J. D. TOMPKINS.

APPARATUS FOR DRYING PAPER.

APPLICATION FILED MAY 25, 1908.

976,948. Patented Nov. 29, 1910.

Fig: 1

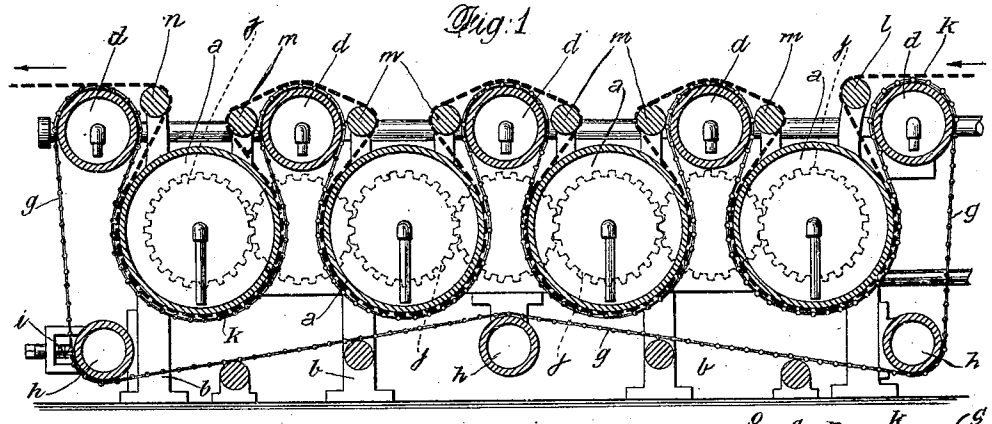


Fig: 2

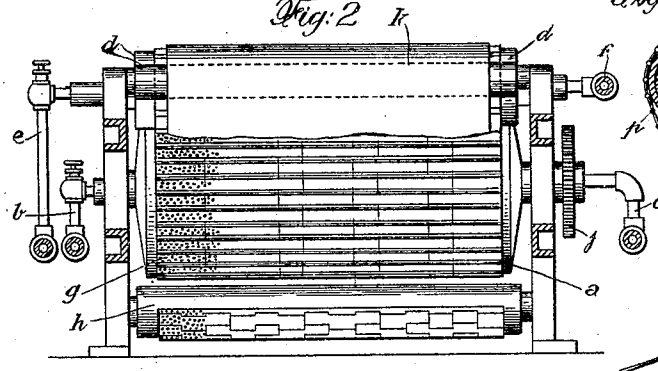


Fig: 3

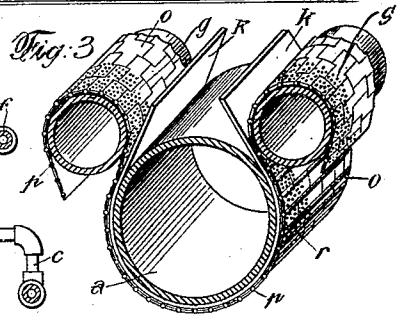


Fig: 4

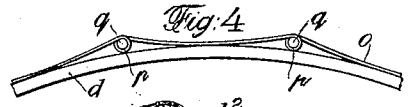


Fig: 5

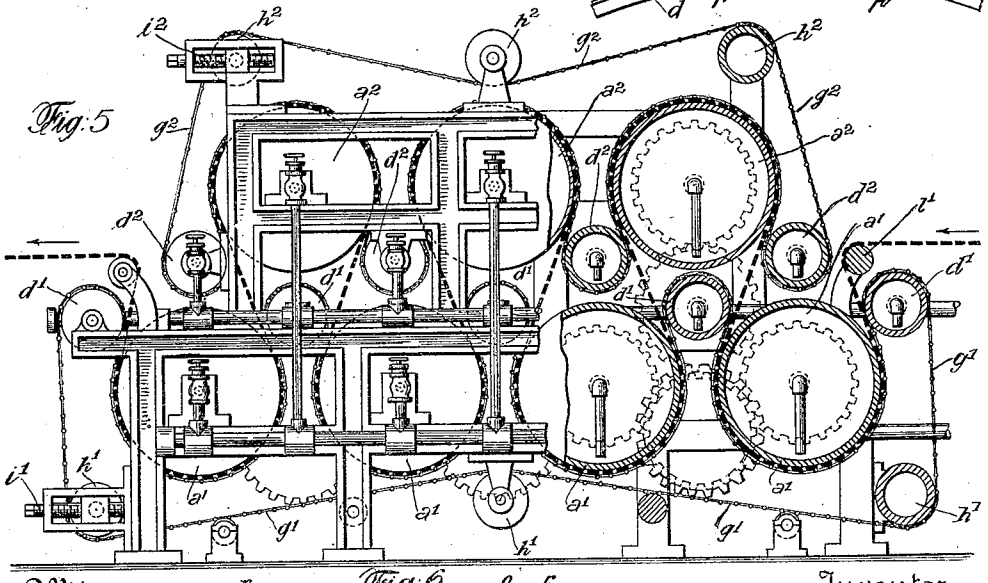
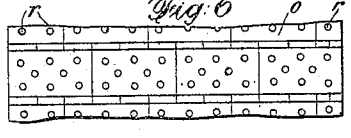


Fig: 6



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JOHN D. TOMPKINS, OF VALATIE, NEW YORK.

APPARATUS FOR DRYING PAPER.

976,948. Specification of Letters Patent. Patented Nov. 29, 1910.

Application filed May 25, 1908. Serial No. 434,936.

To all whom it may concern:

Be it known that I, JOHN D. TOMPKINS, of Valatie, in the county of Columbia and State of New York, have invented a certain new and useful Improvement in Apparatus for Drying Paper, and do hereby declare that the following is a full and exact description thereof.

The object of my invention is to provide an apparatus for rapidly drying a traveling web of paper so as to produce a product having the qualities in almost every respect of paper dried at low temperatures and in the presence of atmospheric air. That is to say, that I provide an apparatus which will rapidly heat and dry a traveling web of paper, which latter when dried will have a very great tensile strength. In order to accomplish this result, I make use of an apparatus in which the traveling web of paper is heated on both surfaces simultaneously, one surface being heated by a series of steam heated drums, and the other surface being heated while the paper is in contact with said drums by means of a heated foraminous metal apron. By heating both surfaces simultaneously in this manner, the web of paper can be dried at a much lower temperature for a given speed, than is possible when only one surface of the web is heated for the purpose of drying it. The paper in this instance is also heated and dried at a more even temperature than would be the case where the web is heated from one surface only. This is a very important factor, as uneven heating produces uneven drying and shrinking, and as a consequence, there is a tendency to the production of internal strains which can only result in lessening the tensile strength of the paper and making it more liable to tearing.

