(No Model.) 2 Sheets—Sheet 1.

H. PARKER, G. F. CUSHMAN & H. FAIRBANKS.

PULP DRYING OR PAPER MAKING MACHINE.

No. 491,717. Patented Feb. 14, 1893.

Fig. 1.

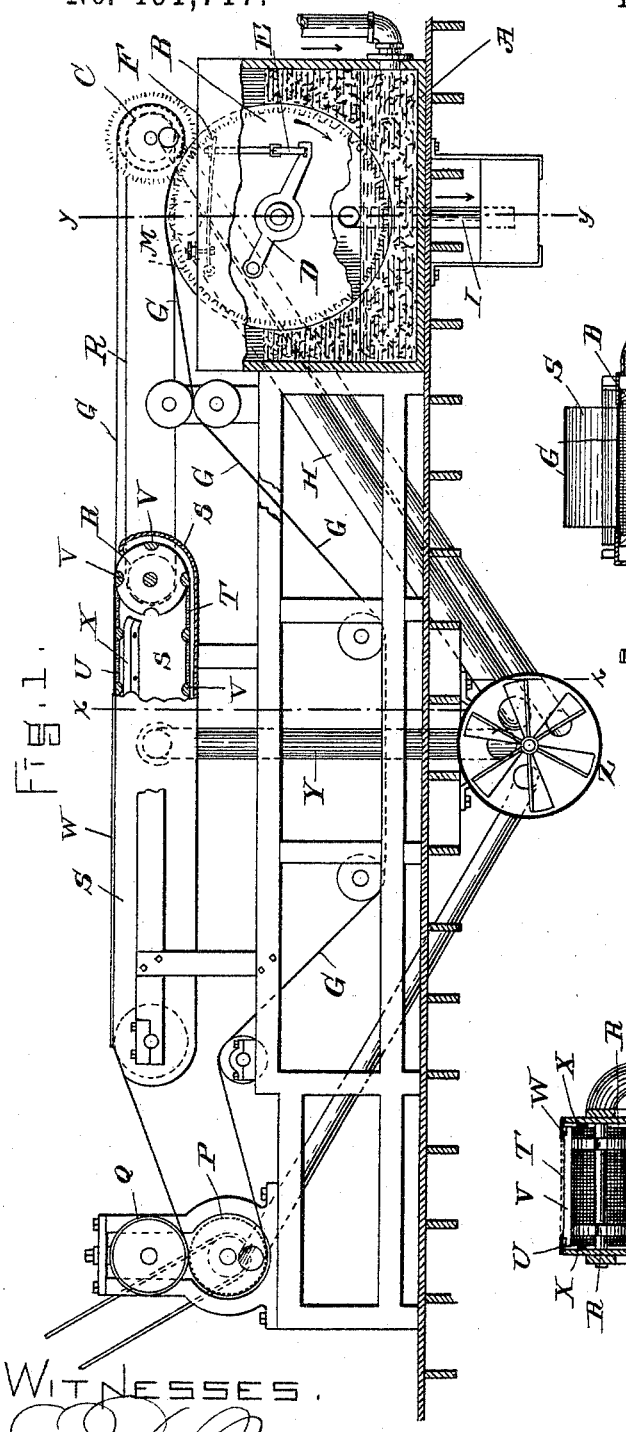


Fig. 3.

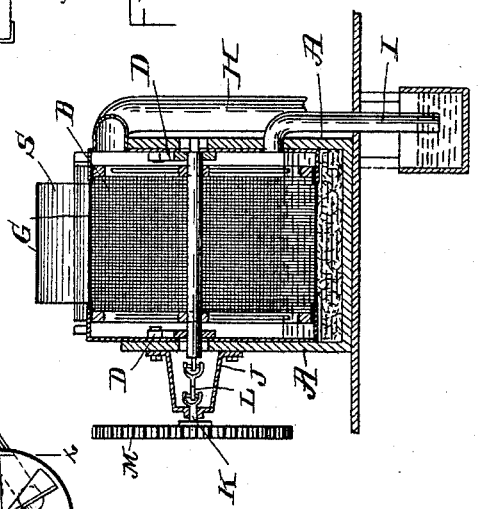
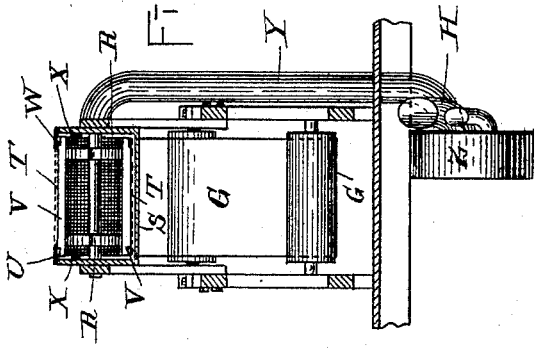


Fig. 2.



