

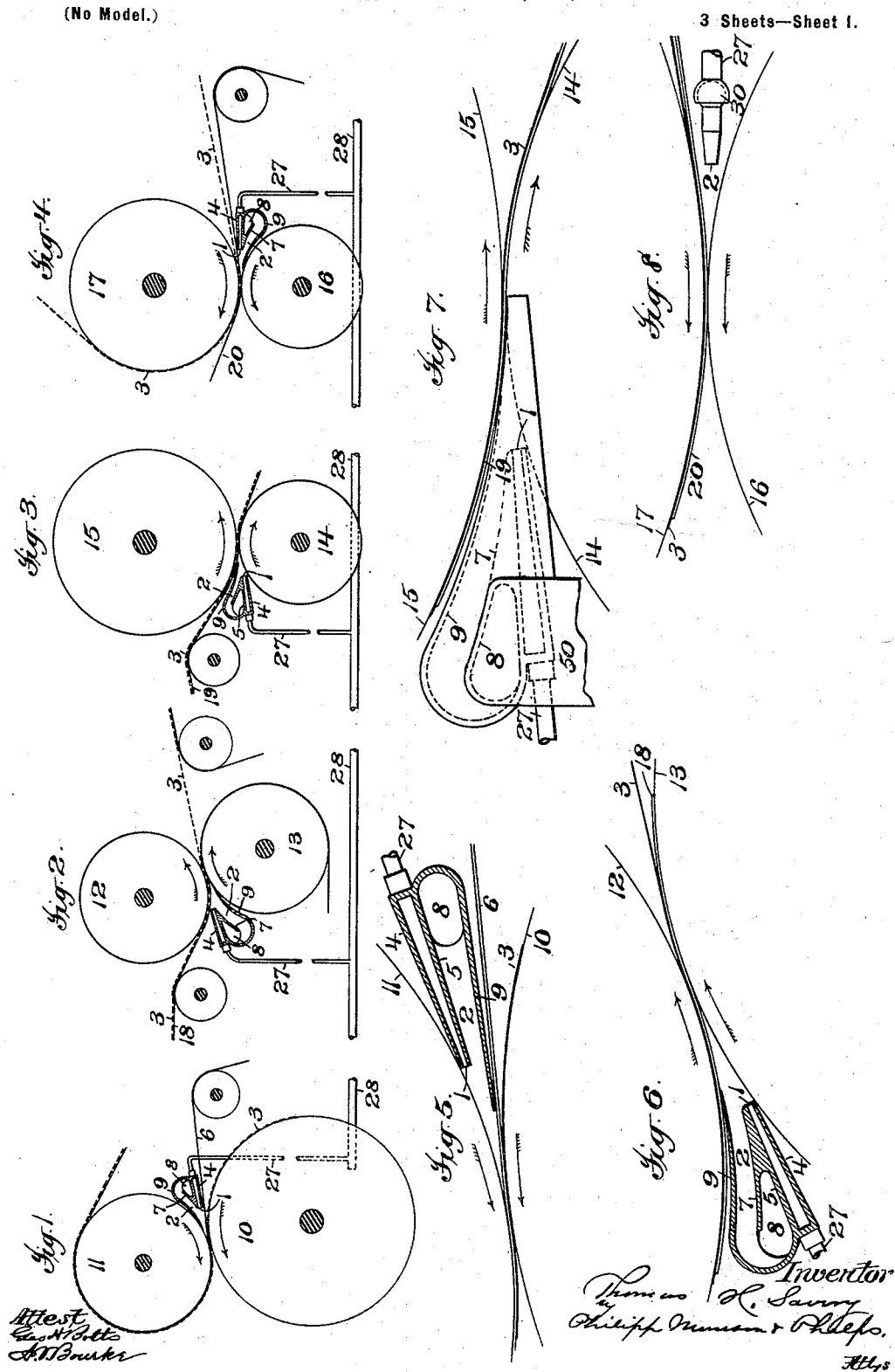
No. 611,422.

Patented Sept. 27, 1898.

T. H. SAVERY.
PAPER MAKING MACHINE.

(Application filed Nov. 14, 1896.)

(No Model.)



