J. OLSEN.

PULP SCREEN.

APPLICATION FILED NOV. 19, 1906.

1,022,750.

Patented Apr. 9, 1912.

5 SHEETS—SHEET 1.

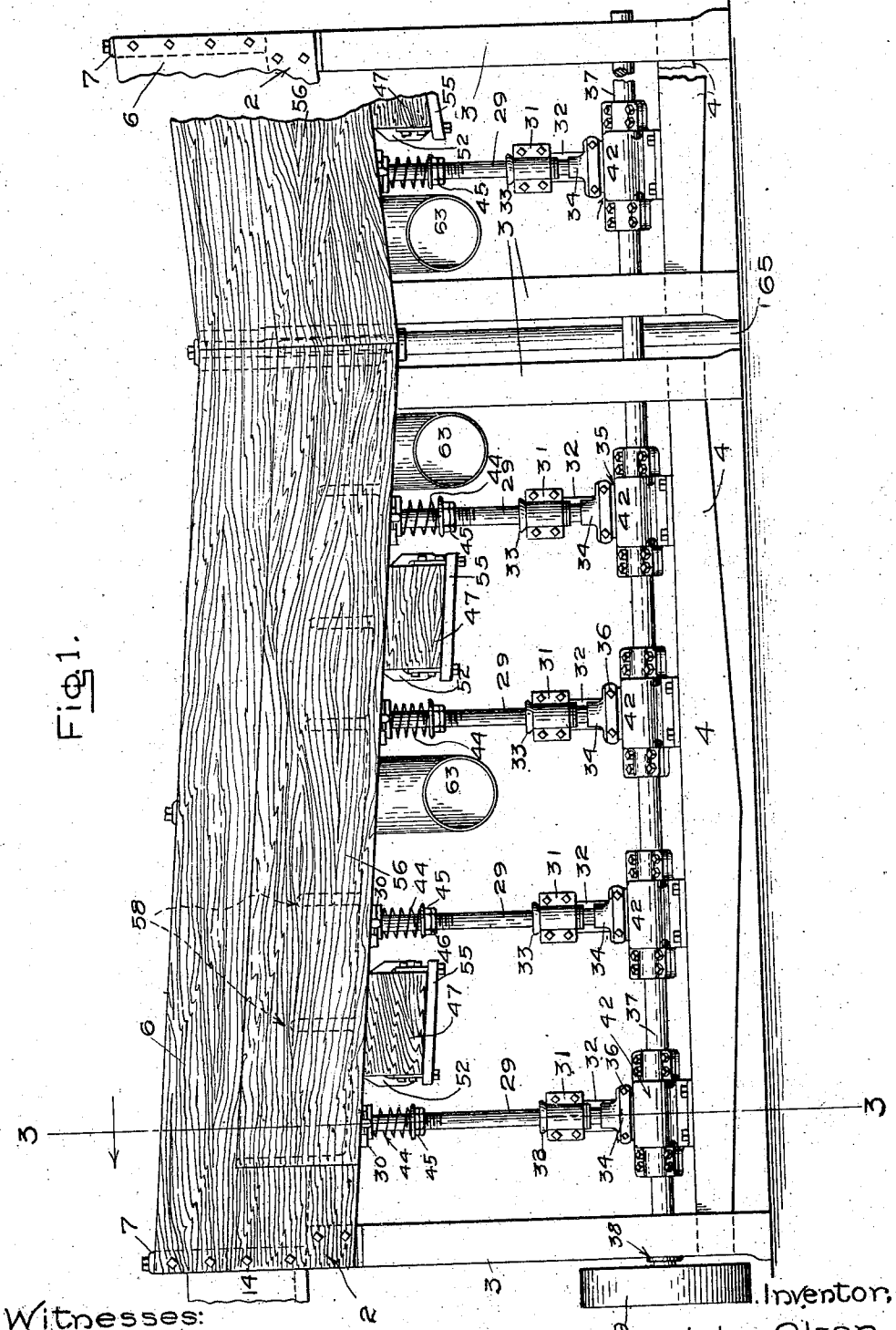

Fig. 1.

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5 SHEETS—SHEET 2.

Fig. 3.

