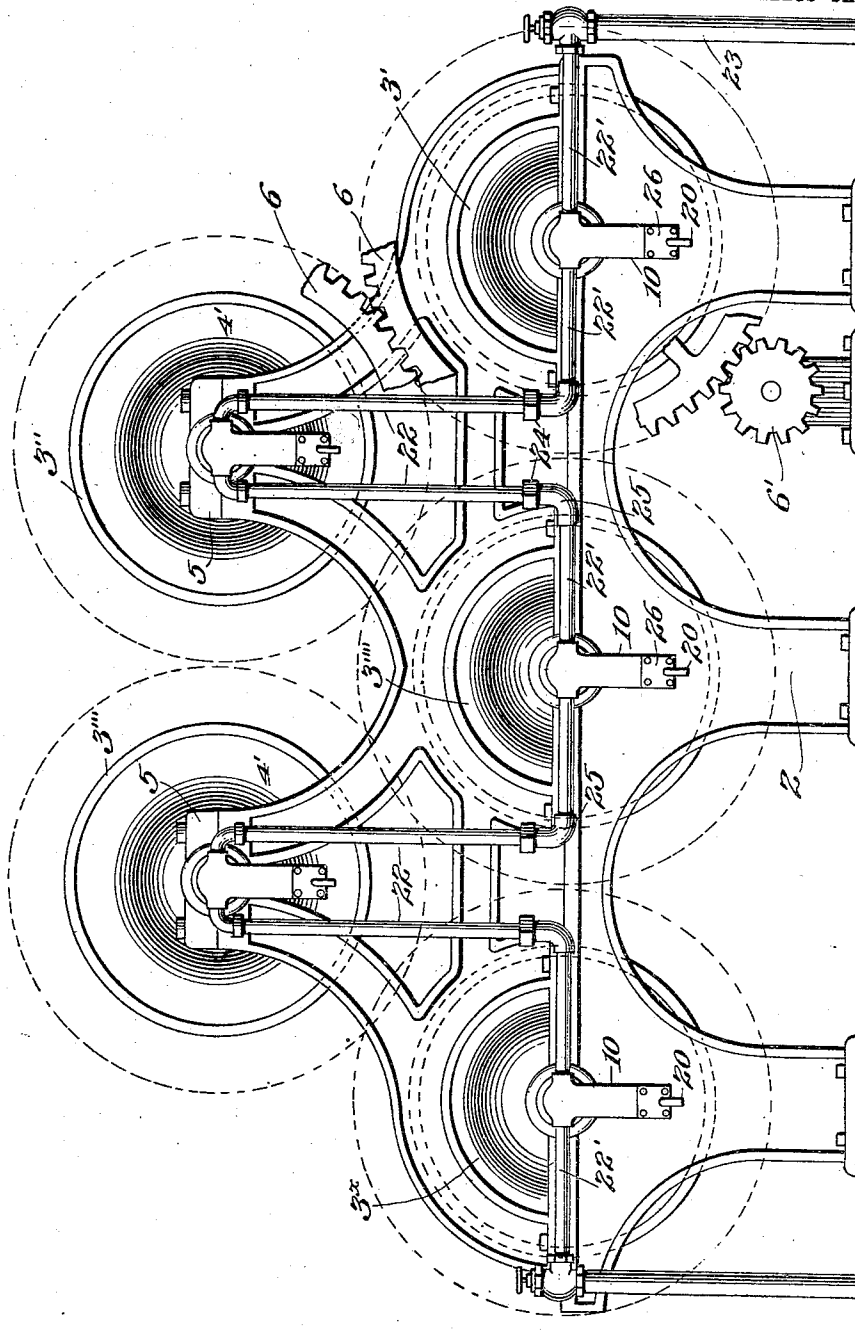


935,771.

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PAPER DRYING MACHINE.
APPLICATION FILED AUG. 5, 1908.

Patented Oct. 5, 1909.
3 SHEETS—SHEET 1.

Fig. 1.



