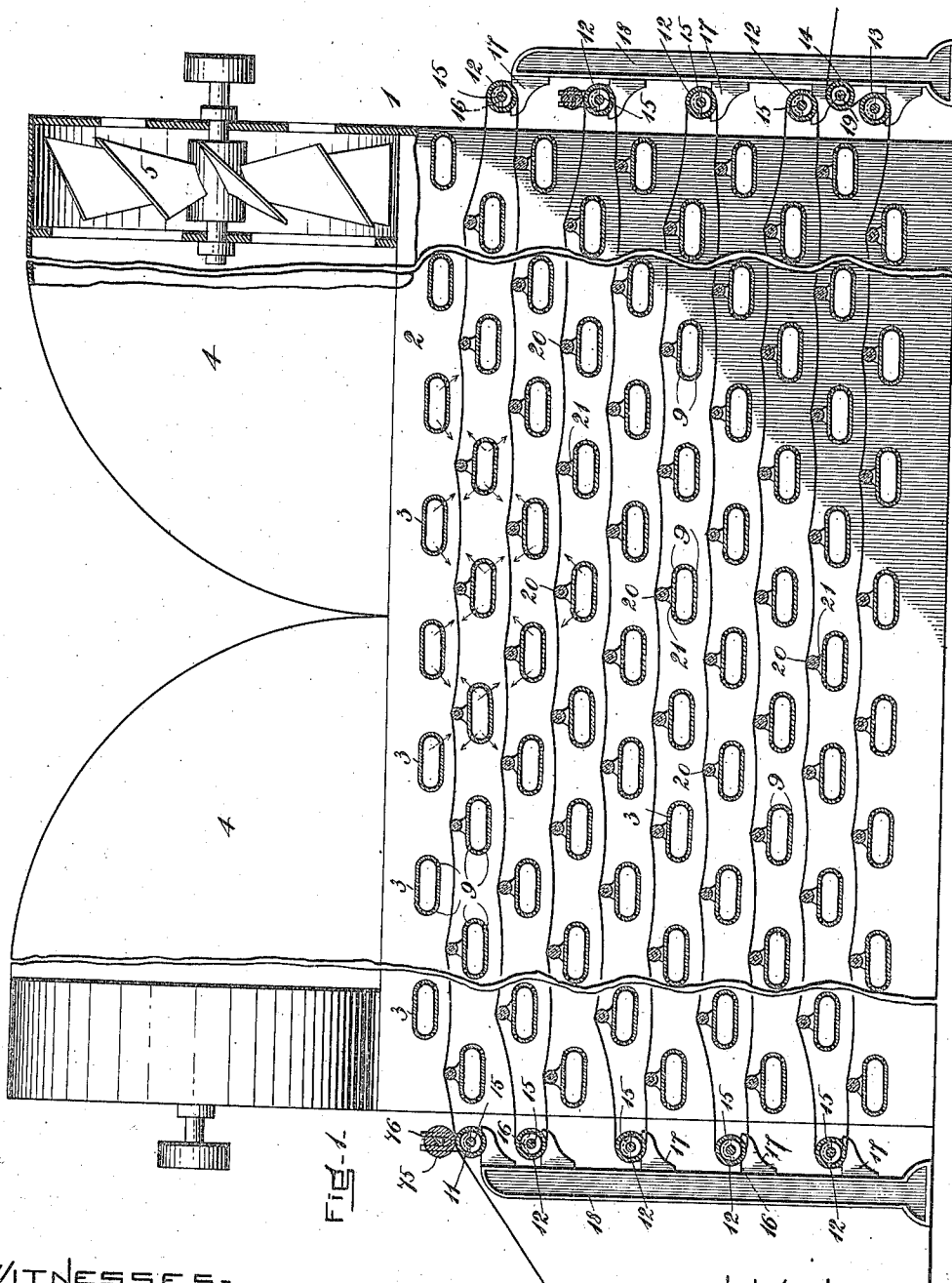


W. M. BARBER.
PAPER DRYING MACHINE.
APPLICATION FILED MAR. 7, 1913.

1,090,964.

Patented Mar. 24, 1914.

5 SHEETS—SHEET 1.



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5 SHEETS-SHEET 2.

