also above the upper one of the series. The chambers may all be of the same size, and all except the second washer are to be provided with removable heads and suitable draw-cocks at their lowest and vent or escape pipes at their highest points.

The operation of my apparatus is as follows: The pulverized ore is fed into the hopper E, and from thence into the chamber A, under pressure or not, as desired. Water, steam, hot air, or any desired compounds are admitted, and by the motion of the stirring devices are mixed therewith. The ore mixture, by means of steam or other pressure exerted upon it in chamber A, is projected in jet form with great force through the feeding device or tube M into a large column of hot mercury in the connecting-pipe H, whence it passes to the lower pair of disks in the amalgamating-chamber G, before entering which, if necessary, the ore mixture receives additional propulsive force from the auxiliary steam-pipe F', which carries it between the disks J' K', by the action of which it is intimately commingled with the charge of mercury in the said chamber, and then compelled by its specific gravity and pressure exerted upon it to rise through the entire charge of mercury, which should about fill the chamber G, and be subject to continued agitation and rubbing during its immersion. As the sand, water, and impurities constituting the tailings rise to the top of the mercury in the amalgamating-chamber they are forced by the pressure of the succeeding charge, which may be assisted and re-enforced, if necessary, by a stream of water from the upper one of the branches *n*, up into the washer P, which has water flowing through it and is kept full of water, and the contents thereof being constantly agitated by the stirrer the sand and

dirt is carried off into the second washer, and from them away from the apparatus. As the contents of the amalgamating-chamber pass upward into the washer it frequently happens that some of the amalgam is carried up, and also that from the heat and friction of the disks some of the mercury becomes vaporized and rises with the tailings.

By placing my washer, as stated, above the amalgamating-chamber, the vaporized mercury is thus condensed, and the tailings being thinned with water any particles of amalgam are also intercepted and allowed to settle back into the amalgamating-chamber. The second washer, D, is provided so that in case of any accidental overflow of mercury it will not be wasted. The chamber A is also used in the process of desulphurizing the ore, which is effected by admitting superheated steam or air thereunto and above or below, or above and below, a charge of dry pulverized ore while in said chamber, the pressure of said steam or air serving to expel from said chamber the sulphurous vapor liberated by the heat so applied. Water or other fluid is then admitted, and the ore mixture is fed from said chamber to the lower end of the amalgamating-chamber.

The mercury used in the amalgamating-chamber can be fed with the ore through the hopper or poured directly into the chamber G through suitable inlet. Any desired materials may be mixed with the ore, whether hot or cold, wet or dry, by placing the same in the hopper E.

By arranging the mixing and washing chambers above the amalgamator backflow of the mercury is avoided, and the mixing-chamber kept free for use in desulphurizing, heating, and mixing, as stated.

Having described my invention I claim—

1. The amalgamating-cylinder and tapering alternating rotating and stationary disks, in combination with the mixing-chamber and stirring devices, the connecting-pipe H, the section L and feed-tube M, and the auxiliary steam-pipe F′, arranged to enter said pipe H near its discharging or lower end, suitable steam and water pipes, and an elevated receiving-washer, substantially as set forth.

2. The combination of the mixing-chamber A, provided with suitable stirring devices and supply and discharge pipes, the feeding-hopper E and suitably-perforated discharge-tube M, the amalgamating-chamber G, provided with the connecting-tube H and with alternating rotating and stationary disks J K, shaft I, water-pipes W and branches N′, discharge-pipe *d*′, the grinding-disks J′ K′ and a washing-chamber, P, located above the amalgamating devices, and the auxiliary steam-pipe F′, substantially as described.

3. In an amalgamator having alternating rotating and stationary disks, the disks J′ K′, formed with roughened grinding-surfaces extending over a portion of their coinciding faces, in combination with the collar *j*, suitable set-screws, *k*, the shaft I, and casing G, substantially as described, for vertically adjusting the lower of said disks, as set forth.

4. In combination with vertical driving-shaft and the inclosing-casing, the annular tapering disks J K, formed with projections O on their upper and lower faces, the disks J sloping from their centers to the outer edges, and the disks K sloping from their outer edges to their central annular openings, and adapted, when alternately arranged, to form a continuous sloping zigzag passage through the series, substantially as set forth.

5. The combination of the mixing-chamber provided with suitable mixing and stirring devices and steam and water inlet pipes, and the outlet-pipe H, provided with removable section L, and the adjustable feeding-tube, substantially as shown and described.

6. The feeding-tube M, in combination with the pipe H, removable section L, provided with bearing or shoulder *p*, the chute *t*, and chamber A, substantially as shown and described.

7. The combination of the amalgamating-cylinder provided with suitable grinding and stirring disks, the pipe H, and the mixing-chamber, with the steam-pipe F and the auxiliary steam-pipe F′, connected, as described, to the mixing-chamber and suitably connected to said connecting-pipe H at a point opposite the said grinding-disks, whereby additional impetus may be imparted to the material discharged or fed between said disks, substantially as and for the purpose specified.

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

HUGH M. THOMPSON.

Witnesses:

W. C. DUVALL,

FRANKLAND JANNUS.