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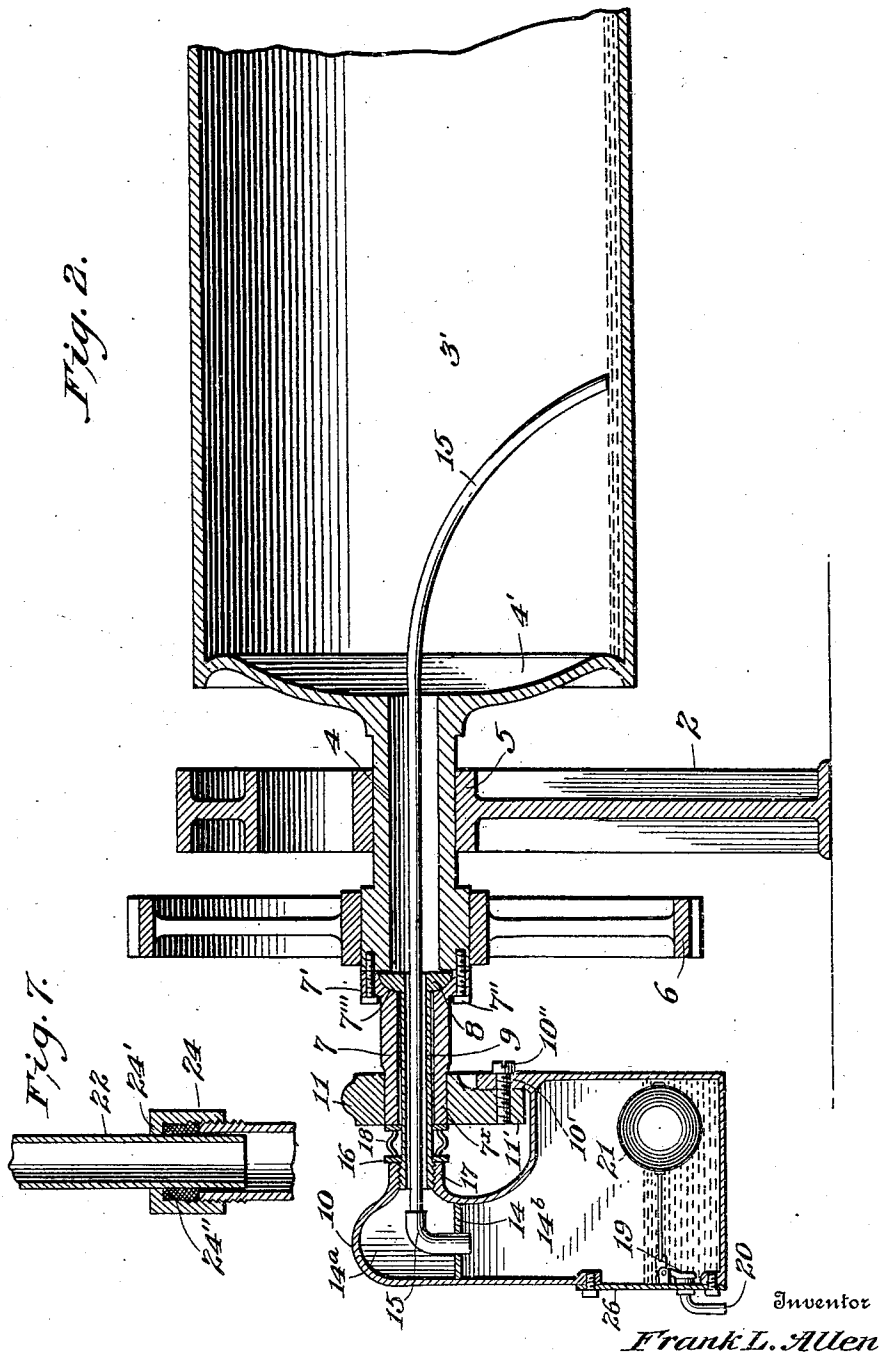
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3 SHEETS—SHEET 3.

Fig. 3.