WITNESSES.

Henry Marsh.

O. H. Chapin

INVENTORS

Howard Parker.

Geo. F. Cushman

Henry Fairbanks

by A. G. & Geno

their atty

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

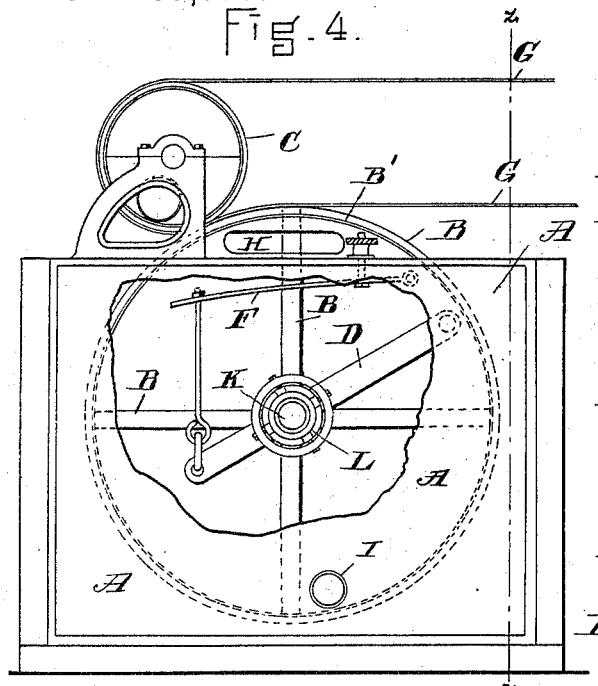


Fig. 5.

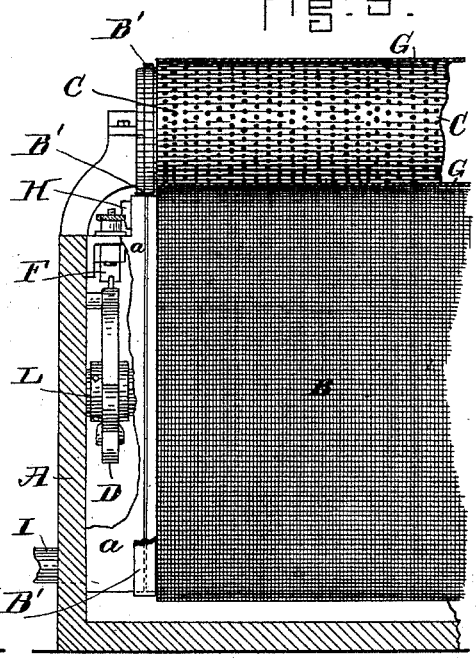


Fig. 6.

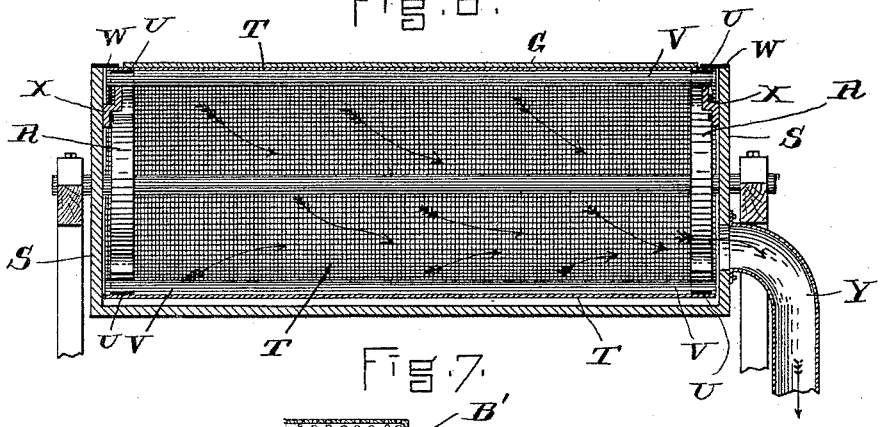
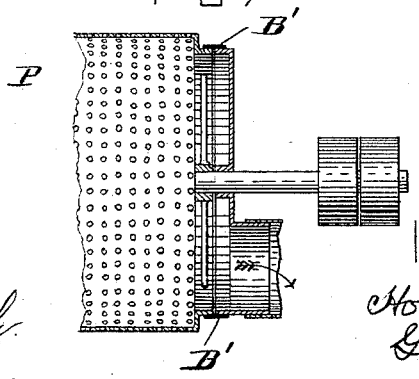


Fig. 7.