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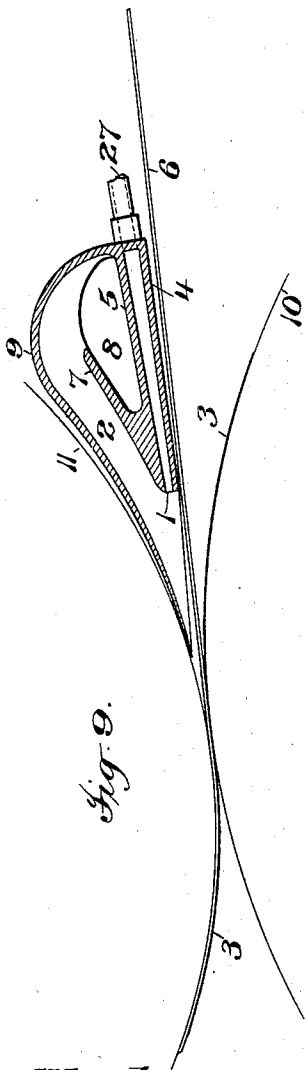
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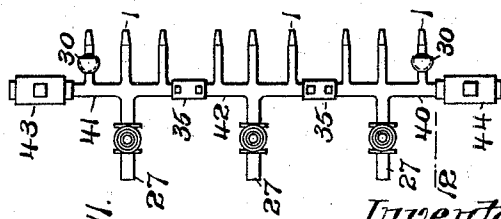
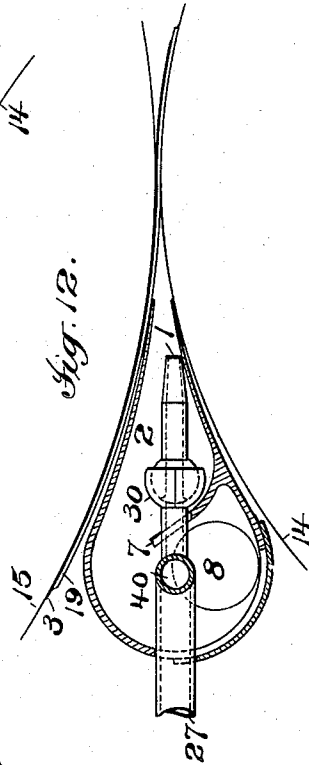
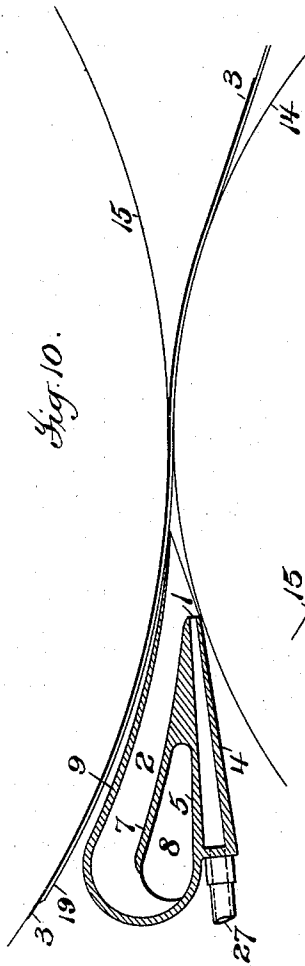
(Application filed Nov. 14, 1896.)

(No Model.)