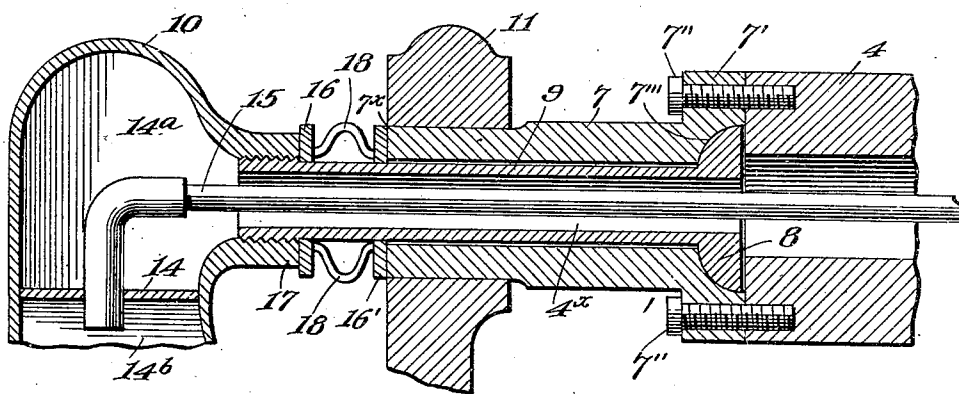


Fig. 4.

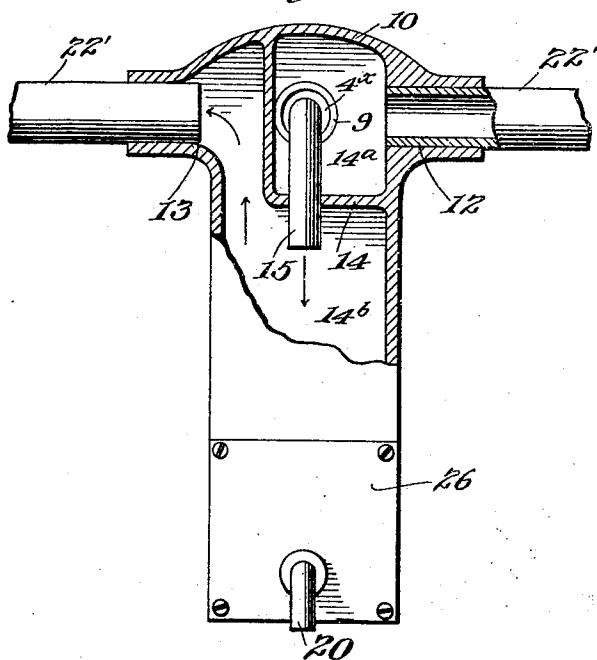


Fig. 5.

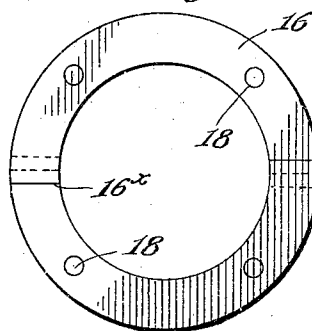
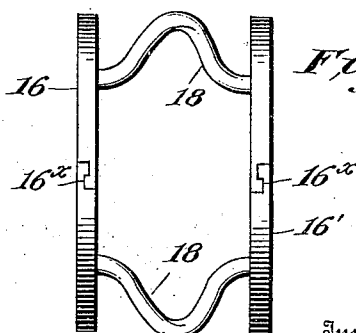


Fig. 6.



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PAPER-DRYING MACHINE.

935,771.

Specification of Letters Patent.

Patented Oct. 5, 1909.

Application filed August 5, 1908. Serial No. 447,010.

To all whom it may concern:

Be it known that I, FRANK L. ALLEN, a citizen of the United States, residing at St. Joseph, in the county of Berrien and State of Michigan, have invented certain new and useful Improvements in Paper-Drying Machines, of which the following is a specification.

My invention relates to drying machines, and particularly to drying cylinders arranged in series, and means whereby the series of cylinders are supplied with steam and the water of condensation removed, my invention being particularly applicable to machines for drying paper, though I do not limit myself to this application of my invention.