WITNESSES.

C. Henry Marsh.

Edw. F. Spencer.

INVENTORS.

Howard Parker

Geo. F. Cushman

Henry Fairbanks

by A. H. Brewer & Co.

UNITED STATES PATENT OFFICE.

HOWARD PARKER, GEORGE F. CUSHMAN, AND HENRY FAIRBANKS, OF ST. JOHNSBURY, VERMONT.

PULP-DRYING OR PAPER-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 491,717, dated February 14, 1893.

Application filed August 29, 1890. Serial No. 363,457. (No model.)

To all whom it may concern:

Be it known that we, HOWARD PARKER, GEORGE F. CUSHMAN, and HENRY FAIRBANKS, all of St. Johnsbury, in the county of Caledonia and State of Vermont, have jointly invented certain new and useful Improvements in Pulp-Drying or Paper-Making Machines, of which the following, taken in connection with the accompanying drawings, is a specification.

This invention relates to improvements in paper-making machinery, especially in the ordinary wet machine used for removing the water of suspension from paper pulp, in which the thin pulp, as it comes from the grinder or beating engine, is made to deposit its fibers upon the surface of a mold-roll from which the soft layer is taken upon a felt apron, dried on the way, and finally rolled upon a press-roll, or taken off as paper.

Our improved machine has the hollow couch-roll in fixed bearings, its cylindrical surface perforated, and its interior connected with a large volume exhaust; the mold-roll arranged to move toward the couch, driven by power, and preferably exhausted; the felt apron passing over a large suction-box, of which a traveling porous belt forms the top, said box being also connected with the exhaust; and the hollow under press-roll, over which the felt passes, perforated and preferably connected with the exhaust. This special or large volume exhaust for the mold-roll couch roll, suction-box and press-rolls, either or all, consists of an exhausting fan or fans, connected by suitable tubes or passage ways with the interiors of said parts, and adapted to induce, through their permeable surfaces, air-currents of moderate tension, but of great volume and remarkable efficiency. In the use of such exhausting-fans we make a wide departure from previous methods of utilizing such devices, in that we do not attempt to close tightly all openings in the rolls, boxes, or other chambers to be exhausted, other than the perforations in their surfaces on which the pulp is carried; but, on the contrary, by leaving certain portions of our rolls, boxes, &c., wholly or partially uncovered, or by other means, expressly provide air-inlets for the admission of air to their interiors without passing it through the pulp-layer; and we provide an exhaust of sufficient power and volume to maintain a strong suction current inwardly, not only through the pulp-carrying surfaces, but also through such inlets; thus not only drawing in the water rapidly from the pulp-layer, but blowing or sweeping it off in the form of spray or mist from the inside of the straining surfaces.

In the drawings, Figure 1 is a side elevation, partly in vertical section, of a machine embodying our several improvements. Figs. 2 and 3 are transverse sections on the lines *x*—*x* and *y*—*y* respectively, of Fig. 1. Fig. 4 is an elevation of the pulp-vat or tank, with a part broken out to show the yielding bearing on the mold-roll. Fig. 5 is a vertical section through the vat and felt apron on the line *z*—*z*, of Fig. 4, with part of the shell and packing broken away to show such yielding bearing. Fig. 6 is a transverse section through the suction-box, in the plane of its exhaust outlet Y, Fig. 1. Fig. 7 is a detail illustrating the perforated under press-roll, with its exhaust-pipe and driving pulleys.