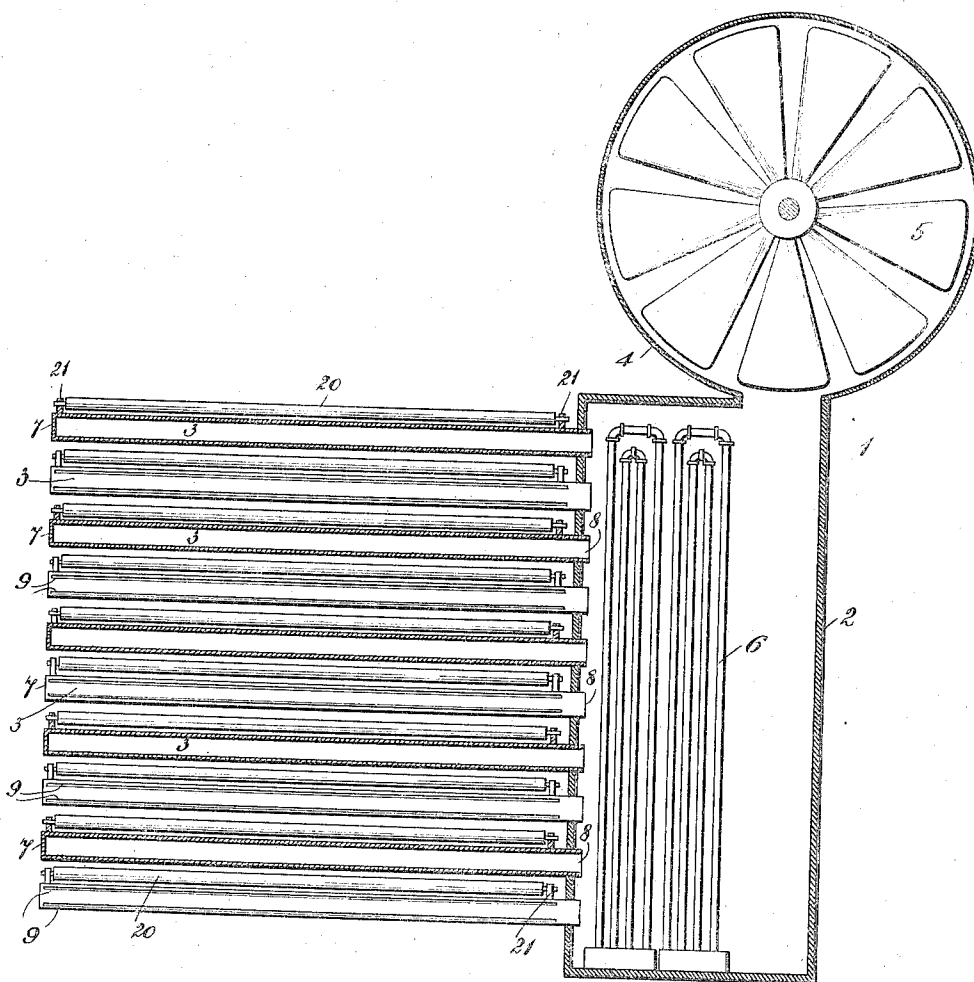


FIG-2-

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5 SHEETS—SHEET 3.