Drying cylinders ordinarily constructed are arranged in series, each cylinder however being supplied with steam independently from a common supply pipe, and hence the temperature of the cylinders is never equalized or constant throughout the whole series. With this also the means commonly employed for removing the water of condensation from these cylinders is inadequate and not positive whereby more or less water always remains within the cylinders, and at various levels in different cylinders, thus creating differences in temperature in the several cylinders, instead of the equal temperature which is necessary to a proper treatment of the web passing thereover. In addition the presence of water in the cylinders acts to cause back pressure in the steam pipe, and further steam is also liable to escape by way of the water outflow pipe causing waste of steam.

One main object of my invention is to overcome these difficulties by providing means whereby the steam may pass through the series of cylinders successively, thus securing the equalization of temperature in all the cylinders.

Another object is to provide automatic means for positively forcing any water out of the cylinders and into a separator or collector whenever it accumulates in any cylinder, and in this connection to provide means whereby the steam which may force the water into the separator or be carried over with it shall not be wasted, but shall be separated from the water and carried on to the next succeeding cylinder.

A still further object is to prevent the escape and consequent waste of steam which

occurs at the junction of the cylinders with the outlet and inlet pipes.

To these ends my invention consists: First, in connecting the drying cylinders in series to each other by steam conducting pipes and connecting the first cylinder of the series to a source of steam whereby the steam passes from one cylinder to another in succession, thus having free circulation between the same. Second, in providing water separating chambers or casings at intervals along the line of conducting pipes into which a pipe from the interior of the cylinder leads whereby the steam in its effort to find a passage from said cylinder will positively force the water in said cylinder out into said separating chamber, wherein the water will be retained, while the steam is conducted on to the next cylinder as before described.

My invention further consists in a peculiar construction of steam joint whereby the steam is prevented from escaping at the junction of the cylinder journal with the said separator.

In the drawings, Figure 1, is a side elevation of a drying machine constructed in accordance with my invention. Fig. 2, is a longitudinal section of one of the cylinders thereof. Fig. 3, is an enlarged detail section of the cylinder journal and the lining and packing ring therefor. Fig. 4, is a face view of one of the separators partly broken away. Fig. 5, is a face view of one of the thrust collars. Fig. 6, is a front elevation of said collars, and Fig. 7, is a detail section of one of the pipe joints used in the conducting pipes.

The supporting frame 2 of my apparatus may be of any usual or desired construction. Rotatably supported upon it are a series of hollow cylinders, 3', 3'', 3''', 3'''', 3^x, each having a hollow journal 4 which is supported by a bearing 5 formed upon the frame 2. I have shown five of these cylinders or drums arranged alternately on a higher or lower plane, and in a series around which a web of paper, cloth or other material is to be passed for drying. I have not shown the guide rollers, etc., as these are well known and have nothing to do with my invention. Each of these drums consists of a cylinder of thin metal having opposed heads. One of these heads 4' is provided with a tubular or hollow journal 4 which rotates in the journal box 5. Fast upon this journal is a toothed gear wheel 6 which

meshes with the corresponding toothed gear wheel on the next cylinder in order. Thus the gear wheel of the cylinder 3' meshes with the gear wheel 6 of the cylinder 3'' which in turn conveys power to cylinders 3''', 3'''' and so on. The gear wheel 6 of the first cylinder may be driven by any suitable means as by a spur gear 6' driven in turn by any desired prime mover not shown.

Broadly my invention contemplates connecting the drying cylinder through its journal with a steam inlet pipe, and leading out of the cylinder through the journal thereof a steam and water outlet pipe, which passes into a separator wherein the water falls to the bottom and the steam, in the upper portion of this separator, is conducted to the next following drying cylinder. In detail my preferred construction is as follows:

Located at the end of the hollow journal 4 is a tubular extension 7 which practically forms part of said journal having its inside end outwardly flanged as at 7'. The margin of this flange is provided with bolts 7'' whereby the extension is attached and rigidly connected to the end of the hollow journal 4 and rotates therewith. The bore of the extension 7 is somewhat smaller than the bore of the journal 4, as will be seen in Fig. 3. The inner end of the extension 7 which fits tightly against the journal 4, is formed with an annular rabbet 7''' forming a seat, whose face is concaved and ground to fit tightly against a packing ring 8. This packing ring is less in interior diameter than the opening of the journal 4 and is attached to the inner end of a tubular lining or sleeve 9, which fits fairly closely within the extension 7. At its outer end where it projects outward beyond the extension 7 this sleeve or lining is screw threaded for connection with the casing 10 which forms a water collector and steam separator. The packing ring in cross section is the segment of a circle, one of the flat faces of which bears against the inner end of the journal 4, while its curved or convex face bears against the concave face of the seat 7'''.