In the common wet machine the mold-roll is in fixed bearings, and the couch-roll carrying the felt rests its weight upon the mold-roll, the felt carrying it by its surface friction. In this construction the pressure is too great and unequal, the felt sometimes lifting, and the movement is at the expense of great strain and wear of the felt. As improved by us the couch-roll C is in fixed bearings and the axis of the mold-roll B runs in bearings just inside the ends of the pulp-vat A, which bearings are in levers D, Figs. 1 and 5, arranged to swing, on a stud at one end, directly toward the couch-roll, while the free end of each lever is connected by a link E to an adjustable spring F, on the upper edge of the pulp-vat. This arrangement allows the mold-roll to be held with constant, light pressure in yielding contact with the felt G under the couch-roll. The swinging levers D, carrying the axis of the mold-roll B, are inclosed within a circular extension *a* of the mold-roll, formed or fixed on the inner wall of the vat and of a diameter equal to that of the mold-roll. One end of the mold-roll is closed, the other open. The open end revolves in close proximity to

the edge of this extended shell *a*, and the packing-strip B′, secured to either of them, laps over the crevice between their adjacent cylindrical edges, so that the interiors of the mold-roll and of the shell *a* form substantially one chamber, although the shell *a* is stationary. The packing B′ prevents the entrance of too much air into the mold-roll where the edges of the roll meet the edges of the shell *a*. Said packing does not interfere with the slight movements of the mold-roll to and from the couch. An exhaust pipe H leads out from within the shell *a* to the exhausting fan Z. Said pipe may enter the shell *a* near the top, while the water drawn through the surface of the roll flows away through a pipe I, near the bottom, said pipe being carried down and arranged to dip in water, so that the flow from it will not be reversed by the exhaust.

When in operation, as shown in Fig. 1, a portion of the permeable, cylindrical surface of the mold-roll is submerged in the pulp, a second portion is covered by the film of pulp taken up and on its way to the apron; a third portion is covered by the apron in contact with the pulp, which it takes off and carries over the couch-roll; and a fourth portion, to wit that between its line of contact with the couch-roll and the point where it enters the pulp, is uncovered and exposed to the free entrance of the air-current created by the exhaust. A sufficient amount of air to fully supply the exhaust is however not admitted through this portion of the roll, and a strong inward current is still maintained through the portion of the roll carrying the pulp and that in contact with the felt. A strong inward suction is also exerted upon the portion submerged in the pulp. The effect of this exhaust throughout the roll is to materially aid in the deposit of pulp upon the submerged surface of the roll, and to draw in water rapidly from the pulp-layer so deposited. The water runs off freely through the outlet provided, or is drawn out through the exhaust passage in the form of spray or mist. Under this system a much smaller cylinder than is usually required for the mold-roll becomes equally effective in taking up a heavy, even web.

At the end of the mold-roll opposite from the exhaust outlet, Fig. 3, we put upon the outer end of the pulp-vat a hollow projection or bracket J, furnishing a bearing for a short arbor K, in the line of the usual position of the axis of the mold-roll. The inner end of said arbor carries the first fork of a common double universal-joint L, of which the last fork is the end of the axis of the mold-roll; so that said arbor and axis, while not rigidly connected, must rotate together. The outer end of said arbor carries a gear-wheel M, of the same diameter as the mold-roll and gearing it to the couch-roll, so that said rolls rotate with equal and coincident peripheral travel. The couch-roll is connected with the press-roll P, over which the felt passes, by a belt or by two sets of bevel gears, not shown, in such a manner that said press-roll rotates at the same speed as the mold-roll and couch, and the felt is relieved from strain.

By reason of the drying action of the exhaust through the mold-roll upon the pulp-layer the pulp taken up is thicker before it reaches the apron than in the ordinary machines, and therefore lies more upon the surface of the felt, so that less washing of the felt is necessary to keep it clean, and it lasts much longer.

The couch-roll C of our machine carries the felt G, as usual. The roll being in fixed bearings the tension upon the felt is constant. Its cylindrical surface is perforated and its hollow interior connected with the exhaust. We usually cover the surface of the roll with one or two thicknesses of porous cloth, through which light covering the strong exhaust current readily passes, spraying the water drawn through the felt from the pulp and carrying it rapidly away from the inner surface of the roll, both that part of said surface which is under the felt and that part which is not. Said cloth covering being partially dried during that part of the roll's revolution when the felt does not rest upon it, is in condition, when it again meets the felt, to absorb the water rapidly from the felt and the pulp layer thereon. Sufficient air passes through said covering and the part of the roll which is free from the felt to partially but not fully supply the exhaust, so that a considerable portion of the inward current must pass through the felt and pulp. We also perforate the peripheral surface of the hollow under press-roll P, Figs. 1 and 7, which carries the felt apron at the other end of the machine. It is also connected with the exhaust, and the water pressed or drawn from the pulp through the felt passes freely into the interior of the roll, thus making the pulp more dry as it winds upon the upper press-roll Q. Air to supply the exhaust current in addition to what passes through the felt, enters that portion of the roll not covered by the felt.