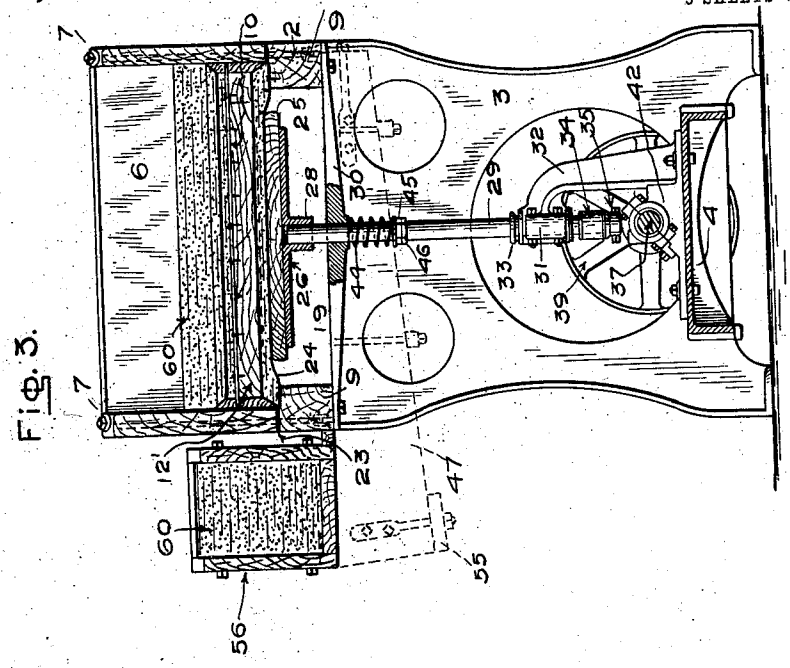
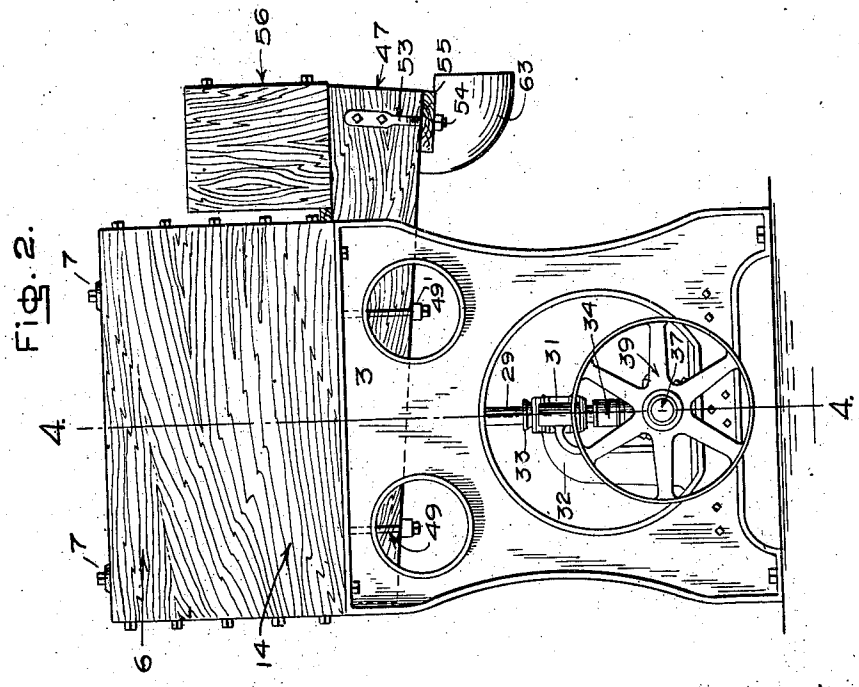


Fig. 2.



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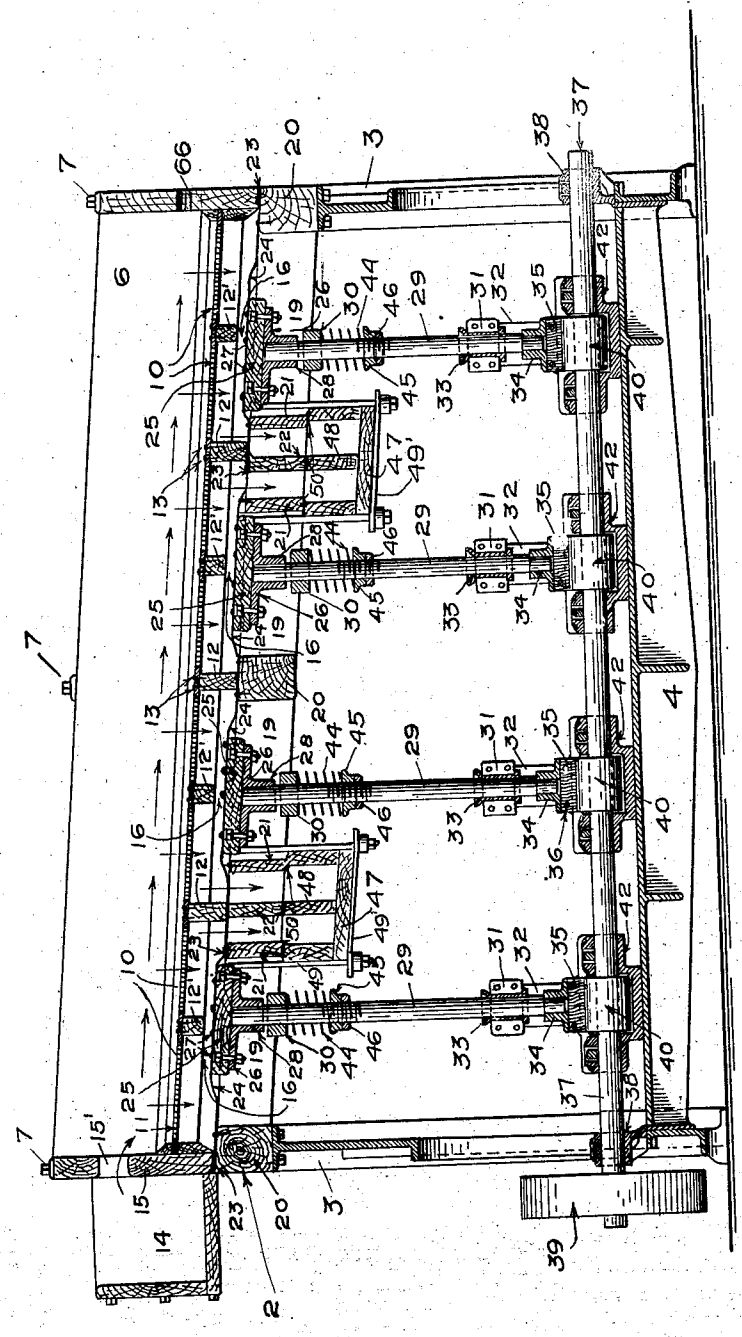
5 SHEETS—SHEET 3.