3 Sheets—Sheet 2.



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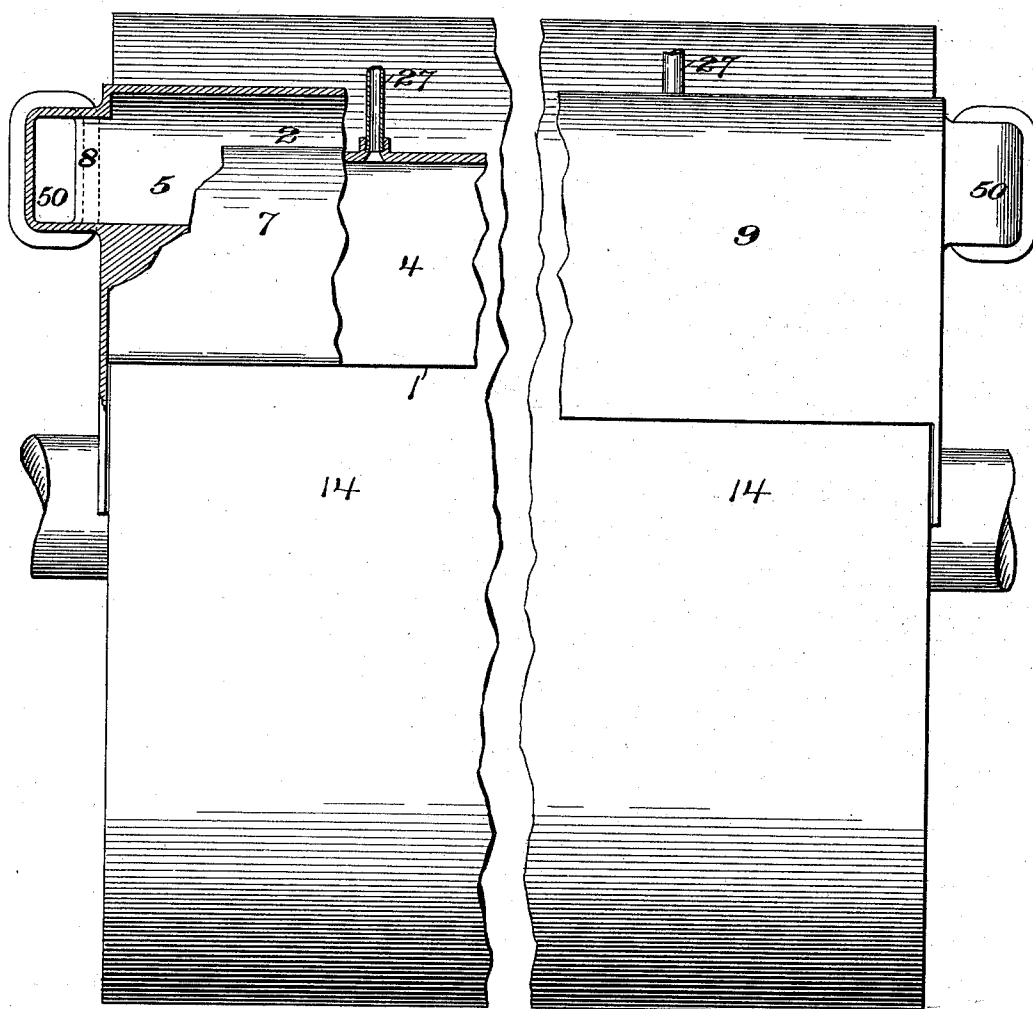
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3 Sheets—Sheet 3.

Fig. 13.



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UNITED STATES PATENT OFFICE.

THOMAS H. SAVERY, OF WILMINGTON, DELAWARE.

PAPER-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 611,422, dated September 27, 1898.

Application filed November 14, 1896. Serial No. 612,100. (No model.)

To all whom it may concern:

Be it known that I, THOMAS H. SAVERY, a citizen of the United States, residing in the city of Wilmington, county of New Castle, and State of Delaware, have invented certain new and useful Improvements in Paper-Making Machines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to paper-making machines, and more particularly to an improvement upon the subject-matter of my two other applications, Serial Nos. 612,098 and 612,099, executed and filed of even date herewith.

The object of the present invention is the rapid and continuous removal of the water which is expelled from the forming paper through pressure applied thereto by the moving cylindrical surfaces between which it passes, and which water enters into the angular space existing between the carrying-felt and the couch-roll of a cylinder-machine, between the carrying-wire and the couch-rolls in a Fourdrinier machine, and between the carrying-felt and the press-rolls in all paper-making machines and would exist between press-rolls if the carrying-felt were omitted. This angular space constitutes a recess at the front or entrance side of such rolls in which a body of this expelled water ordinarily accumulates and is maintained and from which it is thus enabled to reënter the paper stock or stuff or the traveling support or carrier thereof, from either or both of which it was derived, and thereafter act injuriously by staining the forming paper by rewetting the paper stock or stuff or its support or carrier, and thereby necessitating more extended operations in the forming of the paper or rendering the devices which aid in the formation of the paper defective in their operation.

The particular invention embraced herein is a pneumatic appliance consisting of means for removing this injurious water from said recess by means of a blast of air; but the invention also includes details of the structure or appliance made use of for that purpose.