The water collector and steam separator consists of a rectangular casing which is attached to and supported by a hanger 11 which surrounds the journal extension 7 but is loose thereon. In detail the extension is reduced as at 7* to receive the hanger 11, and the hanger is widened out at its bottom to form a plate 11' to which the thickened upwardly extending flange 10' on the rear of the separator 10 is attached by tap bolts 10''. At the upper end of the separator is an inlet opening 12 formed with a nipple for the attachment of a conducting pipe conveying steam either from a boiler

or from one of the other cylinders, while directly opposite an outlet opening 13 having a nipple is provided to which a conducting pipe is attached leading to one of the other cylinders or to any suitable final outlet pipe.

At its upper end the separating chamber 10 is provided with a partition 14 which divides the separator into two portions or compartments 14^a, 14^b. This partition extends downward from the top of the casing at one side of the opening 9' leading from the cylinder and between said opening and the outlet opening 13 to a point below the level of the inlet pipe 12. The partition then extends to the side of the separator below the entrance of pipe 12. I shall hereafter term the compartment 14^a the inlet compartment, and the compartment 14^b the outlet or separating compartment.

Located within the tubular journal 4 and its extension 7 and suitably spaced therefrom is a steam and water conducting pipe 15, the inner end of which is downwardly turned at a point adjacent to the lowest portion of the cylinder. At its outer end the pipe 15 projects through the extension 7 and extends into and through the compartment 14^a, through the partition 14 and into the outlet compartment 14^b. The pipe 15 is for the purpose of conducting steam and condensed water from the cylinder to the separator, while the annular space surrounding it is for the purpose of conducting steam from compartment 14^a to the interior of the cylinder. In order that a steam tight joint shall be made between the rotating journal-extension 7 and the said lining 9, so that steam may not escape around the lining or at the junction of the journal with the separator I provide the expansible thrust collars 16, 16', shown in detail in Figs. 5 and 6, working in connection with the packing ring 8 and lining sleeve 9. The rear face of the upper end of the separator is formed with a shoulder 17 and located between this shoulder and the end of the extension 7 are the expansible thrust collars 16, 16' above referred to. The collars are separated by springs 18 which act to force the collars apart, and as the springs are twisted they also tend to rotate one collar relatively to the other, the springs tending to straighten from the spiral condition, and in this straightening action to force the collars apart. The rings or collars 16 are made in two halves which permits the collars to be removed from engagement around the extension 7 and also permits the two connected sections to be rotated relatively to each other a sufficient amount to properly twist the springs 18. The ends of the sections are formed with an interlocking joint 16*, the springs by their torsion acting to hold the two sections interlocked. The operation of

these thrust collars will be evident from the drawing. The lining carries at its inner end the packing ring 8, and at its outer end has a screw threaded connection with the separator casing as before explained. The outward pressure on the thrust collars thus acts to draw the lining outward, thus forcing the convex face of the packing ring 8 into close engagement with the concave face of the seat 7'''. In consequence, as the cylinder rotates, these two concavo-convex surfaces will move upon each other and will shortly wear to an exact correspondence, thereby preventing steam from passing out around the outer face of the packing ring and so out between the lining and the extension 7. Of course at its forward end the lining 9 is connected to the separator and thus no steam can escape from this joint. It will be seen that I have provided then a rotary packing which is kept constantly steam tight and which operates automatically to provide a ground seat for itself.

At the lower end of the compartment 14^b of the separator, I provide a water drain pipe 20, the opening to this pipe being controlled by a valve 19 operated by a float 21 pivoted on brackets projecting from the side of the casing, this float being so adjusted that it will close the valve before the water has sunk below the opening of pipe 20. The lower end of the casing may be provided with a removable plate 26 whereby the casing may be cleaned out when desired, or the ball valve adjusted.