In my apparatus while the traveling web of paper is passing from one drum to the next succeeding drum, the metal apron is arranged to be re-heated by being led over the periphery of an auxiliary heating drum. During this interval, the web of paper is separated from the metal apron so as to allow the water vapor to escape from both surfaces thereof simultaneously, and as a consequence, to allow the paper to dry rapidly and evenly. After the paper has been dried in this manner and the metal apron re-heated in the manner described, the two are again led upon a succeeding drying cylinder or drum where the web of paper is heated again in the manner above described. These steps are repeated in the order described until the web of paper has become completely dry.

An important feature of my apparatus is the metal apron. I make use, for this purpose, of an apron consisting of a series of linked perforated plates. This is the most desirable way of constructing a metal belt in machines of this character, as, where the belt is made of woven wire or is constructed in any other way of flexible metal, the metal has a tendency to crystallize from the constant flexing and to eventually break. This necessitates frequent repairing and results in a frequent loss of time in the operation of the machine. Again, in using a metal belt comprising a number of metal plates, I am enabled to maintain a greater body of heat in the traveling apron and thereby obviate to any great degree the tendency to cool that must, of necessity, be present where the belt is intermittently heated. Furthermore, metal plates maintain a closer contact with the surface of the traveling web of paper and are thereby enabled to transfer a large body of heat and more evenly to the web of paper.