Preferred forms of the invention are illustrated in the accompanying drawings, wherein—

Figure 1 is a diagrammatic side elevation,

reduced scale, showing this invention as applied to a cylinder paper-making machine. Fig. 2 is a similar view showing the said invention as applied to the couch-rolls of a Fourdrinier paper-making machine. Fig. 3 is a similar view showing the said invention as applied to the first press-rolls of a cylinder or Fourdrinier paper-making machine. Fig. 4 is a similar view showing the said invention as applied to the second press-rolls of a paper-making machine. Fig. 5 shows at one-half normal or ordinary practical size a sectional elevation of so much of a cylinder paper-making machine as will exhibit an embodiment of this invention in its relation to the carrying-cylinder, couch-rolls, forming-felt, and the web of stock or stuff operated upon. Fig. 6 is a like representation of the embodiment of this invention with the couch-rolls, endless wire forming-apron, and the stock or stuff, as in a Fourdrinier paper-making machine. Fig. 7 is a like representation of an application of this invention to the first press-rolls and felt of any paper-making machine, substantially as in Fig. 3; but its interior structure, indicated by dotted lines, is shown in sectional elevation in Fig. 10. Fig. 8 is a like representation of the application of this invention to the second press rolls and felt of any paper-making machine. Fig. 9 is a substantial repetition of Fig. 1, is an enlarged or half-size view, and shows the pneumatic appliance more perspicuously. Fig. 10 is a substantial repetition of the structure of Fig. 7, but shows the pneumatic appliance in sectional elevation. Fig. 11 is a plan view, reduced scale, of a modified form of the blast-conveying devices, the upper roll being removed. Fig. 12 is an enlarged sectional elevation thereof, taken on section-line 12 of Fig. 11, showing the same as provided with a guard and discharging-aperture. Fig. 13 is a plan view, partly in section, of the structure shown in Fig. 7, with the upper roll removed, the view being made upon a scale corresponding therewith.

The invention is shown in Figs. 1, 5, and 9 as applied to the forming devices of a cylinder paper-making machine, in Figs. 2 and 6 as applied to the couch-rolls of a Fourdrinier paper-making machine, and in the remaining

figures as applied to press-rolls of paper-making machines generally.

In the cylinder paper-making machine (see Fig. 1) the reticulated forming-cylinder 10 is a cylindrical surface arranged in practice to revolve in a vat, (not shown,) and for the most part is immersed in a mass of diluted pulp or stuff constantly supplied thereto, as is common. This forming-cylinder is surmounted by another cylindrical surface, which is a couch-roll 11, and has coöperating with it and said roll a carrying-felt 6, which, passing in contact with the top surface of the forming-cylinder, runs under and returns over said couch-roll. Since the film of fibrous matter or layer of stock or stuff 3 taken up by the forming-cylinder 10 upon its onward-moving surface is first carried against the under side of the felt 6 and passes therewith to and between the cylindrical surface of the forming-cylinder 10 and that of the couch-roll 11, it results from the pressure thus exerted upon it that a large portion of the water which it then contains is expelled therefrom and must pass upwardly through said felt 6 and be received in the recess formed at the front side of the couch-roll 11 and between it and the felt 6. While the water thus delivered into this recess and accumulated on top of the felt 6 may have its excess quantity spread rearward on the felt 6 and be carried off the same at the sides thereof, there will always be an accumulation or a body of water remaining in the said recess sufficient to substantially fill it, such body of water being retained therein either by gravity, owing to the fact that said recess is lower than the plane in which that portion of the felt rearward of it runs, or is held there by the action upon the water of the forward travel of the felt 6 on the cylinder 10 or the onward movement of the surface of the couch-roll 11 or by the conjoint propelling action of the two. A body of water maintained in such recess will, either by capillary attraction, greatly aided by the damp condition of the felt 6, its onward movement, or the forward travel of the cylindrical surface of the cylinder 10 and that of the couch-roll 11, reënter the web of stock or stuff from which it was expressed and stain the same, whether or not it has accumulated impurities, and thus damage it or retard the forming operation. In order to constantly remove the water from this recess and the similar ones at pairs of cylindrical surfaces, as couch-rolls 12 13 and press-rolls 14 15 16 17, and to keep it clear thereof, so as to avoid not only its defective action but form the paper as dry as possible at each stage of the operation thereon when water is to be expelled therefrom, such recess (it may be one or more in each machine) is provided with a pneumatic apparatus operating to remove the water as it is received in such recess by a blast of air suitably directed into such recess, and thus acting to keep the same free and clear of it. This pneumatic appliance consists, broadly,

