No. 612,405. Patented Oct. 18, 1898.

D. R. DAVIS.

PULP SCREEN.

(Application filed Dec. 22. 1897.)

(No Model.) 3 Sheets—Sheet 1.

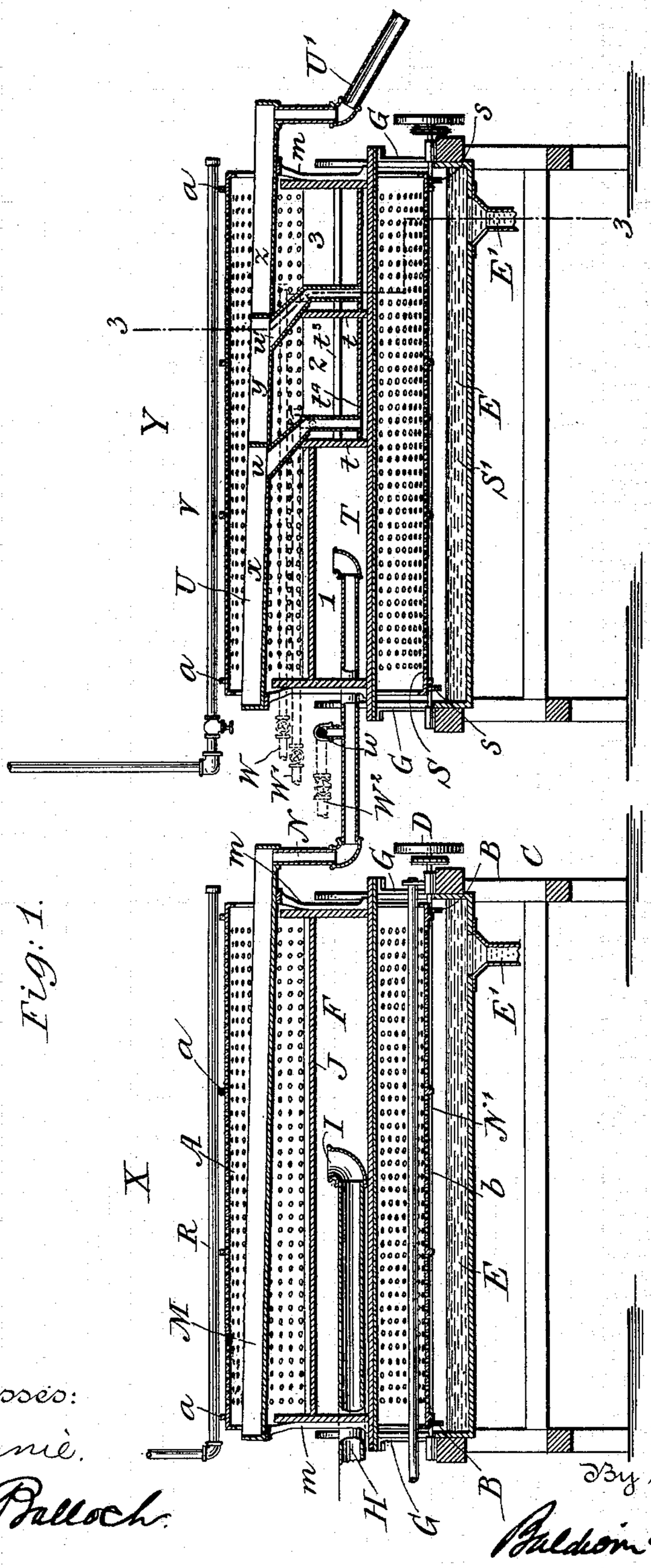

Fig. 1.

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Fig. 3.