Fig. 4.



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1,022,750.

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5 SHEETS—SHEET 4.

Fig. 5.

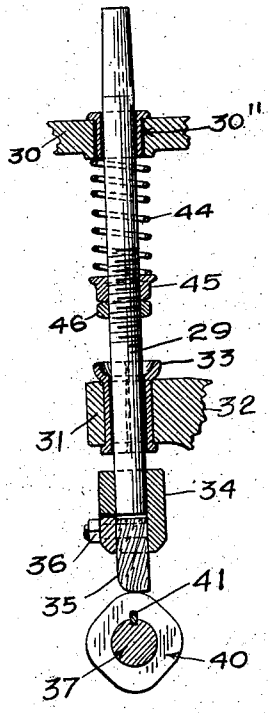


Fig. 6.

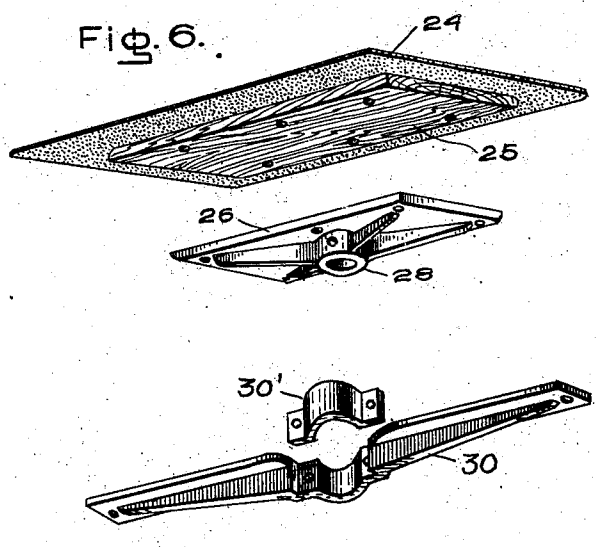


Fig. 7.

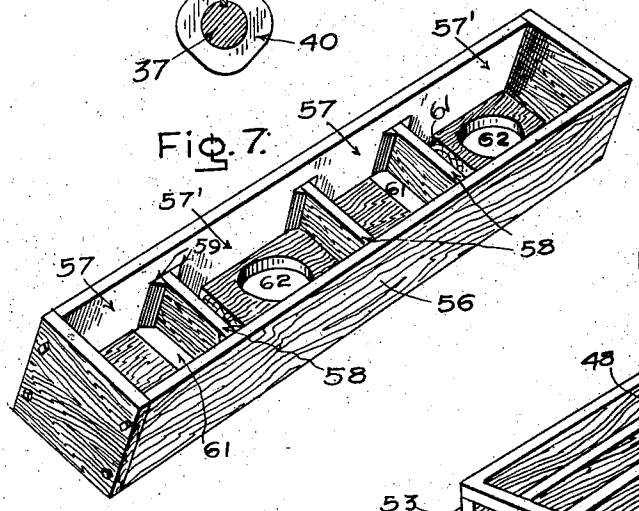
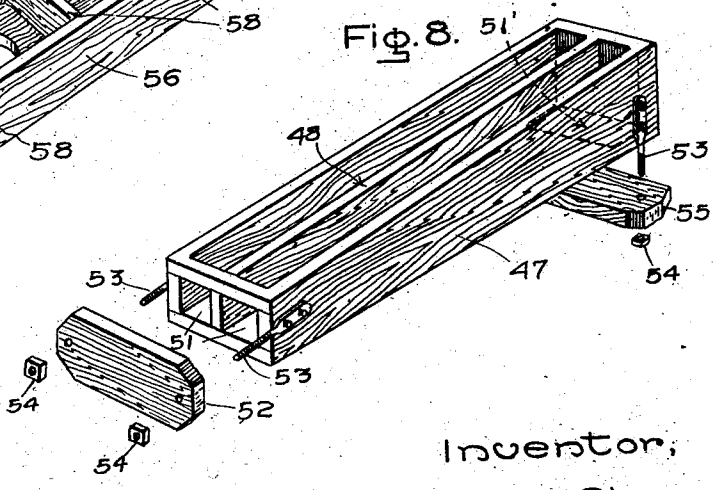


Fig. 8.



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5 SHEETS—SHEET 5.

Fig. 9.

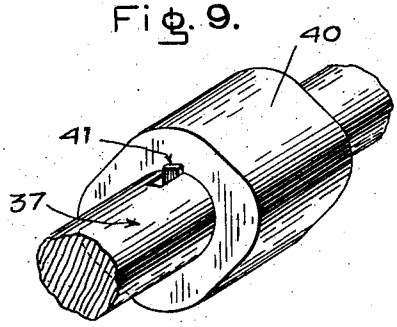


Fig. 10.

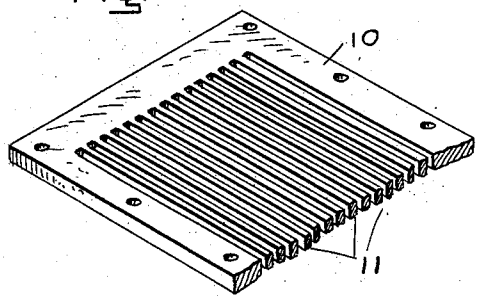


Fig. 11.