in means for directing a blast of air into said recess, so that a body of air thus forcibly guided into it shall so impinge therein or upon one wall thereof as to drive or carry any water it may contain rearwardly out of said recess, guided by the other wall, and thus effectually remove the same from the point where it acts injuriously. There are many ways in which this removal of the water can be effected by the aid of a blast of air—such, for instance, as a suitable number of blast-directing nozzles properly adjusted or pointed therein, a conveying-pipe with suitable perforations or an air-emitting slit, and the like; but as these devices will so dissipate the water as to force it into the room containing the machine, and especially so at the forming-cylinder and the couch-rolls, it is desirable to provide a collecting box-like chamber therefor from out of which the water removed from the said recess may be bodily discharged. One good form of the blast appliance is well shown in Fig. 1, which is a small-scale illustration of the same in its relation to the forming-cylinder 10, carrying felt 6 and couch-roll 11, while the same structure is illustrated at one-half of normal size in Fig. 9. This structure is a hollow metal box-like chamber long enough to correspond with the length of the couch-roll 11, and comprises an air-emitting nozzle 1, formed by a lower member or plate 4, the forward end of which is adapted to rest upon or be supported quite close to the felt 6, being shod or not with a rubber, leather, or protecting-lip of similar material, and the upper member 5 of which supports, preferably inclined rearwardly from its front edge, an abutment 7. The outside wall or top plate 9 of this blast appliance has its forward end curved to conform with the arc of the couch-roll 11 (it may have a protecting-lip) and its rear portion curved in a reverse direction, not only to join the rear end of the nozzle 1 but to provide the interior with a guiding-conduit 2, that leads from the recess in front of the nozzle to the rear of the abutment 7, so as to communicate with the discharge-opening 8. The two ends of this appliance are closed by solid walls, one of which is well indicated by its lower edge line that joins its forward extremity, and each end preferably, it may be one only, has a discharge-opening 8, through which the ejected water and air may be discharged through a connecting-pipe, as 50, or otherwise, and the air-nozzle 1 is provided with one or more pipes 27, that communicate with a pump or other means for supplying air under pressure and which may be provided with means for the regulation of that pressure. This pneumatic appliance thus consists of a hollow structure provided with an air-eduction nozzle or passage and a guiding, conveying, or discharging conduit, between which it is provided with a mouth which connects with or taps the water-receiving recess. It being now understood that when the paper-machine is in operation this

blast appliance is also in action, the following coactive operation of the whole will be apparent.

As the forming-cylinder 10 slowly turns in its vat in the direction of its arrow its action will be to take up upon its exterior, as indicated in Fig. 1, a film or strata of fibrous stock or stuff surcharged with water and carry the same in web-like form upward on and toward the couch-roll 11. This web-like body of stock or stuff 3 in passing between the top surface of the forming-cylinder 10 and the under surface of the felt 6, which is an endless apron that travels over said couch-roll 11, will be simultaneously pressed between these devices and caused to adhere to the felt 6. At the same time much of the water with which it is charged will be pressed through said felt and enter into the recess between the upper side of the felt 6 and the front side of the couch-roll 11, and therefore enter within the sphere of the action of the air-current, said air current or blast being properly directed so as to impinge upon or against said water, and at once act to drive or force said water forward against the surface of the couch-roll 11, whereby it has its course of movement directed upward and rearward into the passage 2, and it is conveyed to the discharge-opening 8, this air-blast thus acting continuously to remove whatever water enters the said recess and comes within the range of action of the blast of air, which in practice will be equal to the entire removal of this water and therefore prevent its accumulation in said recess to produce any faulty action in the machine. It will have been observed that this appliance, as thus far described, has its air-blast directed upon the felt 6, which being the place where the water first appears or through which the water exudes may first be acted upon, but it is practical to cause the air to first impinge upon the surface of the couch-roll 11, whereby it will be given a direction of travel that will guide it first into the recess, whence it will sweep rearward over the felt and thus expel the water. Such a construction is shown enlarged in Fig. 5, where the air appliance is also shown in connection with the forming-cylinder 10, felt 6, and couch-roll 11, but slightly modified to suit this changed relation, as is indicated by like reference characters applied to the various corresponding parts.