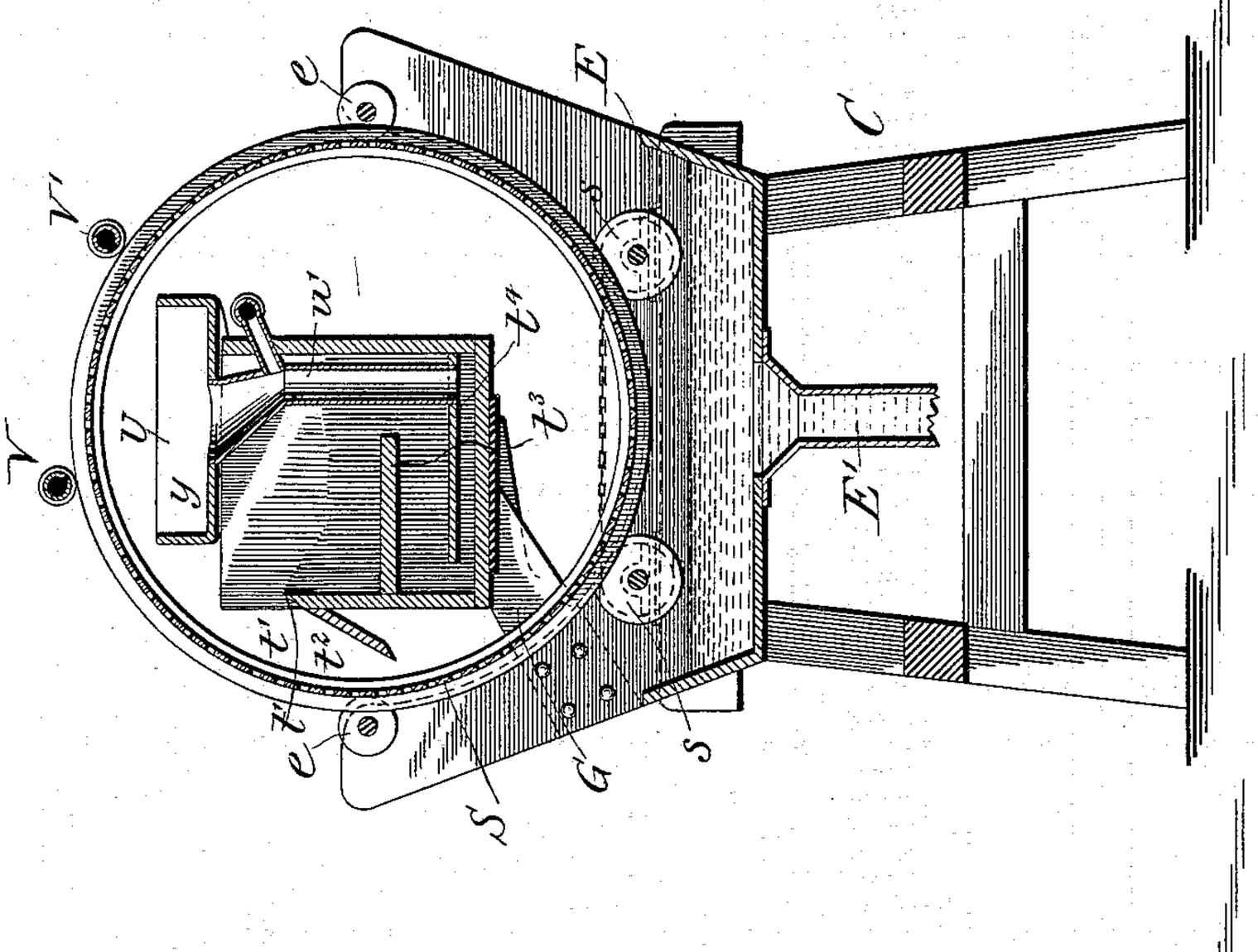
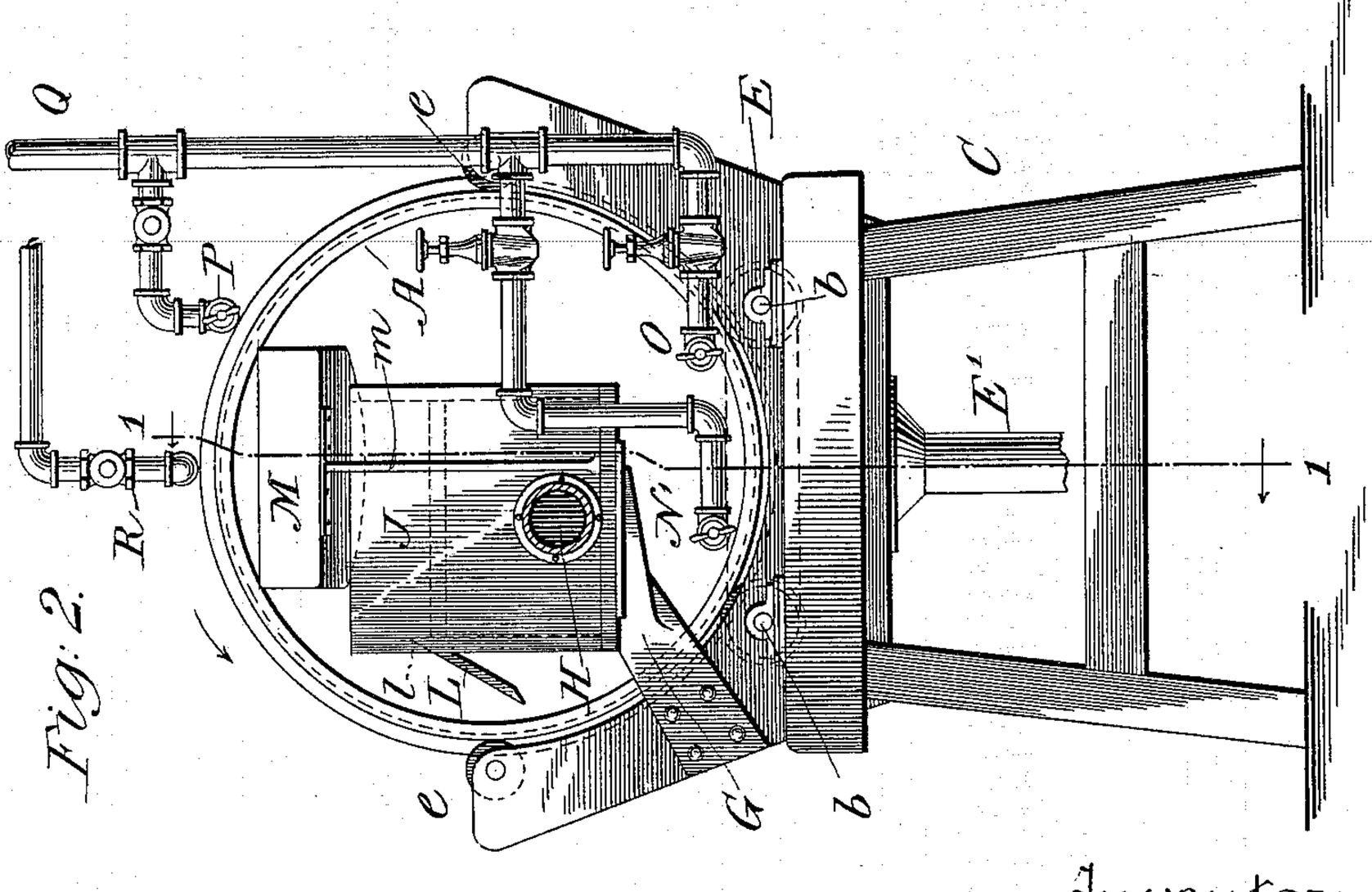