I preferably maintain the cylinders, which are designed to heat one surface of the traveling web of paper, at a higher temperature than the metal belt, although this I do not consider to be absolutely essential. By this feature, the moisture which is located on the inner surface of the web of paper, that is, the surface adjacent to the heating drums, is enabled to escape at about the same rate as the moisture which is located on the outer surface of the web. This follows from the fact that the inner surface is not in contact with the outer air, but is confined by the surface of the heating drum, whereas the outer surface is constantly maintained in the presence of the surrounding atmosphere owing to the provision of numerous perforations in the metal belt. In any case, in my apparatus whether the heating drums are maintained at a higher temperature than the metal belt or not, the provision of a heated metal belt results in maintaining a heated stratum of air on the exterior of the metal belt and adjacent to the outer surface of the traveling web of paper. The heating of this layer of air results in lowering its

degree of saturation and this, of course, facilitates the evaporation of the moisture from the web of paper.

The apparatus is shown in the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of one type of apparatus that I may use; Fig. 2 is a transverse vertical section of the same apparatus; Fig. 3 is a detail thereof; Fig. 4 is a side elevation of the metal apron used; Fig. 5 is a side elevation of another type of machine which may be used; and Fig. 6 is a plan view of a fragment of the metal apron.

Referring to Figs. 1 to 3, *a* indicates a series of main drying drums carried by the supports *b*, each of which is provided with a means for heating the same such as a steam inlet pipe *b* and a steam exhaust *c*, the former being located at one end of each cylinder, and the latter at the other end. Between and above these cylinders are located a series of auxiliary heating cylinders *d*, having similar steam inlet and exhaust pipes *e* and *f*.

A traveling metal belt or apron *g* is adapted to pass around the auxiliary heating drums *d* and the drying drums *a* alternately. The lower portion of the belt *g* is guided and sustained by a series of idler rolls *h*, which may be heated or not as found desirable. One of these rolls may be made adjustable as shown at *i* in Fig. 1, so as to take up the slack in the belt. For propelling the belt *g* and the main drying drums *a*, a train of gears *j* is provided, every alternate one of which is located upon a shaft of one of the drying drums *a*, and the intermediate remaining ones being located between the gears on the drying drums *a*, so as to propel the latter all in the same direction and at an equal speed. The traveling web of paper *k* is led into the machine, as shown at the right of Fig. 1, over a guide roll *l*, from which point it passes downwardly between the metal belt and the drying drum at this portion of the machine. The web of paper after passing around this drum passes upwardly out of contact with the apron and drum and is led over a guide roll *m* located at one side of one of the auxiliary heating drums *d*. Symmetrically placed on the other side of this auxiliary heating drum is a similar guide roll *m* for the paper web. The remaining auxiliary heating drums *d*, with the exception of the one located at the back or end of the machine shown at the left of Fig. 1, are each provided with a pair of guide rolls *m*, similar to those already described The last auxiliary heating roll is provided with a single guide roll *n* similarly located to the guide roll *l*, located at the front of the machine.

Referring to Figs. 4 and 6 which show the construction of the metal belt, I find the most effective arrangement for this portion of my apparatus to consist of a number of curved plates *o* hinged to one another at the points *p* by means of pintles *q* extending throughout the entire width of the metal belt. As shown in Figs. 4 and 6, the method by which I preferably hinge adjacent plates to each other, consists in curving the edges of the plates around the pintles at short intervals throughout the adjacent edge of each plate, one plate being supported from said pintle for a few inches, then the adjoining plate being supported in the same manner for a corresponding distance throughout the entire width of the belt. I have arranged the curvature of each plate so that it will fit closely to the traveling web of paper while it is supported upon the drying drums *a*, so as to obtain the maximum heating effect. I have also arranged the size of the pintles *q* so that while the apron is passing around the heating drums *d*, the central portion of each plate *o* will be in contact with the periphery of the drum, as will also the curved portions of each edge of the plate surrounding the pintles used for hinging one plate to the other. Inasmuch as each plate, therefore, contacts with the heating drum *d* along three different lines, a large quantity of heat can be conducted from the heating drum to the traveling apron. The plates *o* of the apron are provided with a plurality of openings or perforations *r*, which may be of any desired shape or size.