Another feature of our invention is a large suction-box S, Figs. 1, 2, and 6, of special and novel construction, connected with the exhaust by a suitable pipe Y, and applied to the under surface of the pulp-bearing felt, so as to still more rapidly dry the web of pulp.

While the details of construction may be varied, in its essential parts our suction-box consists of a box extending under the felt, from one side thereof to the other, and as long in the direction of the length of the felt as may be required, preferably about three feet; closed except the top, which is covered by a section of a traveling, porous belt T, arranged to move with the felt which rests upon it. The belt T may pass over rollers R, forming the ends of the box, and in that case may return under the bottom of the box, the end rollers running close to the bottom and sides and forming the only air-stop needed. But

we prefer the construction shown, in which the belt T returns inside the box S, its edges being secured to flexible, flat-linked, riveted chains U, which run close to the sides of the box, being held apart by a series of transverse bars V, under the belt, which enter corresponding grooves in the end rollers, so that an accurate movement of the belt is secured. The ends of the box approach close to the belt, but sufficient air can enter at these points or between the chain edges and the sides of the box to provide a sufficient supply of air for the exhaust in addition to what passes through the felt. To direct and control this current any suitable packing may be employed. The rubber cloth dekles W, at the edges of the belt, which may be wider as the web of the paper is narrower, may just touch the sides of the box and act as a packing. The packing should not be so close as to prevent the entrance of a proper amount of air, and still close enough to insure the passage of a certain amount of current through the felt and the pulp thereon, the highest efficiency of the apparatus being secured, as in the case of the mold-roll, couch-roll and press-roll, by the proper adjustment of the quantity of air drawn through the pulp relatively to that admitted through other inlets. If the described air-inlets to the suction-box are insufficient, others may be provided, so placed that the currents entering them will strike the under surface of the porous belt. The axis of one of the rollers R, extends through the side of the box and carries a gear-wheel or a pulley by which it is so connected by a shaft or a belt R′, Fig. 1, to the rolls carrying the felt apron G, that said apron and the belt T, in the suction-box, move together without any sliding friction between them. The belt T moves so easily that the apron resting upon it would carry it, but driving it by power relieves the apron of all possible strain from this source. The transverse bars V, which support the belt T against the pressure of the atmosphere while under the apron, slide upon smooth tracks X secured to the inner sides of the box, parallel with its top, or said bars and the chains U may be supported by other means. The suction-box described will work as well under a wire apron as under the felt apron of this machine, and will be equally valuable.

The large volume fan-exhaust described is of very great importance in securing the rapid removal of water from the pulp, and we apply it to the mold-roll, the suction-couch, the large suction-box and the under press-roll, either or all, and preferably by branch pipes leading to each of said inclosures from the fan-case, about as shown in Fig. 1. The exhausting devices that have been commonly used, based merely on the idea of producing a vacuum under the pulp, are effective in a very small way if no air leaks in, but the necessary leakage into the inclosures so operated upon greatly reduces the degree of exhaustion effected and destroys the efficiency of the apparatus.

Our improvements involve the substitution of the large volume ventilated fan-exhaust current, maintained through the entire permeable surfaces of the rolls and under, as well as through, the felt passing over the rolls and suction-box, for the high pressure exhaust attempted by the use of air-pumps or other means.

Parts of our improved machine may be used without using the whole. The counterbalanced mold-roll, rising to its work, may be used where a suction-couch takes the place of a felt in transferring the web of pulp to the press-roll, or when in a paper-machine a felt passes over several mold-rolls; any mold-roll and couch-roll may be geared and driven by power; the one in adjustable bearings being connected to its gear-wheel through a universal joint; either roll may be connected with an exhaust constructed on our system, while the others are not; and the suction-box described may be used without the suction-rolls, or the rolls without the box.

We believe that our several improvements, as thus specified, constitute a marked advance in the means of treating webs of pulp, and will materially reduce the percentage of moisture therein, as compared with the product of apparatus heretofore known.