Fig. 2.



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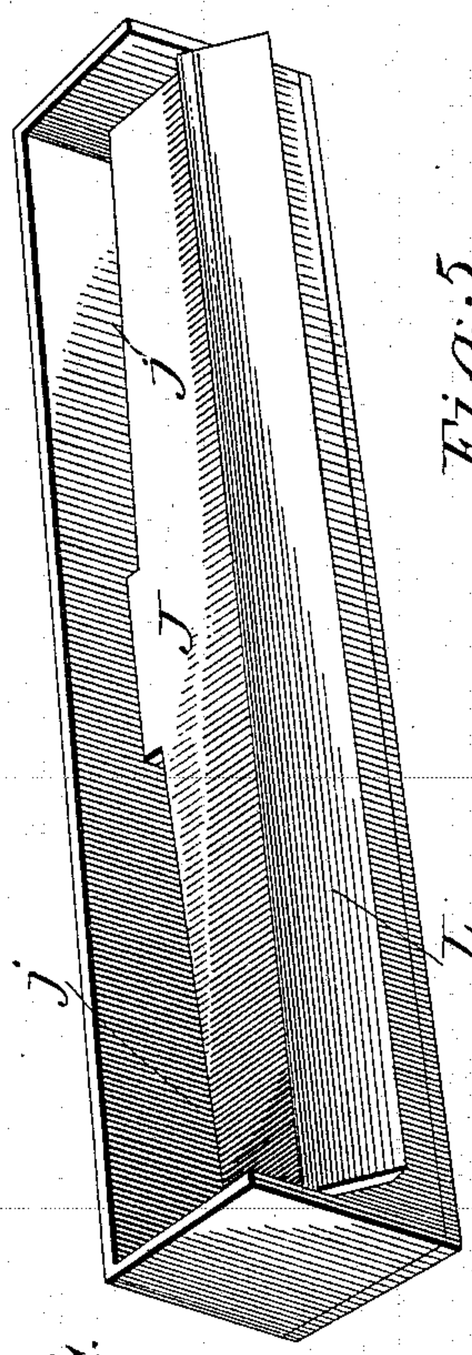

Fig. 4.