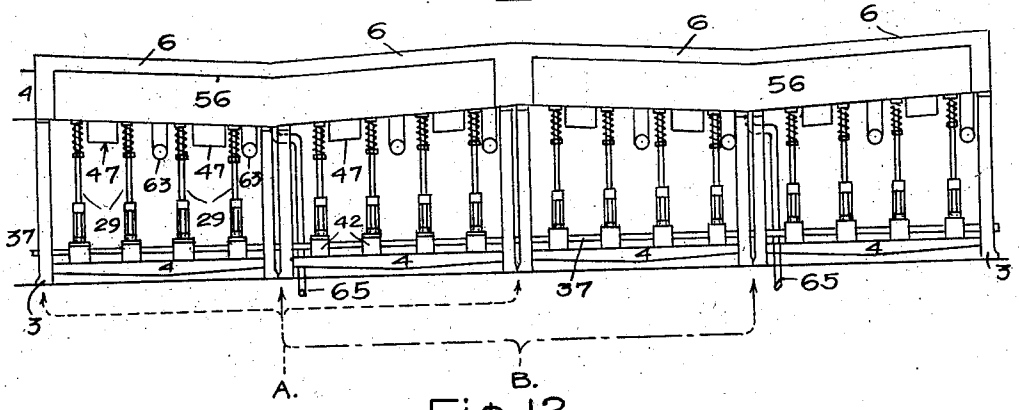
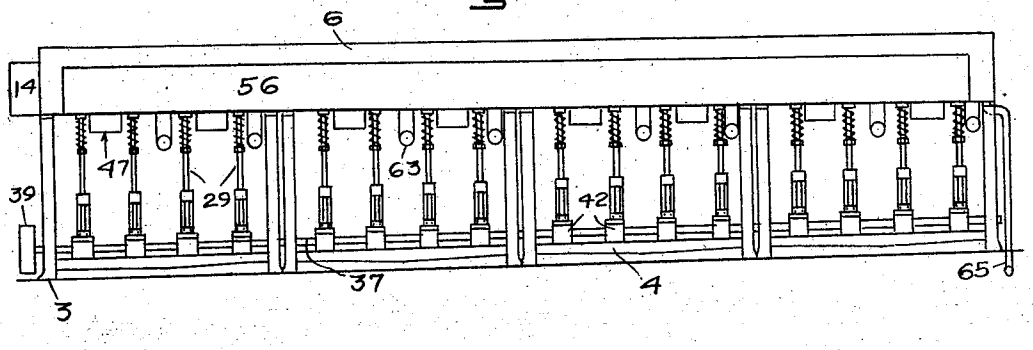


Fig. 12.



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UNITED STATES PATENT OFFICE.

JOHN OLSEN, OF WATERTOWN, NEW YORK.

PULP-SCREEN.

1,022,750. Specification of Letters Patent. Patented Apr. 9, 1912.

Application filed November 19, 1906. Serial No. 343,999.

To all whom it may concern:

Be it known that I, JOHN OLSEN, a citizen of the United States, residing at Watertown, in the county of Jefferson and State of New York, have invented certain new and useful Improvements in Pulp-Screens, of which the following is a specification.

This invention relates to improvements in screens, designed for use in connection with the manufacture of pulp, fiber and similar materials employed in making paper and paper products.

The invention relates particularly to improvements in the class of devices described and shown in United States Patents granted to one Darwin B. Gotham, numbered 511,771 and 530,586, dated respectively January 2 and December 11, 1894.

The object of my invention is to provide a machine for screening or straining pulp or fiber of various kinds, which is simple, strong and effective, and wherein provision is made for increasing the flow of the mass of unscreened material over the screen plates, thereby effecting the proper screening of a greater amount of pulp in a given time, than other machines of the class are capable of handling.

A further object is to provide simple means for preventing the coarse pulp and extraneous matter, such as dirt and grit, from accumulating upon and clogging the screen plates, and a further object is to provide for the discharging and carrying away of said matter without hindering or delaying the work, or straining or otherwise injuring the plates.

An important feature of the invention consists in providing a series of stationary screen-vats which are mounted upon a solid and heavy frame, and combining them into a single machine equipped with means for delivering the unscreened material to each vat separately, the said vats being provided with suitable screen plates, and built and combined in such manner that they incline longitudinally in opposite directions, the degree of inclination of each vat being sufficient to effect a rapid and continuous flow of the unscreened material over the screen plates, thereby making it practicable to construct pulp screening machines of greater lengths, and facilitating the rapid and effective handling of a larger amount of pulp material, than is possible by the use of the well-known horizontal types of machines.

A further feature of the invention consists in disposing the inclined sections or vats in such manner that when two of them are joined together, either the two high or elevated ends, or the two low ends of said vats abut and are rigidly attached. In the first instance, the screen plates incline downwardly in opposite directions away from the abutting point or middle of the machine, and in the second instance, the screen plates incline toward and terminate near the middle of the machine at the point where the vats are joined. In either case, the unscreened material is delivered to the vats and deposited on the screen plates of the several sections at the point of highest elevation, and thence flows down the inclines. The greater portion of the pulp and the water mixed with it is drawn through the perforations or slots in the screen plates, by the process of screening employed, and the coarse portion of the material which is not sucked or drawn through the plates gravitates to and is discharged from the lowest point of the vats, instead of being allowed to accumulate on the plates and requiring removal by hand or otherwise.