Regarding now Fig. 2, the air appliance will be found to be slightly modified to suit the relative disposition of the cylindrical surfaces or couch-rolls 12 13 and the wire apron 18. In practice it will be found that the stretch of the wire apron 18 over a portion of the lower surface of the upper couch-roll 12 will cause some water to be given off and that the nip of the two couch-rolls 12 13 will by their pressure express from the stock or stuff itself additional water, all of which will flow into the recess that exists between these

couch-rolls at their front or entrance side, only the excess quantity thereof flowing by gravity into the floor-vat beneath them. The structure of this air appliance may therefore, while constructed in general as has been hereinbefore explained, as indicated by corresponding reference characters, be modified, as shown in that figure, so that the mouth of the air appliance will cover a considerable area of the wire 18, where it bears upon the upper couch-roll, and the nozzle of the blast-pipe be set rearward far enough to act upon such large area. If it should be found desirable that the blast of air be primarily directed against the couch-roll, the disposition of parts may be as shown in Fig. 6, which illustrates the top member 9 of the same as extended well forward to protect the wire 18 from the blast, as it may in some instances require to be. This air appliance may be equally well applied to the cylindrical surfaces or press-rolls, as 14 15, as is exhibited in Figs. 3, 7, 10, and 12, and to the cylindrical surfaces or press-rolls, as 16 17, as is exhibited in Figs. 4 and 8, when it will operate in substantially the same way as hereinbefore explained, but it may have various modified forms, some of which are exhibited in Figs. 8, 11, and 12, as applied to ordinary press-rolls. It should be noted, however, with respect to press-rolls, that each successive set in a paper-making machine expresses less water than its preceding set, and that consequently the water-receiving appliance may have its capacity reduced at each successive point where it is applied and also vary its structure, as will hereinafter appear. The structures of this air appliance shown in Figs. 3, 7, 10, and 13 are alike, one view, Fig. 3, being made upon reduced scale to show the rolls entire, and that of Figs. 7, 10, and 13 being enlarged to one-half ordinary size. The structure is substantially that shown in Fig. 6, as appears from a comparison of the parts which bear like indicating reference characters, but it is slightly modified to adapt it to first press-rolls, where its upper member 9 may be extended farther forward than in connection with couch-rolls.

The structure shown by Fig. 4 is substantially like that exhibited in Fig. 2, as appears by comparison, its blast-pipe being arranged to cause the blast it emits to first impinge on the under side of the felt apron 20 in like manner as said blast impinges upon the wire 18 in Fig. 2.

In Figs. 8 and 12 the air appliance, shown for convenience in the former as connected with second press-rolls 16 17 and in Fig. 12 in connection with first press-rolls 14 15, is modified so as to include an air-blast nozzle connected to its supply-pipe 27 by a universal joint 30, whereby it is made capable of pointing in any desired direction. With reference to second press-rolls (shown in Figs. 4 and 8) it will be understood that the amount of water expressed by them is a small quan-

tity, and especially so when water-discharging conductors are applied at other points earlier in action during the formation of the paper. Such discharge, therefore, may be so small in quantity that a chamber may not be needed for its collection and conveyance away from the machine, and for this same reason and the further fact that quick drying is important a collecting-chamber may be omitted, as in Fig. 8, and the air used at this point may be heated. At the first press-rolls, however, the amount of water is great enough to make it desirable to collect the discharged water, and hence an inclosing chamber is used, as shown in Figs. 3, 7, 10, 12, and 13, which chamber is provided with a guiding-conduit 2 for the conveyance of the matter discharged, which conduit is preferably supplied with an abutment 7 for its control, although its omission is possible, as shown in Fig. 5.

In Fig. 11 there is shown a further modification of the air appliance. This consists of a set of three longitudinally-arranged sets of conveying-pipes 40 41 42, each having independent supply-pipes 27. The innermost ends of the sets 40 41 are shown as joined with the set 42 by means of sleeves 35, and the outermost ends of the sets 40 41 are capable of turning in journals 43 44, so that all may have a longitudinal stiffness capacitating them to move as a unit and admit of a common vertical adjustment of the nozzles they support or enable the sets to be independently adjusted, these pipes 40 41 42 being of course provided at their respective ends with closures, or are blanked, thus making them independent conveyers. Independent sets of blast-conveyers are desirable in cases where it is expedient to apply a differing force of air to various parts of the recess; but the blast-nozzles and the pipes 40 41 42 may be a single device, longitudinally considered, and either in this form or the three-part form shown in Fig. 11 may have the end nozzles provided with a universal joint connecting them with their supply-pipe, as Fig. 12 is made to additionally show, though it is to be understood that the device of Fig. 12 is to have the inclosing chamber or not, as may be desirable, according to the place where it is used. The making of these end nozzles universally adjustable is at all times desirable, and especially so when the inclosing chamber is not used, for the reason that then the appliance may be more efficient as a whole if the blast at the extreme ends of the roll drives slightly inward and downward and with increased force, so as to prevent any water reaching the overhanging felt.