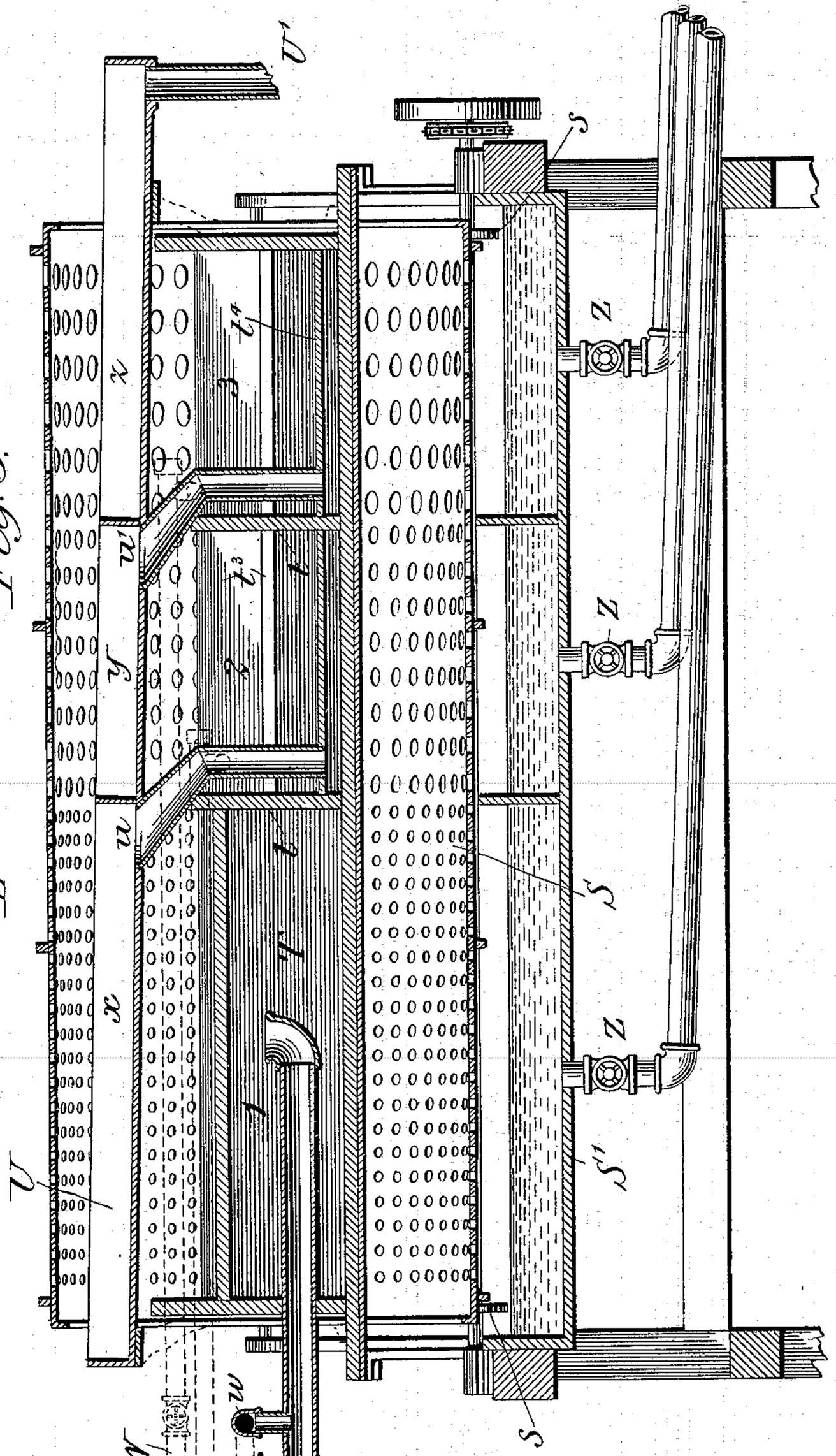

Fig. 5.

Witnesses:
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UNITED STATES PATENT OFFICE.

DAVID R. DAVIS, OF EAU CLAIRE, WISCONSIN.

PULP-SCREEN.

SPECIFICATION forming part of Letters Patent No. 612,405, dated October 18, 1898.

Application filed December 22, 1897. Serial No. 663,074. (No model.)