Other features and parts of the invention will be more readily understood from the detail description which follows, and by reference to the accompanying drawings which form a part of this specification, and in which—

Figure 1 is a side elevation of my pulp screen, with a portion of one of the inclined sections broken away. Fig. 2 is an end elevation of the machine. Fig. 3 is a vertical cross-section, substantially on the line 3—3 of Fig. 1, showing the position of the working and flow parts. Fig. 4 is a vertical longitudinal section of one of the inclined parts of the machine, substantially on the line 4—4 of Fig. 2, showing feed-box, inclined screen-vat, suction chambers and divided flow-spouts; also showing the vibratory diaphragms and other working parts. Fig. 5 is an enlarged detail view, showing the plunger rod and related parts, also showing the cam which operates the same. Fig. 6 is a multiple perspective view, showing the principal parts of the diaphragm, also showing the parts of the bridge-tree. Fig. 7 is a perspective view of one of the flow-boxes. Fig. 8 is a perspective view, showing the flow-spout, also showing the detachable parts and the manner of connecting them to

the spouts. Fig. 9 is a perspective view, showing the cam which operates the plunger rods and a portion of the driving shaft. Fig. 10 is a perspective view, showing a portion of the slotted screen plate. Fig. 11 is a side elevation, showing a modified form of pulp screen, having four sections joined together. Fig. 12 is a side elevation, showing another modified pulp screen, having all of the sections inclined in the same direction.

Similar characters of reference are assigned to corresponding parts throughout the several figures.

In the drawings, 2 represents a frame, commonly known as the bellows-frame, of a pulp screen, which is provided at its opposite ends and at its middle with standards 3, 3. The frame is built on an incline and is preferably made of any suitable kind of hard wood, but it may be made of a non-rusting metal. The standards are preferably made of cast metal or pressed steel and should be heavy and strong. The standards 3 are tied together longitudinally by channel girders 4, 4, bolts being used for fastening the same.

6 represents a screen-vat, or a series of screen-vats mounted upon frame 2, and secured thereto by a series of bolts 7. These bolts pass downwardly through the wooden walls of the vats and engage nuts 9 embedded in the timbers of the bellows-frame. This mode of securing the vats to the frame is employed to facilitate the detaching of the vats, whenever such action becomes necessary for repairing or cleaning the machine.

10 represents a screen plate, or preferably a series of screen plates disposed so as to form a bottom or floor in the vats 6. These plates are usually narrow sheets of brass or other non-rusting or non-corroding metal, having a large number of narrow evenly spaced slots or openings 11, which are arranged so that they practically cover the entire exposed portion of the plates, through which pulp of various kinds and grades is drawn, or strained, for the purpose of producing stock of even consistency for making paper and like products. Screen plates 10 are preferably disposed crosswise in the vats, and are mounted upon a series of cross-bars or girts 12 and 12′, and screws 13 are employed to secure the plates to the bars. The said bars are rigidly secured to the side timbers of the vats by mortising, or by bolts. The slots in the screen plates are made large or small according to the kind and quality of paper it is desired to make from the screened stock.

The vats of my improved pulp screen are preferably constructed of wood, and are built and disposed so that each vat, as well as the screen plates carried by it incline in one direction or another, as shown in the drawings, and where but two of the vats are joined together to form a complete machine, they are preferably arranged with their low ends abutting, as illustrated in Fig. 1, and by the dotted lines A in Fig. 11. The vats may, however, be so arranged that when only two are joined together, the high ends thereof are brought together, as shown by the dotted lines B in Fig. 11. In either case the pulp is intended to be delivered to the vats at the high or elevated ends, and in order to provide for a steady and even flow of the liquid material upon and over the screen plates, a feed box 14 is disposed across the full width of the high end of each vat. The liquid mass of unscreened material is supplied to the feed boxes by any suitable means, as by pumping or by gravity flow. The inner side or wall 15 of the feed box is formed by cutting a slot 15′ in the end of the vat, and the top is lower than the other side and the ends, so that the unscreened material flows over it as over a dam. At the low ends, the several vats are preferably inclosed by separate end pieces (see dotted lines Fig. 1), which permit of the removal of one vat for repairs or cleaning without disturbing or distorting the neighboring vats. As far as the screening of the pulp is concerned, however, one end piece may be employed to separate two vats with the same results.

The screen plates 10 are disposed in the vats in such manner that a hollow space of several inches in depth occurs beneath the plates and the bottom of the vats, as shown in Fig. 3. This hollow space is divided into a number of narrow transverse compartments or suction chambers 16, which are formed or defined in part by the cross-bars or girts 12 and the side walls of the vats, and each of said chambers or compartments is subdivided by a cross-bar 12′. Two screen plates 10, one for each sub-division, form the upper side of chambers 16.

In bellows-frame 2, upon which vats 6 are mounted, lateral spaces or openings 19 are provided, which correspond with suction chambers 16. These spaces or openings extend between the heavy cross timbers 20 and the lighter parallel pieces 21 of frame 2. Openings 19 are arranged so that their centers are directly beneath cross-bars 12′. Each pair of cross-bars 21 are preferably spaced six or eight inches apart, and between these are disposed a similar part 22, which divides the intervening space centrally. All of the cross pieces 21 and 22 are preferably made of wood, although suitable metal may be employed with good results.