I have above described one of the cylinders, its connected separator and the inlet and outlet pipes. It is to be understood of course that each cylinder is precisely the same as that above described. The manner in which these cylinders are connected to each other by the conducting pipes 22, 22' is shown clearly in Fig. 1. An inlet pipe 23 leads from a source of steam supply into the inlet opening 12 of the first separator, thence the steam passes into compartment 14^a and into the interior of the cylinder 3', through the annular passage 4^x and back to the compartment 14^b of the separator. From thence the steam is carried to the next cylinder by means of the conducting pipes 22, 22'. The vertical conducting pipes 22 are connected to the horizontal conducting pipes 22' by unions 24 and elbows 25 of any ordinary construction, the ends of the vertical pipes 22 having however a slight telescopic movement within the unions, thus permitting a certain amount of vibration in the parts of the mechanism. The details of this connection between the pipe 22 and the union are shown in the section Fig. 7, wherein the union has at one end a screw threaded connection with the elbow 25, into which

pipe 22 telescopes. At its upper end the union has a flange 24' surrounding pipe 22, the interior of the elbow being packed as at 24''.

The operation of my apparatus is as follows: Steam is let into the primary inlet pipe 23 and passes from thence by pipe 22 to the compartment 14^a of the separator attached to the first cylinder 3', thence it passes by the annular inlet 4^x to the interior of the cylinder. If there is any water in the cylinder, it will of course gather at the lowest point thereof around the mouth of the pipe 15. If the water is deep enough to cover the mouth of the pipe the steam entering the cylinder 3' will positively force the water out through pipe 15 and into the compartment 14^b of the separator. Here the water will fall to the bottom of the separator and the steam will pass out the opening 13 in the upper portion of the compartment 14^b into the conducting pipes 22, 22' by which it will be conducted to the compartment 14^a of the next succeeding cylinder 3''. Here the steam enters the cylinder in the same manner as before described forcing whatever water may be therein out and into the separator thereof, and passing over to the next cylinder 3'''. In this manner the steam passes through the whole series of cylinders successively, keeping up a constant circulation of steam through the battery of cylinders, and in each one forcing any water of condensation out through pipe 15 into the separator attached to that cylinder. When sufficient water has gathered in any separator the float thereof opens the drain pipe and the water runs off, or is forced out by the pressure of steam behind it. As the float is adjusted to fall and close the valve of the drain pipe before the water has entirely left the compartment 14^b, steam will not be wasted, as none can pass out through the drain pipe on account of the water seal. The advantages of my invention lie particularly in the fact that while steam is used to positively force out any water in the cylinders, yet this steam is not wasted as it would be did the pipe 15 empty into an outlet or drain pipe. If the latter were the case, not only would steam be more or less constantly passing off into the drain pipe and thus the heat thereof be wasted, but if there was a period when the mouth of pipe 15 was sealed, a period wherein water could collect within the cylinder that is, and then a forcing out or carrying away of the water, followed by a period when the cylinder would be practically empty of water there would be periodical changes and fluctuations of temperature within the cylinder due not only to differences of water level, but also due to the checks in the circulation of the steam and the varying quantities of steam

which would accumulate in the cylinders at various times. There would be constant fluctuations in temperature, and this would induce sweating of the cylinders, changes in the heat radiation therefrom, consequent spotting of the paper or cloth being dried, and variations in the strength of the web passing thereover. By my apparatus there are no fluctuations of temperature for the reason that the steam acts at all times to positively force any water gathered in the cylinders into the separators and does not allow the water to collect to any amount in the cylinders at all. Thus there is no obstruction to the constant circulation of steam equally through the entire battery of cylinders, and the cylinders are not only kept at an equal and proper temperature throughout the entire battery, but that temperature is regulatable by controlling the admission of steam.