To all whom it may concern:

Be it known that I, DAVID R. DAVIS, a citizen of the United States, residing at Eau Claire, in the county of Eau Claire and State of Wisconsin, have invented certain new and useful Improvements in Pulp-Screens, of which the following is a specification.

The object of my invention is to separate by improved devices the fine fibers of paper-pulp from the coarse fibers or slivers thereof.

In carrying out my invention I provide an apparatus one portion of which is arranged to separate most of the fine particles from the coarser particles, while the other portion of the apparatus is arranged to separate from the coarser particles the small percentage of fine particles that are not separated in the first part of the apparatus. In constructing the first part of the apparatus I provide a rotary cylindrical screen and a flow-box from which the pulp to be screened is delivered and from which it passes to a distributer that feeds it to a revolving cylinder. The fine fibers or particles of the pulp pass through the meshes of the screen, while the coarser fibers and slivers are delivered to a carrying-off trough, or the fine particles may be made to pass through the screen into a carrying-off trough, while the coarser fibers are carried away in other ways. The flow-box is so arranged as to deliver the wet pulp to the screen in a comparatively thin sheet and the screen is arranged above the water-level in the receptacle below it. The flow-box and the carrying-off trough are arranged to extend throughout the entire length of the working surface of the cylinder, and the organization is such that the finer particles of pulp are made to pass through the cylinder without any longitudinal movement thereof, and the coarser particles are moved vertically and without longitudinal movement, separated from the finer particles, and delivered to devices which carry them away from the screen. In order to separate the coarser fibers or slivers from the cylinder, I employ a spray-pipe which causes jets of water to impinge against the cylinder, pass through the meshes thereof, separate the particles of pulp therefrom, and direct them into a receptacle provided for them and by which they are carried away. Ordinarily the fine particles or the greater portion of them will pass through the meshes of the screen as soon as they fall onto the surface of the cylinder, the water with which they are mixed being generally sufficient to wash them through the meshes; but in order to promote the screening and to wash through the screen any small particles that might adhere after the water that came from the flow-box has passed through the screen I preferably employ one or more spray-pipes which cause jets of water to flow over the screen and wash through it the remaining small particles that may be adhering. Generally speaking, the screen is self-screening, and a new clean surface is constantly being presented in front of the spillway of the flow-box to receive the wet pulp therefrom. Sometimes, however, especially when working with green wood, there is a gummy deposit upon the screen after it has been used for some time, and it is desirable to use some additional means for cleaning it. I therefore provide a perforated pipe running longitudinally of the cylinder and cause steam to pass through it and into the meshes of the screen, so as to cause the gummy matter and other clogging material to be separated. It is only necessary to clean the screen with steam occasionally—that is to say, after it has become clogged from continued use.

The portion of the apparatus above described is shown, described, and claimed in my application for patent, Serial No. 657,063, filed November 1, 1897. The unscreened material from the first part of the apparatus passes to the second part of the apparatus. This apparatus is similar in most respects to that just described, but is divided into sections, the arrangement being such that the material being treated is subjected to several separate washings. The material which enters the apparatus first passes into one section of the flow-box and is then delivered to the screen. The finer particles pass through the screen, while the coarser particles are raised and delivered to the first section of a carrying-off trough, from which they pass to the second section of the flow-box. From this section of the flow-box the material passes to the screen, the finer particles passing through the meshes thereof, while the coarser particles are raised and delivered to the second

section of the trough. This material is then delivered to the third section of the flow-box, and the operation continues as before. The size of the meshes in the screen may be graduated, and the receptacle which receives the strained material may, if preferred, be divided into sections and provided with separate carrying-off pipes. This apparatus may be used in connection with the first apparatus described, or it may be used separately and the entire operation of screening performed in it.

The details of construction will be hereinafter more fully described; but I wish it understood that my invention is not confined to the details of construction shown in the drawings and hereinafter specified, but, irrespective of these details, consists particularly in providing an unsubmerged screen to which the wet pulp to be strained is fed from the flow-box, which delivers the wet pulp in a thin sheet from end to end of the working surface of the cylinder, or practically so, and in providing means practically coextensive with the flow-box for carrying off the material that does not pass through the screen.

In the accompanying drawings, Figure 1 is a longitudinal central section through an apparatus embodying my improvements on the line 1 1 of Fig. 2. Fig. 2 is an end view of the first screening apparatus. Fig. 3 shows a transverse section through the second part of the apparatus on the line 3 3 of Fig. 1. Fig. 4 is a perspective view of one of the flow-boxes employed. Fig. 5 shows a longitudinal central section of the second part of the apparatus with some of the parts modified.