The other modification, as shown in Fig. 5, consists of a lower series of drying drums a' and an upper series of drying drums a^2, located intermediate of the members of the lower series of drums. The lower series of drying drums are provided with a series of auxiliary heating drums *d*, located in the same relation thereto as in the modification shown in Fig. 1. The upper series of drying drums a^2 are provided with a like series of auxiliary drying drums d^2, located in an analogous manner, though below instead of above the series of drums. A train of gears j', similar to the gears *j* already described, is provided for rotating the lower drying drums a', and gears j^2 are arranged so as to mesh with these to drive the upper drying drums a^2 through the agency gears j^3. Idlers h', such as those shown in Fig. 1, are also provided for the lower series of drums a', and similar idlers h^2 are located adjacent to the upper series of drying drums a^2, but above instead of below the drums. One of the idlers in each set on this machine is made adjustable, as shown at i' and i^2, so as to take up the slack in each of two aprons g' and g^2, traveling around the respective sets or series of drying drums. The traveling web of paper in this instance is led into the machine over a guide roll l', shown at the right of Fig. 5, whence it pro-

ceeds around the first member of the lower series of drying drums, thence upwardly over the first member of the other series of drums, and then downwardly again to the next drum in the lower series, and so on until it has passed around all of the drums in the machine. During the passage of the web of paper from one drum to another, each of the traveling belts or aprons g' and g^2 is led around one of the auxiliary heating drums d' and d^2 so as to be pre-heated or re-heated preparatory to being led into contact with the outer surface of the traveling web of paper while it is supported upon the drying drums.

In either of the modified forms of the apparatus above described, the moist web of paper is led into the machine between a drying drum and the traveling metal belt or apron passing over the same, the drying drum being preferably, though not necessarily, maintained at a higher temperature than the temperature of the metal apron while it is in contact with the web of paper supported upon the drum. The web of paper is thus heated from both surfaces simultaneously, so that before it leaves one drum it has become effectively and thoroughly heated throughout its entire thickness. The inner surface of the web, however, that is to say, the surface adjacent to the drying drum, is maintained at a somewhat higher temperature than the outer surface of the web of paper, for the reason that it is much more difficult for the moisture to escape from the body of the paper next to the cylinder than it is from the outer surface of the web of paper, inasmuch as the latter is constantly in contact with the outer air, whereas the moisture in other parts of the body of the web is compelled to pass through the web itself before escaping. The heated metal belt further maintains a stratum of highly heated air in contact with the outer surface of the traveling web of paper. This stratum of air because of its high temperature, has a lower degree of saturation than has the surrounding atmosphere. Such being the case, the moisture from the web will evaporate much more rapidly and readily than were the air at this point not heated. Again, from the fact that the web is heated from both surfaces simultaneously, it follows that the paper will dry and shrink much more evenly. This is very important, because in the case where the paper is heated from one surface alone, that surface will have a tendency to dry much more rapidly and shrink in a corresponding manner and consequently set up unequal strains throughout the body of paper, resulting in a product which will have a much greater tendency to tear than in the case where the web is dried evenly.

It will be seen that by the provision in my apparatus of the guide rolls located on either side of the auxiliary heating drums, the traveling web of paper is periodically separated from the heating drums. This results in allowing the web of paper to become dried as rapidly as possible and as evenly as possible. During these intervals, portions of the metal aprons are heated so as to raise them as nearly as possible to their ideal temperature before passing again to the succeeding drying drums.

While I have described my machines above in detail, I do not wish it to be understood that I am necessarily limited to the details herein described, as I consider that many changes might be made without departing from the fundamental principles of my invention.

I claim:

1. In a paper-drying apparatus, the combination of a drying drum and a foraminous metal apron consisting of hinged plates traveling with a web of paper over said drum and adapted to maintain the traveling web of paper in contact with the drying drum.