The screening of pulp by my improved machine is accomplished by means of a vacuum draft or by suction, and to do said work in an effective manner, I employ a

series of vibratory diaphragms, each of which is connected with and operated by a reciprocating plunger or piston rod, by means of which forcible currents are produced through the slotted screen plates 10. The suction or vacuum chambers 16 are formed by the screen plates and diaphragms, and by the meeting of the girts and other parts of the bellows-frame and the vats, between all of which is disposed strips of rubber or felt packing 23, to make air-tight and water-tight joints. Each diaphragm consists of a flexible sheet 24, preferably made of rubber or other water-proof material; a wooden diaphragm 25, and an iron base 26. The rubber diaphragm is secured to the wooden part by brass screws 27, and the wooden part is secured to the iron base by means of bolts or screws.

In order to complete the formation of vacuum chambers 16, the outer edges of the rubber diaphragms are secured to the cross-bars or girts 20 and 21 of the frame. The rubber sheet or part 24 is considerably longer and wider than the wooden part 25, and when its edges are tacked or otherwise secured to the bars and girts, the rubber sheet affords sufficient flexibility to permit the plunger and other working parts to move upward and downward a short distance. The iron base 26 is provided with a hub 28, which receives the upper tapered end of plunger rod 29. Hub 28 projects from the under side of base 26 at an angle which allows the diaphragm to be disposed on an incline corresponding to the slant of the screen vat and screen plates.

It is essential for the effective working of my machine, that the upper or rubber face of the diaphragms and screen plates be arranged so that their planes are exactly parallel, in order that the suction or draft produced by said working parts may be the same at every part of the plates. Hub 28 on the iron base, therefore, is formed in such manner that while the diaphragm is inclined, it depends vertically in line with plunger 29. Piston or plunger 29 passes through and is supported by a bridge-tree 30, which is secured to the underside of frame 2, as shown in Fig. 3.

30′ represents a detachable part of the bridge-tree, which is provided to facilitate dismounting the plunger 29.

30″ represents a bushing, preferably of bronze, in which the plunger has its bearing. Near its lower end the plunger passes through a vertical bearing 31, formed on a metallic goose-neck part 32. The bearing at 31 preferably consists of a bronze bushing 33, which is rigidly clamped and held by the head of the bracket 32. Part 32 is secured to the top of the girder 4 by bolts or other suitable means. On the lower end of piston rod 29 is mounted a plunger-head 34, which extends below the piston a sufficient distance to receive a wooden or metallic shoe 35, which is held in place by bolts or set-screws 36. The plunger rods 29 for each section, owing to the inclination of the vats and other parts, are each of a different length, as will be seen by reference to Figs. 1, 4, 11 and 12.

37 represents a main driving or operating shaft, which is mounted in suitable bearings 38 secured to the standards 3 at each end of the machine. On one end of shaft 37 is mounted a pulley 39 by which the shaft may be connected with an engine or other source of power. On shaft 37 at intervals corresponding to the location of the diaphragms and plungers are disposed a series of cams—preferably four-throw cams 40 secured by keys 41. One of these cams is arranged directly beneath and in contact with each of the shoes 35, as shown in Figs. 4 and 5. Each cam is inclosed in a casing 42, consisting of two parts bolted together and preferably set rigidly upon girder 4 at a slight angle to the plane of shaft 37, as shown in Fig 3, so they may be assembled and taken apart more readily. By this construction the millwright is able to get at the boxes from the front side of the machine to make repairs without going underneath the machine. Furthermore it does away with the necessity of taking out the plungers or dismantling the machine in order to remove the shaft, as it is only necessary to remove the bolts which hold the casings together, swing the cap around to one side and lift out the shaft. Casings 42 are stationary and serve as bearings for shaft 37. They are hollow and made tight enough to hold a supply of oil for lubricating the cams, shoes and plungers. Near the upper end of each plunger rod 29 is disposed a stiff and powerful coil spring 44 employed to effect the downward stroke or movement of the plungers and diaphragms after the cams have forced them upward. The upper end of the springs bear against bridge-trees 30; the lower ends bear against a nut or stop 45, which is adjustably secured to the plunger rods by means of threads, as shown in Fig. 5. The wooden shoes 35 are connected to cams 40 by contact only, and ordinarily the weight of the plunger and diaphragm parts would be sufficient to bring these parts down after they have been lifted by the throw-points of the cams, but when a machine is doing actual work, the working parts are operated at a very high speed, and the cams force the plungers and diaphragms upward six or seven hundred times per minute, hence, in order to produce the required amount of screened pulp, it requires some additional force or power to assist in the rapid reciprocation of these parts. Spring 44 is employed for this purpose, and it may be given any desired tension by means of the thread-

ed nut or stop 45. Without the springs 44 the return movements of the vibratory parts would be too slow to meet the requirements of a rapidly working pulp screen. 46 represents a check-nut employed to hold the stop 45 in place when set.

47 represents one of a series of flow-spouts provided to carry away the mass of screened material after it is drawn through the plates into suction chambers 16. These spouts are preferably arranged so that one will take care of the material screened by two of the diaphragms, as illustrated in Figs. 1 and 4. Long experience in screening pulp has shown the necessity of providing and constantly maintaining a complete seal in the flow parts leading away from vacuum chambers 16, in order to prevent the admission into said chambers of any air to destroy the perfect suction produced by the diaphragms, and to that end, I provide a partition 48 in each flow-spout to keep the liquid flowing from each chamber 16 separated from that of the other like chambers. The side walls and the partition of each blow-spout are preferably made the same height and their upper edges are spaced to correspond with the under edges of cross pieces 21 and 22 (see Fig. 4). The flow-spouts are detachably secured to the underside of the frame by a series of hanger-bolts 49, saddles or cleats 49′, and a series of nuts which fit said bolts. The joints between the abutting edges of the flow-spouts and cross parts 21 and 22 are sealed with rubber or felt packing 50 for the purpose of making them air and water tight. While a machine is working, the flow-spouts are kept full of the liquid material, and as there is but a slight current in the spouts, more or less sediment consisting of slime and fine grit constantly settles in the bottom of the spouts, and in a short time they become filled with the same to such an extent that their capacity is greatly reduced. The spouts therefore require frequent cleaning, and in order to facilitate clearing them in a simple manner, I provide openings 51 in one end of the spouts which lead to the separate flow-ducts, and inclose the same with detachable caps 52, secured by hanger-bolts 53 and nuts 54. At the other end of each spout openings 51′ shown in dotted lines in Fig. 8 are provided in the bottom of each duct or channel and these are held normally closed by caps 55, secured by similar hanger-bolts 53 and 54 respectively.