In Fig. 1 I have shown two pulp-screens X and Y, differing somewhat in details of construction, but connected together to operate simultaneously. The cylinder A of the apparatus X is composed mostly of perforated sheet metal in cylindrical form, with suitable frames or flanges at the ends to stiffen it. It is, however, without spokes, and it is open at each end. The cylinder rests on small carrying-wheels B, mounted in suitable bearings on a supporting-frame C. The shafts *b* of the rollers may extend from end to end of the cylinder, and one of the shafts carries a pulley D, to which power may be applied. By suitable gearings both shafts may be driven from this pulley. In this way the cylinder may be made to revolve in the direction indicated by the arrow in Fig. 1. In order to stiffen or strengthen the cylinder, annular ribs *a* may be formed on or secured to it at proper intervals, as indicated in Fig. 4. The cylinder is arranged over a receptacle E, adapted to receive the water which passes through the screen and also the fine particles of pulp that are carried through by the water. This receptacle has end pieces extending up along the side of the cylinder and carrying rollers *e*, which bear against the end flanges *a* and prevent endwise movement of the cylinder and also lateral movement thereof. As will be seen by a close inspection of Figs. 1 and 4, the bottom of the cylinder is arranged above the top of the trough or receptacle E and is therefore unsubmerged, being above the water-level in the receptacle.

The flow-box F extends, preferably, from one end of the cylinder to the other. It is preferably arranged inside the cylinder, and, as shown in the drawings, it is supported on brackets G, secured to the receptacle or box E outside of the edges of the cylinder. A delivery-pipe H passes through one end of the flow-box and extends to near the middle thereof, where it is provided with an elbow I, that delivers upwardly. A partition J, arranged below the upper edge of the flow-box and above the elbow I, holds down the pulp as it is delivered, but permits it to flow through openings *j*. (Shown clearly in Fig. 3.) The wet pulp passes over onto the top of the partition J and then out over the edge of the flow-box and falls onto a distributer or spreader L, that delivers to the cylinder A.

A carrying-off trough M is arranged in the upper part of the cylinder above the flow-box and is supported on brackets *m*, as indicated in Fig. 1. The trough is inclined, is imperforate, and is provided with a delivery-pipe N at its lower end. The apparatus, as shown in the drawings, is equipped with three water-spray pipes N′, O, and P, the pipes N′ and O being arranged inside the cylinder and the pipe P outside thereof. Water is supplied to all of these pipes through the service-pipe Q, and branch pipes lead from the pipe Q to the spray-pipes, which latter preferably extend from end to end of the cylinder. The pipes may be equipped with suitable valves to regulate the supply. I preferably also employ a steam-pipe R, extending from end to end of the cylinder, and it is perforated to permit steam to impinge upon the cylinder and to force through it any material that may be lodged in the meshes thereof. This pipe is only occasionally used to clean the screen when clogged with gummy matter, &c., after constant use.

I do not wish to be confined to the precise manner of mounting the cylinder or of arranging the flow-box and carrying-off trough. For convenience, as well as for obtaining the best results, the flow-box is arranged inside the cylinder and the carrying-off trough is arranged above the flow-box within the cylinder. The water that flows out from the flow-box is usually sufficient to wash the fine material through the screen, and therefore it is not always necessary to employ spray-pipes for supplying additional quantities of water for this purpose. The water supplied by the spray-pipes N′ and O should be in small quantities and should not act to force the material through the meshes of the screen, but merely act to gently wash the fine material adhering between the meshes of the screen into and through the meshes thereof without tending to force the larger particles or slivers there-

through. It is not essential that a steam-pipe should be used to clean the cylinder, as the cylinder is largely self-cleaning; but it is sometimes desirable to employ such an additional cleaning device, and I find it advantageous to use it in order to obtain the best results.

The operation of the apparatus is very simple. Briefly stated, it is as follows: The pulp is brought in by the pipe H and delivered by the elbow I to the flow-box. It then rises through openings *j* and flows over the partition J and then over the edge of the spillway *l* and falls onto the distributer or spreader L, which delivers it into the interior of the cylinder while it is revolving in the direction indicated by the arrow. The fine fibers of the pulp pass through the perforations in the cylinder with the water, and the slivers and coarse pulp stay in the cylinder, adhere to the inner surface thereof, and are carried by it around past the pipes N′ and O up to the trough M. As before stated, it is not essential that the pipes N′ and O should be used, inasmuch as the water that passes out of the flow-box is usually sufficient to carry all the fine particles through the screen, and this occurs within a small area just at the side of or below the flow-box; but the pipes N′ and O may be employed, if found necessary, to obtain the best results and insure perfect work. There is no liquid standing in the cylinder at any time, the liquid-level being below the bottom of the cylinder, and the coarse particles and slivers which adhere to the interior of the cylinder are comparatively dry or only moist. When they reach the trough M, jets of water from the spray-pipe P impinge against them and drive them into the trough, a sufficient quantity of water being derived from the jets to flow the material down the trough to its destination.