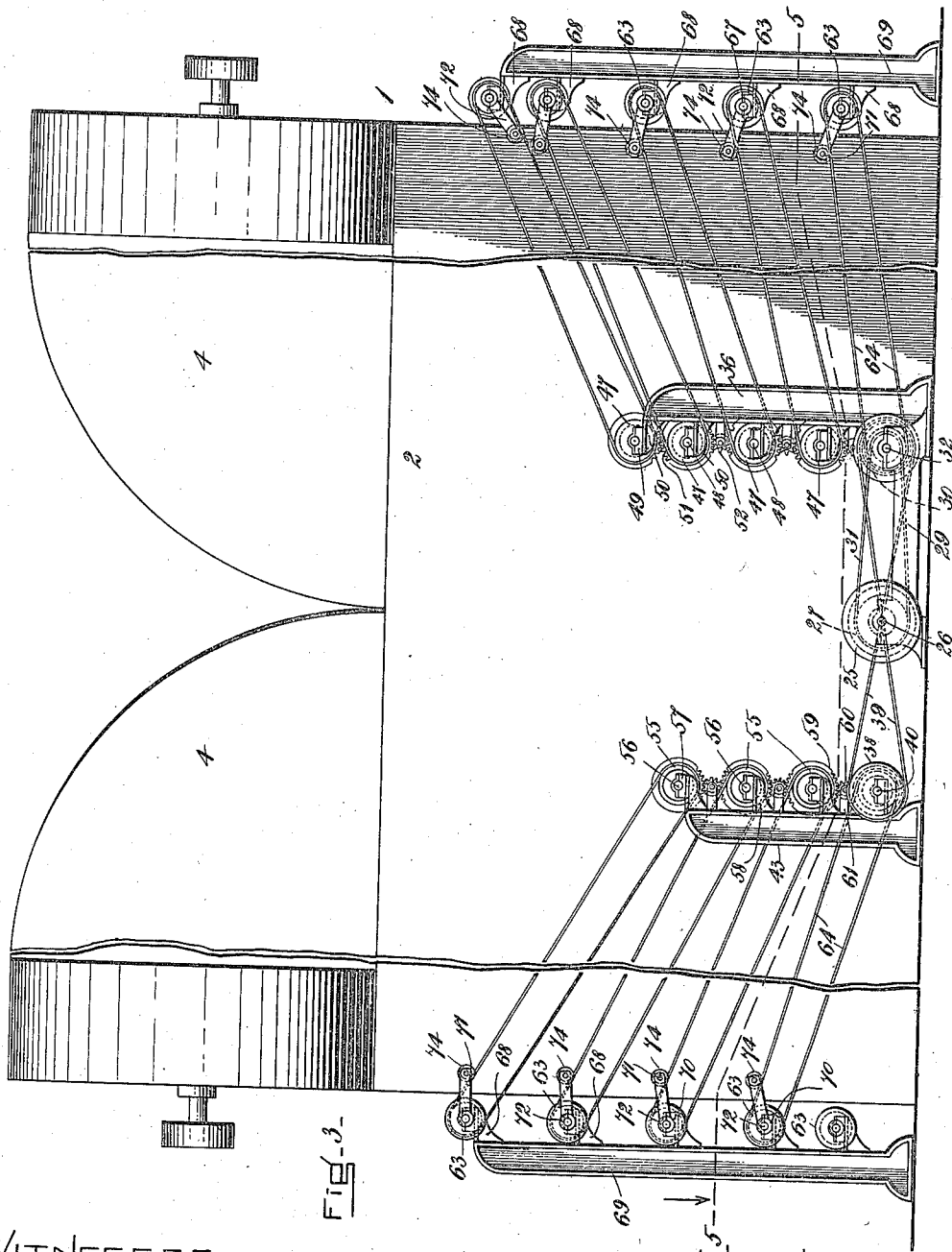


FIG. 3.

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5 SHEETS—SHEET 4.