56 represents one or more flow-boxes mounted preferably on the front side of each section of the machine and secured by bolts or other suitable means. These are preferably made of wood and disposed so that the bottom of the flow box and the bottom of frame 2 have about the same plane. The preferred construction of the flow-boxes is shown in Fig. 7 with compartments 57 and 57′ which receive the screened material as it flows upwardly from each duct of the flow-spouts 47. The joints between the boxes and spouts are also sealed with felt or rubber packing. The compartments 57 and 57′ are formed by means of removable partitions or dams 58, held in place by guide strips or cleats 59. These dams are provided to increase the depth of the liquid and thereby make a stronger seal to exclude air from suction chambers 16, and are made narrower than the depth of the box to allow the liquid to flow over them into the discharge compartments 57′ without overflowing the sides of the box and thus causing a waste of the screened material. There is a moderate sized opening 61 in the bottom of each of the compartments 57 and 57′ through which the liquid enters when forced upward from the spouts. One of these openings is disposed over each channel or duct of the flow-spouts. After the screened material enters a compartment 57′, it passes through a circular opening 62 in the bottom thereof, and thence into discharge pipe 63, by means of which it is carried away to be used in making paper &c. 60 represents the pulp shown in the vat and flow-box in Fig. 3.

In the screening or straining of pulp by the use of my inclined screen plates and vats, all of the waste or refuse material, such as coarse pulp, slivers, coarse grit and other dirt, gradually work their way down over the plates by the force of the suction and vibratory action of the working parts, and accumulates finally at the lower end of the vats, or at the foot of each of the inclines. As the inclination of the screen plates is not more than five feet in a machine one hundred feet in length, the refuse or waste material, if allowed to gather at the lower ends of the vats in any considerable quantity, would back up over the slots of the nearest plates, and interfere with the free and perfect straining of pulp through the same. For that reason, I provide waste-pipes 65 and attach them to the low ends of the vats as shown, and these pipes communicate with the interior of the vats by means of a hole or opening 66. As this waste material, naturally carries with it more or less good fiber or pulp, it is preserved in a suitable manner for rescreening in the future.

In the manufacture of pulp, the unstrained material consists chiefly of ground pulp and water which are thoroughly mixed by agitation. This material is pumped up into the feed-boxes 14 located at the highest ends of the screen vats, and flows over the dams 15 onto the screen plates 10, in a steady even stream of sufficient volume to cover the plates to a depth of three or four inches. As the material flows down the inclined

screen plates forming the floor of the vats, a large percentage of the pulp and the water mixed with it, is drawn through the fine slots or openings in the plates, by means of the strong suction produced by the diaphragms, and is carried away through the flow-spouts and flow-boxes, to be used in making paper. All of the coarse particles of the material including the grit and other extraneous matter remaining on top of the plates are washed down by the steady flowing stream to the lowest part of the vats, either at the middle or at the ends of the machine and is carried away by waste pipe 65.

To accomplish the screening of pulp, the series of vibratory diaphragms disposed beneath the screen plates are operated at a high rate of speed by the main driving shaft 37 and the springs 44. The said shaft is only employed to raise the diaphragms by means of the cams 40 and this upward stroke causes a strong current or pressure to be exerted against and upward through the fine slots in the plates. This feature is employed for the purpose of blowing out any of the material which may become lodged in the slots by the force of a previous suction, and it therefore clears said slots, so that when the diaphragms are pulled downward by the tension of springs 44, they create a strong suction which draws the fine pulp and water through the plates into the suction chambers. These reciprocating movements of the diaphragms are so short and quick that when a machine is running at full speed, the suction is almost continuous. The vertical movement of the diaphragms is not more than one-quarter of an inch which permits of said parts being operated at an extremely high rate of speed, without injury to the flexible parts of the diaphragms.

In my machines, the degree of slant or inclination of the screen plates is sufficient to cause the unscreened material to flow from the highest to the lowest end of the vats in a stream which is constantly changing, because when the coarse material and refuse is drawn down upon the plates by the downward operations of the diaphragms and then forced upward free from the plates by the upward stroke of the diaphragms, which dislodges the refuse, the force of the flowing stream of new material will carry the refuse farther down the incline, so that when the next suction occurs, it will be drawn against the plates at a lower point, and thus said matter will be jogged along, step by step until it reaches the lower end of the vat, where it will be discharged. Hence I claim that machines having the inclined vats are practically self-cleaning, and a greater amount of serviceable stock may be obtained in a given time, without any loss by reason of having to shut down the machines, and besides there is very little waste of the good pulp.