A machine constructed like that just described has been found to separate approximately ninety-five per cent. of all the fine particles of pulp from the wet pulp delivered from the flow-box. This fine pulp, which is received into the receptacle E, is carried off from it by any suitable passage E′ and is preferably treated in a "diaphragm-screen," by which small particles of sawdust and the like may be separated. The other five per cent. of material which passes into the trough M flows therefrom through the pipe N into the apparatus Y, which is constructed on somewhat the same principle as the apparatus X, but differs therefrom in details of construction. This apparatus comprises a perforated cylinder S like the cylinder A, mounted on rollers *s*, which are revolved in suitable ways to rotate the cylinder, and a receptacle S′ is arranged below the cylinder to receive the water and strained material therefrom. The flow-box T in this apparatus is divided into three sections 1, 2, and 3 by transverse partitions *t*. It extends from end to end of the working surface of the cylinder and is provided with a spillway *t′* and a distributing-board or spreader t^2. A partition t^3 is arranged horizontally in the flow-box to quiet the liquid before its delivery over the spillway. Above the flow-box in this apparatus is arranged a carrying-off trough U, which is also divided into sections *x y z* and is inclined from the front or entrance end of the cylinder to the opposite end thereof. At its lower end it is provided with a discharge-pipe U′, which may lead to the river or any other place to receive the waste material.

The pipe N delivers to the section 1 of the flow-box, below the horizontal partition therein, and the section 1 of the flow-box has no communication with the sections 2 or 3 thereof. The section *x* of the trough U, however, is connected with the section 2 of the flow-box by means of a pipe *u*, and the section *y* of the trough is connected with the section 3 of the flow-box by a pipe *u′*. Preferably this pipe extends below the horizontal section t^3 and through a lower horizontal partition t^4. The number of horizontal partitions used, however, is not of very great importance, so long as the arrangement is such as to prevent the liquid from violent agitation or "boiling," it being desirable that the liquid should be quiet at the top of the flow-box and flow gently and uniformly over the spillway down across the delivery-board into the cylinder. The liquid that passes from the pipe N falls over the spillway of the section 1 of the flow-box and over the delivery-board onto the inner surface of the cylinder, and all of the water and most of the fine material pass through the meshes of the screen into the receptacle S′ below the screen. The coarser material adheres to the inner surface of the cylinder and is carried vertically thereby up over the section *x* of the trough U. When it reaches this point, it is detached and driven into the section *x* of the trough by means of water-jets from the pipes V V′, which are under considerable pressure and act to thoroughly separate the material before it passes by the trough. The spray-pipes from which the jets are delivered extend, preferably, from end to end of the cylinder. The coarser material received by the section *x* of the trough flows through the pipe *u* into section 2 of the flow-box. Thence it falls over the spillway of section 2 onto the interior of the screen, and the water and finer particles pass through the screen, while the coarser particles adhere to the interior of the cylinder and are carried thereby up to the section *y* of the trough U. The water-jets V V′ then act upon this material and drive it into the section Y of the trough. This material then passes through the pipe or passage *u′* into the section 3 of the flow-box, whence it passes out over the spillway onto the cylinder, the fine particles passing through the meshes thereof into the receptacle S′, while the coarser particles are delivered to the section *z* of the trough and pass out through the waste-pipe

U′. The advantage of treating the material in this way is that it is subjected to several separate washings, and thus the fine material, such as is suitable for being worked up into paper, is completely separated from the worthless material. As before stated, the apparatus X separates approximately ninety-five per cent. of the fine material. The apparatus Y only operates upon five per cent. of the material and separates from this five per cent. nearly all of the material that can be used, that going to waste containing a trifling amount of good stuff.