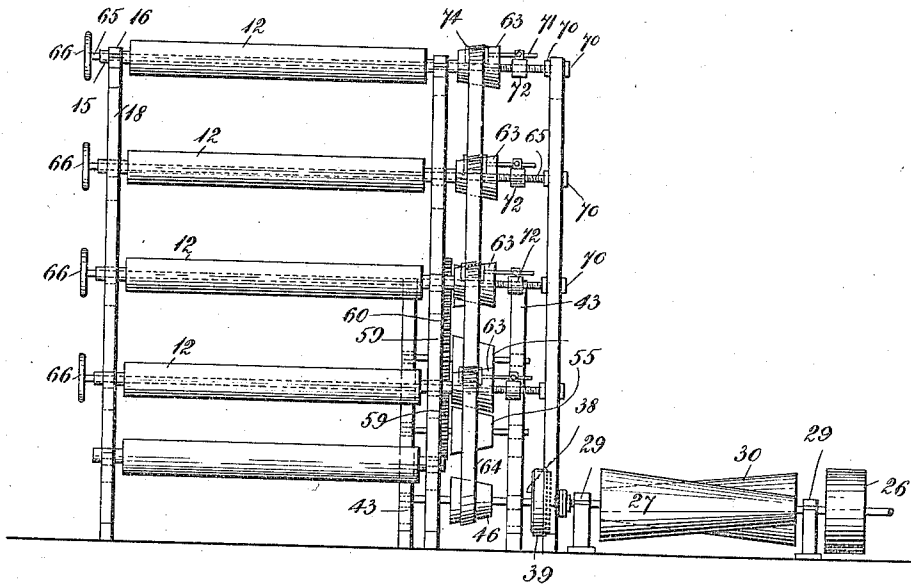


Fig. 4-

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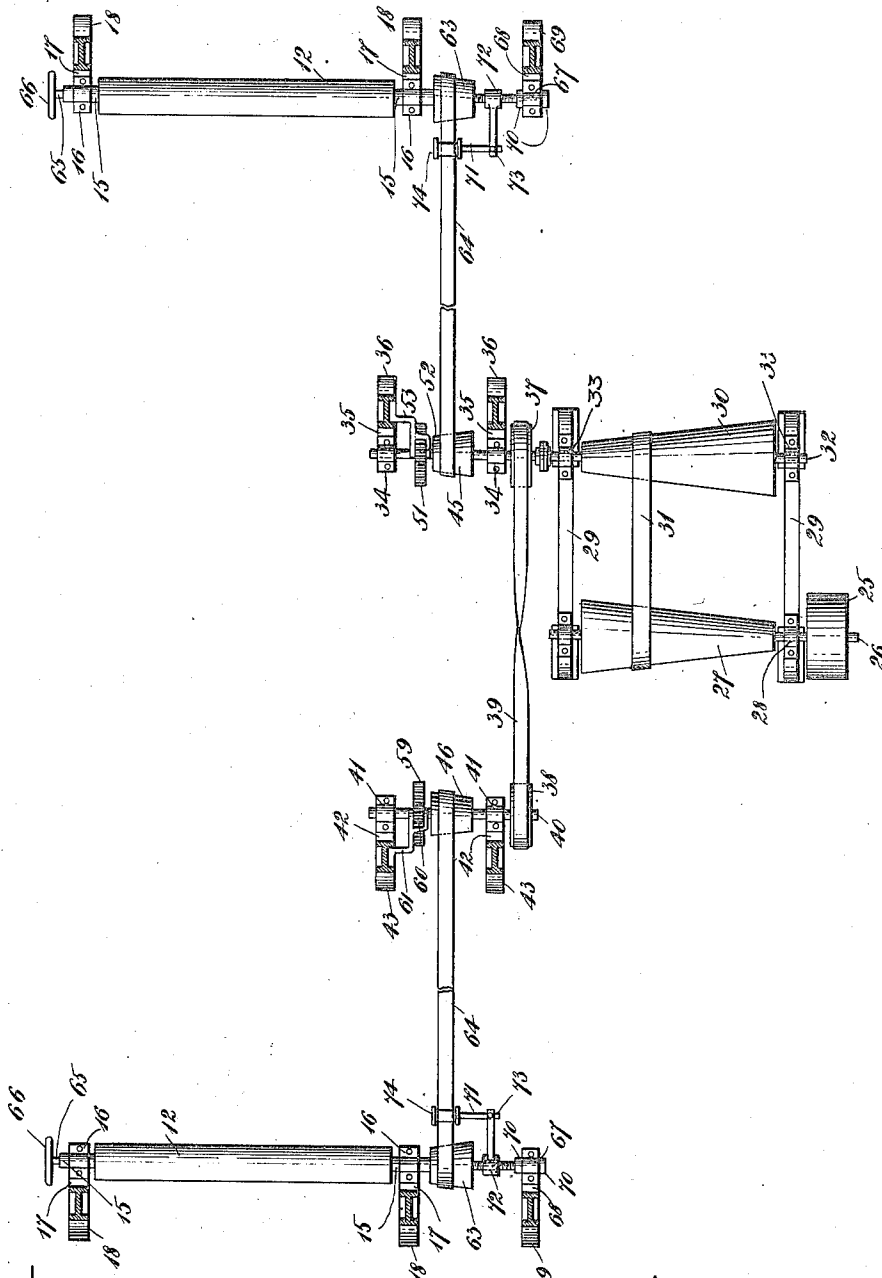
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5 SHEETS—SHEET 5.

FIG. 5-



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UNITED STATES PATENT OFFICE.

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PAPER-DRYING MACHINE.

1,090,964.

Specification of Letters Patent.

Patented Mar. 24, 1914.

Application filed March 7, 1913. Serial No. 752,581.

To all whom it may concern:

Be it known that I, WILLIAM M. BARBER, of Somerville, in the county of Middlesex and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Paper-Drying Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

My invention relates to a machine for drying paper in the continuous web.

The chief objection to drying paper in the continuous web by the application thereto of artificial heat has been the stretching and consequent weakening of the paper, for as the paper dried it contracted and as this contraction was not properly compensated for, the tightening of the paper tended to straighten out and stretch the bonded fiber and thereby weaken it. In this connection it will be understood that as the paper is formed in the "Fourdrinier machine," the tremulous motion of the wire tends to effect an interlacing of the fiber and it is the fibers thus interlaced which are straightened out and stretched as before described. A further objection to drying paper in the continuous web resides in the use of drying rolls for this purpose. These rolls tend to bake the paper especially if steam-heated rolls be used. Whatever the type of heating rolls employed, however, the large surface presented by the rolls with the web of paper hugging tight and held against the same by a drier felt, gives insufficient opportunity for the paper to contract as it becomes dried or such opportunity as I desire to obtain.

It is accordingly the object of my invention to provide means whereby paper may be dried in the continuous web by the direct application thereof of a continuous and steady current of heated air without the use of drying rolls; and in a manner also whereby the contraction of the paper as it becomes dried may in no way be retarded and without stretching out and weakening the bonded fiber as it comes from the "Fourdrinier machine."