The slight opening shown between the front edge of this appliance and the nip of the felt 6 and couch-roll 11, as well as between the wire 18 and couch-rolls 12 13, the felt 19 and press-rolls 14 15, and the felt 20 and the press-rolls 16 17, will in many cases be objectionable, although the movement of the air and

water moved thereby is nearly directly rearward. To prevent any air and water being projected laterally through this opening, the air appliance has its end plates or closure extended far enough forward so as to cover and thus close these openings, it may be, by extending them so as to lap over the ends of the rolls past the nip thereof, (see Figs. 7 and 13,) provision, however, being made, as shown in Fig. 7, for the passage of the felt or wire. In most of these illustrations the air appliance is shown as furnished at one end with an air-supply pipe 27, which in turn in each instance is connected with a pipe 28, leading to an air-pump or other convenient means for providing a current of air under pressure by which the air-blast is supplied. Suitable ones of these pipes may have cocks or other devices to control the amount of air used or the force thereof, which may thus be made to differ in extent at different places, as is sometimes desirable.

Concerning the damaging effect of water made use of in the production of paper it is to be noted that where water, even though it be pure, is allowed to soak into a paper web by moving backward into the same after it has been expelled therefrom it has the effect to impart to the web stains that present irregular bounds or form waved lines which are the limits to which this returning water extends before it is so far absorbed as to cease its movement. These stains are readily perceived in the finished paper and cause the sections of the web containing them to be useless, which damaging action of the water, pure or impure, is prevented by this invention.

In some cases the stock or stuff undergoing formation into paper may be so far freed from water as it leaves the couch or first press rolls that it can be led to and passed through the first or second press-rolls without the aid of a carrying-felt, in the absence of which felt this invention will coact with the web of stock or stuff and a press-roll and operate to almost completely remove its remaining dampness, and such arrangement is therefore comprehended by this invention.

By the use of this invention the water is removed from said recess as rapidly as it is expressed from the stock or stuff by means which have a positive action thereon and the following advantageous results are obtained: A high speed of production may be attained, for the reason that the paper becomes stronger because drier at all stages of its formation. Larger couch and press rolls may be employed, the number of sets of press-rolls may be reduced, and a less extent of drying-surface be required or less heat needed for the drying operation.

Another important and beneficial effect is produced by this improvement upon the end-less felts, which, in order to produce the best results, are made wider than the press-rolls are long, whence it results that such pro-

jecting parts are not clamped between the rolls, but, on the contrary, are free and therefore in the best condition to readily absorb water if the same is present in said recess between the press-rolls. The result is that when water is present there and the edges of the felt become charged with it they not only carry the water onward and fling it over the machine, but in consequence of such wet edges being in contact with the paper web after it has passed the press-rolls they give off the water they carry to the edges of the paper, and thus impregnate the otherwise drier body of the web with water, so that the pressing and drying thereof must be great enough for the treatment of the wet edges or, otherwise stated, in excess of what is required for the body portion. In consequence of the fact that this conductor prevents the return of practically all water that is once removed from the stock and the wire or felt carrying the same, with the advantages already stated, it also results in causing the forming paper to be made drier in the earlier stages of and throughout its formation, and therefore enables its course of travel to be lessened and permits of a reduction of the great length in which these machines are now constructed.

The application of these improvements to a paper-machine enables stronger paper to be made, because being formed drier it does not require to be heated so much and injured thereby. It enables more paper to be made in a given time, because in the web state it is drier, and hence not so liable to break and make waste. It saves the felt of the driers from injury, because a lower degree of heat may be used and the paper when led to them not being so wet as when made by a machine without this improvement there is less wetting and consequent drying of said felts, which rots them. It improves the quality of the paper by running faster, because there is less water to take out of it during the greater portion of its formation, and by its action it keeps impurities from entering the felts, and thus soiling them, so that they require frequent washing, which is detrimental in that felts frequently washed are thereby worn out and rendered useless, and it prevents the edges of the press-felts from receiving water and carrying it into the borders of the paper beyond the rolls.

What is claimed is—

1. In a paper-making machine the combination with cylindrical surfaces between which the forming paper, its stock or stuff is carried and from which water is discharged into a recess between these surfaces at the entrance side thereof, of means, exterior to said surfaces, cooperating with said recess to direct a blast of air therein and expel said water therefrom, substantially as described.