We claim as our joint invention:

1. In a pulp drying or paper making machine, the couch roll and fixed bearings in which it is mounted, in combination with the mold roll and yielding bearings in which it is mounted, for the purpose herein set forth.

2. In a pulp drying or paper making machine, a hollow permeable mold roll and couch roll, and mechanism adapted to raise the mold roll into yielding contact with the couch roll, in combination with a short arbor, substantially a prolongation of the axis of the mold roll, but in fixed bearings, and carrying the drive wheel, and with a universal joint connecting said arbor and axis, for the purpose set forth.

3. In a pulp drying or paper making machine, a hollow perforated suction couch roll and fixed bearings in which it is mounted, and a hollow permeable mold roll with yielding bearings in which it is mounted, in combination with a traveling apron passing between and pressed by said rolls, and with an exhausting apparatus connected with the interior of said couch roll by an exhaust passage, substantially as set forth.

4. In a pulp-drying or paper-making machine, the combination of moving, permeable surfaces of suitable material adapted to receive, support or carry the film of pulp, inclosed chambers within or beneath such moving, permeable surfaces, air-tubes or passages leading from such chambers to a rotary exhausting fan mounted at the end of such air-passages and adapted to produce and main-

tain an exhaust air-current of large volume inwardly through such permeable surfaces and the film of pulp thereon; suitable vents being also provided, to permit the ingress of air to said chambers without passing it through said pulp, substantially as described.

5. In a pulp-drying or paper-making machine, a pulp-vat, a pulp-carrying apron, a hollow, rotating mold-roll mounted in the pulp-vat and adapted to be partially submerged in the pulp therein, said roll having its ends closed, its whole interior formed substantially in one chamber, and having a pervious cylindrical surface adapted to permit free ingress of air and water, in combination with a rotary exhausting fan connected by a suitable tube or passage with the interior of said roll and adapted to maintain a suction air-current of large volume inwardly through the unsubmerged portion of the surface of said roll and a flow of water inwardly through the submerged portion thereof, substantially as described.

6. In a pulp-drying or paper-making machine, in combination with the endless traveling apron carrying the layer of pulp, a hollow roll over which the apron passes, said roll having its ends closed, its cylindrical surface perforated or otherwise made permeable to air and water, and so adjusted that when in operation a portion of its said surface will be covered by the pulp-carrying apron, and the remaining portion wholly or partially uncovered and exposed to the free inflow of the air-current through its said permeable surface, and a rotary exhausting fan connected by suitable passages with the interior of said roll and adapted to maintain a continuous exhaust air-current inwardly through the permeable surface of said roll and through and beneath said apron and the pulp-layer thereon, substantially as set forth.

7. In a pulp-drying or paper-making machine, the combination of the moving endless apron carrying the web of pulp, a suction-box over the top of which the apron passes and provided with suitable air-inlets admitting air to its interior, transverse rollers journaled in the ends of said box, a permeable endless traveling belt mounted on said rollers and moving over the top of said box beneath and in continuous supporting contact with said pulp-carrying apron, and a rotary exhausting fan connected by suitable passages with the interior of said box and adapted to maintain an exhaust air-current of large volume inwardly through and beneath said belt and apron and the web of pulp thereon, substantially as set forth.

8. In a pulp drying or paper making machine, in combination with the pulp carrying endless apron, a suction box of which the upper side is a permeable endless belt located beneath the pulp carrying surface of the apron and in contact with it, with means for supporting the flat surface of the belt forming this upper side, and end rollers over which it passes having their bearings in the sides of the box, and driven by power applied to one or both of these rollers, whereby the belt is actuated at the same speed as the apron resting upon it, substantially as set forth.

9. In a pulp drying or paper making machine, having a suction box with a traveling top, the combination of transverse supporting bars across the belt which forms the top of said box, link-work at the edges of said belt, and carrying rolls at the ends of the box, to which rolls the said links and bars are fitted, adapting said belt to be carried forward, coincidently with the pulp carrying apron, by the movement of the turning rolls, and to support said apron against the pressure of the atmosphere, substantially as herein set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HOWARD PARKER.
GEO. F. CUSHMAN.
HENRY FAIRBANKS.

Witnesses to the signatures of Howard Parker and Geo. F. Cushman:

C. M. SPENCER,
GEO. H. FROST.

Witnesses to the signature of Henry Fairbanks:

JAMES P. PRINCE,
A. H. SPENCER.