Other advantages of my invention reside in the peculiar steam joint provided by the packing ring 8 having the curved face fitting within the curved seat 7'''. This ring by reason of the manner in which it is held with a constant pressure against the face of the seat automatically grinds itself and thus the two faces of the seat and of the ring are kept constantly in conformity one with the other, the steam therefor cannot pass around the joint and so into the space between the lining 9 and the interior of the extension 7. It will be seen also that the pressure of the steam passing through the annular space 4^x between the pipe 15 and the interior of the lining 9 acts to force the packing ring attached to the inner end of said lining inward against the face 7'''. It will also be seen that it makes no difference from which direction this pressure comes, the ring will still be forced inward against its seat by reason of the curved faces of the seat and of the packing ring, at the same time a joint is made which provides a steam tight connection between the annular steam space 4^x and the upper portion of the separator.

The peculiar form of thrust collars which I have devised keeps the lining tube 9 constantly forced outward and the packing ring forced solidly against its seat as before described, while at the same time the collars act as a secondary means to prevent any passage of steam out of the space between the exterior of the lining 9 and the journal-extension 7. The twisted springs tend to hold the two sections of each collar in their interlocked position and into close engagement with the exterior face of the lining 9. The separator being independent of the journal of the cylinder and hanging therefrom is always vertical, hence there is no chance of the conducting pipe openings being trapped or otherwise obstructed, either by the accumulation of water in the lower portion of

the separator, or by dirt or other matter clogging the same.

While I have shown what I deem to be the preferable form of my apparatus, I do not wish to be limited thereto, as there might be many changes made in the arrangement of parts and details of construction without departing from the spirit of my invention. I also wish it understood though I have designed my apparatus with special reference to the drying of webs of paper, I may use it for any other purpose to which it is applicable.

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

1. A web drying machine having a series of drying cylinders, concentrically arranged steam inlet and steam outlet pipes for each of said cylinders, said outlet pipes extending to the bottom of their respective cylinders a common steam supply pipe connected to said inlet pipes water separators located along said pipes and said outlet pipes leading from the interior of each cylinder into the separator adjacent thereto, substantially as described.

2. In a web drying mechanism, a drying cylinder, a steam and water outlet pipe leading from the lowest portion of the interior of the cylinder out through the journal thereof, a casing connected to each cylinder into which said outlet pipe leads forming a steam and water separator, a drain pipe in the lower portion of said casing, a steam conducting pipe leading from the upper portion of the casing, a compartment in the upper portion of the casing having a connection to the interior of the cylinders, and connection from said compartment to a source of steam supply.

3. In a web drying mechanism a cylinder having a tubular journal, a steam and water outlet pipe entering said journal but not filling the same and extending to the lowest portion of the interior of the cylinder, a casing loosely suspended from the journal of said cylinder into which said outlet pipe leads, said casing forming a steam and water separator, a drain pipe in the lower portion of said casing, a float valve controlling the opening of said drain pipe, a steam conducting pipe leading from the upper portion of said separator casing and a compartment located in the upper portion of the casing having an opening connected with the space between the drain pipe and the said journal, and means for admitting steam to the interior of said compartment.

4. In a web drying machine, a rotary cylinder having a tubular journal, a separator suspended on the end of said journal but not rotatable therewith and connected to said hollow journal, said separator having a compartment formed in the upper portion

thereof, a steam inlet pipe leading into said compartment and having connection there-
through with the hollow journal, a steam
and water outlet pipe leading from the low-
est portion of the cylinder out through said
hollow journal and through said upper com-
partment into the main portion of the sepa-
rator, and a steam conducting pipe leading
from the upper portion of the main com-
partment of the separator.

5. In a web drying machine, a drying cyl-
inder having a tubular journal, a tubular
extension attached to the end of said journal,
a separator casing, a hanger surrounding
said journal and supported by the same but
not rotatable therewith the lower end of said
hanger being attached to said separator cas-
ing, a partition dividing said separator into

two compartments, the upper compartment
having connection through said hollow jour-
nal with the interior of the cylinder, a steam
inlet pipe leading into said upper compart-
ment, a steam and water outlet pipe leading
from the lowest portion of the cylinder out
through said tubular journal and into the
lower compartment of the separator, and a
steam conducting pipe leading from the
upper portion of said lower compartment.

In testimony whereof I have signed my
name to this specification in the presence of
two subscribing witnesses.

FRANK L. ALLEN.

Witnesses:

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ANNA L. EKVALL.