2. In a paper-making machine the combination with a traveling support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the traveling sup-

port and from which water is discharged into a recess between these surfaces at the entrance side thereof, and means, exterior to said surfaces, cooperating with said recess to direct a blast of air therein and expel said water therefrom, substantially as described.

3. In a paper-making machine, the combination with cylindrical surfaces between which wet stock is fed in web-like form, of means for directing a blast of air into the recess between the surfaces on the entrance side thereof, said blast acting in the general direction in which the stock is moving and operating to expel the liquid which accumulates in said recess by reason of the action of the surfaces on the wet stock, substantially as described.

4. In a paper-making machine, the combination with a traveling support, of cylindrical surfaces between which wet stock is fed in web-like form, and means for directing a blast of air into the recess between the surfaces on the entrance side thereof, said blast acting in the general direction in which the stock is moving and operating to expel the liquid which accumulates in said recess by reason of the action of the surfaces on the wet stock, substantially as described.

5. In a paper-making machine the combination with a traveling support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the traveling support and from which water is discharged into a recess between these surfaces at the entrance side thereof, and means, exterior to said surfaces, for directing a blast of air into impingement upon one wall of said recess and thus operating to drive or carry said water from the recess, substantially as described.

6. In a paper-making machine the combination with a traveling support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the traveling support and from which water is discharged into a recess at the entrance side of said surfaces, and a hollow or box-like structure provided with an air nozzle or passage and a guiding-conduit, between which it has a mouth or orifice that connects with or taps said recess, said conduit connecting with a discharge-opening, substantially as described.

7. In a paper-making machine, the combination with cylindrical surfaces between which wet stock is fed in web-like form, of a blast device operating to direct a blast of air into the recess between the surfaces in the general direction of the travel of the stock, said blast device including means for guiding and delivering air into the recess between the surfaces, and means for guiding the liquid expelled by the air out of said recess, substantially as described.

8. The combination with cylindrical surfaces between which wet stock is fed in web-like form, of a blast device operating to direct the blast of air into the recess between

the surfaces in the general direction of the travel of the stock, said blast device including a conduit or conduits for directing the air into the recess between the surfaces and a wall acting to guide the liquid expelled by the blast out of said recess, substantially as described.

9. In a paper-making machine the combination with a support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the support and from which water is discharged into a recess at the entrance side of said surfaces, and a hollow or box-like structure provided with an air nozzle or passage and a guiding-conduit, between which it has a mouth or orifice that connects with or taps said recess, said conduit connecting with a discharge-opening and being provided with an abutment to prevent the return of said water, substantially as described.

10. In a paper-making machine the combination with cylindrical surfaces between which the stock or stuff is carried and from which water is discharged into a recess at the entrance side of said surfaces, of an air-blast nozzle connected with its source of supply by a universal joint for directing a blast of air into said recess and thus operating to expel said water from the recess, substantially as described.

11. In a paper-making machine the combination with a support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the support and from which water is discharged into a recess at the entrance side of said surfaces, and an air-blast nozzle connected with its source of supply by a universal joint for directing a blast of air into said recess and thus operating to drive or carry said water from the recess, substantially as described.

12. In a paper-making machine the combination with a traveling support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the traveling sup-

port and from which water is discharged into a recess at the entrance side of said surfaces, and a series of air-blast nozzles, the outer ones of which are provided with universal joints for directing a blast of air into said recess and thus operating to drive or carry said water from the recess, substantially as described.

13. In a paper-making machine the combination with a support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the support and from which water is discharged into a recess at the entrance side of said surfaces, and a series of air-blast nozzles capable of vertical adjustment in sections, the outer nozzles being provided with universal joints for directing a blast of air into said recess and thus operating to drive or carry said water from the recess, substantially as described.

14. In a paper-making machine the combination with a support of cylindrical surfaces between which the stock or stuff is accompanied or carried by the support and from which water is discharged into a recess at the entrance side of said surfaces, and a blast-emitting appliance divided into two or more independent sections whereby the water is discharged from said recess by an air-current differing in force at various parts of said recess, substantially as described.

15. In a paper-making machine the combination with press-rolls between which the web of wet unfinished paper is carried, and with the recess at the entrance side of said rolls, of means cooperating with said recess to direct a blast of heated air therein and remove dampness from said web, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

THOMAS H. SAVERY.

Witnesses:

S. WINTHAL,
J. J. KENNEDY.