2. In a paper-drying apparatus, the combination of a drying drum a heated foraminous metal apron consisting of hinged plates traveling with a web of paper over said drum and adapted to maintain the traveling web of paper in contact with the drying drum and means for heating said apron.

3. In a paper-drying apparatus, the combination of a drying drum, a foraminous metal apron consisting of hinged plates traveling with a web of paper over said drum and adapted to maintain the traveling web of paper in contact with the drying drum, and an auxiliary heating drum for preheating the metal apron prior to its being led into coöperation with the drying drum.

4. In a paper-drying apparatus, the combination of a drying drum, a heated foraminous metal apron consisting of hinged plates traveling with a web of paper over said drum and adapted to maintain the traveling web of paper in contact with the drying drum, and one or more guide rolls for supporting the web of paper out of contact with the foraminous metal apron, when the latter is separated from the drying drum, so as to allow it to dry evenly and means for heating said apron.

5. In a paper-drying apparatus, the combination of a drying drum, a foraminous metal apron consisting of hinged plates traveling with a web over said drum and adapted to maintain the traveling web of paper in contact with the drying drum, an auxiliary heating drum for preheating the metal apron prior to its being led into cooperation with the drying drum, and one or more guide rolls for supporting the web

of paper out of contact with the foraminous metal apron, when the latter is separated from the drying drum, so as to allow it to dry evenly.

6. In a paper-drying apparatus, the combination of a series of drying drums and a foraminous metal apron consisting of hinged plates traveling with a web of paper over said drums and adapted to maintain the traveling web of paper in contact with the drying drums.

7. In a paper-drying apparatus, the combination of a series of drying drums and a heated foraminous metal apron consisting of hinged plates traveling with a web of paper over said drums and adapted to maintain the traveling web of paper in contact with the drying drums.

8. In a paper-drying apparatus, the combination of a series of drying drums, a foraminous metal apron consisting of hinged plates traveling with a web of paper over said drums and adapted to maintain the traveling web of paper in contact with the drying drums, and a series of auxiliary heating drums for preheating the metal apron prior to its being led into coöperation with the drying drums.

9. In a paper-drying apparatus, the combination of a series of drying drums, a foraminous metal apron consisting of hinged plates traveling with a web of paper over said drums and adapted to maintain the traveling web of paper in contact with the drying drums, and a series of guide rolls for supporting the web of paper out of contact with the foraminous metal apron when the latter is separated from the drying drums, so as to allow it to dry evenly.

10. In a paper-drying apparatus, the combination of a series of drying drums, a heated foraminous metal apron consisting of hinged plates traveling with a web of paper over said drums and adapted to maintain the traveling web of paper in contact with the drying drums, a series of guide rolls for supporting the web of paper out of contact with the foraminous metal apron when the latter is separated from the drying drums, so as to allow it to dry evenly and means for heating said apron.

11. In a paper-drying apparatus, the combination of a series of drying drums, a foraminous metal apron consisting of hinged plates traveling with a web of paper over said drums and adapted to maintain the traveling web of paper in contact with the drying drums, a series of auxiliary heating drums for preheating the metal apron prior to its being led into coöperation with the drying drums, and a series of guide rolls for supporting the web of paper out of contact with the foraminous metal apron, when the latter is separated from the drying drums, so as to allow it to dry evenly.

12. In a paper drying apparatus, the combination of a series of drying drums, a foraminous metal apron, comprising a plurality of hinged plates traveling with a web of paper over said drums, a series of auxiliary supporting and heating drums for heating the metal apron, means for heating the drying drums and maintaining them at a higher temperature than the metal apron, and a series of guide rolls for supporting the web of paper out of contact with the foraminous metal apron when the latter is separated from the drying drums, so as to allow it to dry evenly.

13. In a device of the character described, the combination of a metal apron, said apron comprising a series of curved plates having perforations, said plates being hinged to one another and a curved surface conforming to the curvature of said plates to support the apron and a web of paper.

In testimony that I claim the foregoing I have hereunto set my hand.

JOHN D. TOMPKINS.

Witnessses:

ANNA NEWCOMB,

MARIAN MEIKLE.