The water that passes into the section 1 of the flow-box through the pipe N is usually sufficient to flow the material therefrom and to pass the fine material through the screen, and the water that is supplied by the pipes V′ is usually sufficient to flow the material out from the section 2 of the flow-box. Should an additional amount of water be required, it may be supplied by separate pipes. In the drawings I have shown supply-pipes suitable for this purpose. As there indicated, pipes W W′ W² extend longitudinally alongside of the flow-box and are provided with branch pipes *w*, communicating with the pipe N and with the spouts *u* and *u′* to supply the water thereto. These pipes may be controlled separately by proper valve mechanism.

In Fig. 1 I have shown a common receptacle for all the material passing through the screen S, the meshes of the cylinder being uniform throughout. In Fig. 5 I have shown the cylinder formed with graduated meshes, those at the entrance end being finer than those at the exit end and those between the two ends being of medium size. The receptacle below the cylinder is in this instance divided into sections, as indicated, and a separate discharge-pipe Z is employed for each receptacle. In this way pulp of different grades may be obtained for use in different qualities of paper. This is sometimes desirable where it is important that the pulp should be of a specified fineness for a particular kind of paper.

While the different forms of apparatus which I have described differ somewhat in details of construction, they are all constructed on the same general principle and embody the broad features of my invention. In each instance, it will be observed, the flow-box delivers from end to end of the working surface of the cylinder, the cylinder is arranged above the level of the liquid which passes through it, and the carrying-off trough is approximately equal in length to the flow-box which corresponds with it.

If the cylinder were arranged above the level of the liquid which passes through it and the liquid pulp were fed in at the end of the cylinder, the water would immediately pass through the meshes of the cylinder and leave the pulp in a thick mass on the surface thereof. On the other hand, if the cylinder were arranged below the liquid-level a large surface of the cylinder would be kept constantly clogged and the cylinder would have to work through the liquid, a constant agitation of the liquid being necessary in order to keep the meshes of the screen open; but by having the cylinder arranged above the liquid-level, supplying the liquid thereto in thin sheets along its entire length, these objections are obviated, the cylinder is constantly kept clean, and the operation of screening is both rapid and efficient.

My machine is so constructed that it can be operated at high speed. The material delivered from the flow-box is immediately screened, the water and fine particles passing through immediately, while the coarser particles are carried only part way around with the cylinder without longitudinal movement and are separated before the cylinder has completed a revolution. Therefore clean portions of the screen are constantly being presented to the flow-box, and the operation of screening can be very rapidly performed.

In Fig. 1 I have shown two machines connected together to perform the operation of screening the pulp; but it will be observed that section 1 of the flow-box in apparatus Y is similar in construction to the flow-box in apparatus X. Good results can be obtained by dispensing with the apparatus X and feeding directly to the apparatus Y, or an apparatus similar to the apparatus Y, but on a larger scale, can obviously be constructed to perform the functions of the two machines.

I claim as my invention—

1. The combination of a rotary screen, a flow-box divided into sections and delivering liquid pulp to the screen, a carrying-off trough also divided into sections, pipes or passages connecting sections of the trough with sections of the flow-box, and means for supplying water to separate particles of pulp from the screen and force it into the several sections of the carrying-off trough.

2. The combination of the rotary screen, a flow-box located within the screen and divided into sections, a carrying-off trough also located within the screen and divided into sections, pipes or passages connecting sections of the carrying-off trough with sections of the flow-box, and a water-supply pipe outside the screen for forcing water through the screen and causing particles of pulp thereon to be driven into the carrying-off trough.

3. The combination of a rotary screen, a flow-box divided into sections and delivering liquid pulp to the screen, a carrying-off trough also divided into sections, pipes or passages connecting sections of the carrying-off trough with sections of the flow-box, and a receptacle below the screen divided into sections and provided with separate discharge-pipes.

4. An apparatus for screening pulp, comprising a rotatable screen, a flow-box extending approximately along the entire working surface of the screen and delivering liquid pulp thereto, a receptacle below the screen

provided with means for keeping the liquid-level thereof below the screen, a trough extending approximately along the entire working surface of the screen for collecting the unscreened material and delivering it, another rotary screen, a flow-box therein divided into sections and delivering liquid pulp to the screen, a pipe connecting the aforesaid trough with said last-mentioned flow-box, a carrying-off trough divided into sections, pipes or passages connecting sections of said trough with sections of the aforesaid divided flow-box, and means for supplying water to the said last-mentioned screen to separate the particles of pulp therefrom and force them into the several sections of the carrying-off trough.

In testimony whereof I have hereunto subscribed my name.

DAVID R. DAVIS.

Witnesses:
LLOYD B. WIGHT,
E. A. BALLOCH.