In most of the machines having horizontal or level vats, the unscreened material is delivered to the vats in such volume as to cover the plates to a depth of three or four inches. When this material is acted upon by the suction created by the downward operations of the diaphragms, that which is fine enough passes through the plates, while the coarser portion remains on top of the plates. At each stroke of the diaphragm some of this latter material is drawn part way through the slots of the plates, and owing to the great force of the suction it sticks there, at least for a time. The greater part of the refuse material remains on top of the plates and is forced upward free from the slots by the currents produced by each upward movement of the diaphragms. Some new material becomes mixed with the refuse at each of the said operations, and the next downward stroke effects the screening of the finer pulp from the whole mass. But in the horizontal machine on account of the large amount of material which is delivered to the plates for screening, and the rapid working of the suction parts, the refuse material increases in amount and depth very rapidly, because it cannot get away, and can only be displaced in the manner described, while the machines are running. As the refuse material increases in depth, the amount of fine pulp obtained becomes less and less, until there is a virtual clogging of the slots, which necessitates the frequent shutting down of the machines for the purpose of cleaning the vats and plates. This results in great loss of time and besides considerable good pulp which becomes mixed with the refuse is wasted. These accumulations of refuse material further become a dangerous element, because considerable sand and other gritty substances forming a part of the unscreened mass, which are too large to be drawn through the plates in the first instance, are repeatedly drawn into and forced out of the slots by the strong alternating currents produced by the working parts, and thus effects a steady wear on the walls of the slots. After a time, the slots become enlarged to such an extent that the screened stock is given an uneven consistency, which is very undesirable, especially for making paper of the finer grades. And in addition to the trouble described, much expense is occasioned by the necessity of frequent renewing the worn-out plates. On the other hand, by the employment of inclined plates and vats as herein described and shown, the coarse pulp, slivers and gritty particles are carried to the lowest end of each vat by the force of a gravity flow, which is strong and rapid enough to carry

the mass of unscreened material down the inclines before they have a chance to clog or injure the plates. Under this arrangement, there is little opportunity for the refuse material to lodge or remain for more than an instant on any portion of the plates, because the latter will be kept free from accumulations and cloggings and therefore a greater amount of strained material can be obtained by the use of my improvement in a given period, and with less wear and injury to the plates, than by any of the old forms of horizontal or level screen vats.

Where my machines are employed, it is possible to greatly increase the volume of unstrained material which is delivered to the screen in the first instance, and by obviating the delays due to frequent stopping of the machine, the output of screened pulp greatly exceeds, both in quality and value, that of any other device of the class known to me.

It is obvious that some of the parts of my machine may be varied without departing from the invention, and I therefore do not restrict myself to the precise construction and arrangement of the same, as herein shown and described.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is—

1. A pulp screen comprising a vat, a screen inclined in the direction of the length of the vat, non-communicating vacuum chambers beneath the screen, a diaphragm for each vacuum chamber, said diaphragms being substantially parallel with the screen, rods for operating said diaphragms, said rods increasing in length from the lowest toward the highest part of the screen, and a flow spout for each vacuum chamber, substantially as described.

2. A pulp screen comprising a vat, a screen inclined in the direction of the length of the vat, non-communicating vacuum chambers beneath the screen, a diaphragm for each vacuum chamber, said diaphragms being substantially parallel with the screen, means for operating said diaphragms, and an outlet for each vacuum chamber, substantially as described.

3. A pulp screen comprising a vat, a screen, a diaphragm below said screen, the space between the screen and diaphragm being divided into separate suction chambers, plunger rods for actuating the diaphragm, and a flow spout leading from adjacent suction chambers and provided with a partition extending upwardly from its bottom to prevent material from one chamber flowing into the adjacent chamber, substantially as described.

4. A pulp screen of the class described, comprising a vat, an inclined screen in said vat, vibratory diaphragms beneath said screen, the space between the diaphragms and screen being divided into independent vacuum chambers, an independent flow-spout, means for permitting the cleaning of said flow-spouts without detaching the spouts, a flow-box having a number of separate compartments adapted to receive and discharge a volume of screened pulp flowing from said flow-spouts, and means for discharging refuse material from the screen vat.

5. A pulp screen of the class described, comprising a number of inclined vats, a series of inclined screens forming the bottoms of said vats, the inclination extending from the head toward the tail end of the vat, a series of inclined flexible diaphragms disposed beneath said screens, a number of plunger rods of unequal lengths adapted to effect the vibration of said diaphragms, a series of flow-spouts, each spout having a partition extending upwardly from its bottom, means for cleansing said flow-spouts without detaching the spouts, and a flow-box into which the flow-spout discharges.

6. A pulp screen of the class described, comprising a number of inclined vats, a series of inclined screens forming the bottoms of said vats, the inclination extending from the head toward the tail end of the vat, a series of inclined flexible diaphragms disposed beneath said screens, non-communicating vacuum chambers between the screens and diaphragms, a number of plunger rods adapted to effect the vibrations of said diaphragms, a series of flow spouts, and a flow box, substantially as described.

7. A pulp screen of the class described, comprising a vat, an inclined screen, the inclination extending from the head toward the tail end of the vat, inclined diaphragms mounted on inclined frames, plungers of unequal lengths to operate said diaphragms, a driving shaft to operate said plungers in one direction, springs to operate said plungers in the opposite direction, a suction chamber for each diaphragm, a flow-spout for each pair of suction chambers, said spout having a partition extending upwardly from its bottom, and a flow-box for a number of flow-spouts.

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

JOHN OLSEN.

Witnesses:
EDGAR V. HARDOUGH,
HARRY DE WALLACE.