The machine embodying my invention can best be seen and understood by reference to the drawings in which—

Figure 1 is a structural front view of a

portion of the machine showing the same partly in elevation and partly in vertical section. Fig. 2 is a vertical cross section of a portion of the machine. Fig. 3 shows the machine in rear elevation. Fig. 4 is a portion of the operating mechanism to which special reference will hereinafter be made. Fig. 5 is a plan of the operating mechanism taken below the sectional line 5—5 of Fig. 3.

1 represents the body of the machine. This comprises in part an elongated receptacle or air chest 2. This chest has an extension depending upon the length of the machine which admits of considerable variation. The chest is closed in order that air may be confined and compressed within it, excepting for openings in the front side thereof in which are arranged pipes 3 to which reference will hereinafter be made, and excepting, also, for pipe connections 4 by which air is directed into and compressed within the chest and also within the pipes 3 connecting therewith to issue from these pipes, as will hereinafter be explained.

For the purpose of forcing the air into the chest and compressing it therein there are arranged in the pipes 4 rotary fans 5. These fans are mounted and operate in the usual manner.

The air within the chest is heated air and for the purpose of heating the air there are located inside the chest steam pipes 6.

The pipes 3, connecting with the openings in the front of the chest, project outwardly and horizontally therefrom. These pipes are considerable in number. In length they exceed somewhat the width of the web of paper to be dried. In form the pipes are preferably elliptical in cross section. Their outer ends 7 are closed; their inner ends 8 open to the interior or chamber of the chest 2 by which air compressed within the chest may fill the respective pipes. The pipes are also preferably horizontally arranged in lines or rows and preferably, also, have a staggered arrangement relatively to one another or to the individual pipes in the respective lines of pipes, as shown in Fig. 1. It is between these lines or sets of pipes that the web of paper passes, the paper passing between two adjacent lines of pipes, thence turning back to pass between the next adjacent lines or sets of pipes, and so on forward and backward.

The space between adjacent lines or sets of pipes between which the paper passes I prefer shall be a relatively narrow space in order that the air expelled from the pipes
5 may be applied directly to the upper and under sides of the paper and become evenly distributed over the surfaces thereof.

Provision is made for the expulsion of air from the pipes 3 by ducts or openings 9
10 therein. These ducts are formed at intervals along each of the pipes, several rows thereof being provided in each pipe and these rows arranged in a manner whereby the air discharged through the various ducts
15 may be directed against the web of paper passing above and below the same to the best advantage.

The web of paper during its passage between the respective sets of pipes is supported and carried in the following manner:—
20 Upon entering the machine the web first passes over a roll 11 located at one side of the machine adjacent the opening between the first two upper sets of pipes. After its
25 passage between these two sets of pipes the web passes successively backward and forward between the other sets of pipes by extension over and around rolls 12 located at opposite sides of the machine beyond the
30 pipes and in proper position to secure such passage. After passing between the last two sets of pipes at the bottom of the machine the web leaves the machine by extension under a roll 13, thence upwardly and around
35 this roll and over a roll 14 arranged just above and adjacent to it. All the rolls with the exception of the rolls 13 and 14 are driven rolls and operate not only to support but also to carry or propel the web of paper.
40 The roll 13 is simply a rotatable roll with a friction strap while the roll 14 is a fixed roll, the same being fixed and cooperating with the roll 13 for purposes to be later explained. All of the rolls with the exception
45 of the roll 14 are provided with shafts 15 arranged to turn in bearings 16 mounted on brackets 17 secured to fixed uprights or standards 18. The roll 14 is mounted upon a shaft 19 secured to one of the brackets 17
50 supporting one of the other rolls. As will later be explained those portions or sections of the web running between the respective sets of pipes and which are subjected to the drying influence of the air are made to run
55 slack between the rolls carrying the same. In order that such slack portions of the web may not contact with the pipes and be held so clear of the pipes as to be properly subjected to the drying influence of the air, such
60 portions are further supported and maintained by small driven rolls 20 which are secured to the pipes, over which the loose sections of the web are passing, by bearings 21 fixed thereto in which the idler rolls are
65 arranged to turn.

According to the construction above described the web is carried or drawn by the respective rolls 11 and 12 by frictional contact of the web with these rolls. The immediate effect of this operation would be to develop tension in those portions or sections of
70 the web passing between the respective sets of pipes. Tension, however, developed in those portions of the web running between the pipes would not permit of the contraction of the paper as the web became dried, and the paper would become stretched. Provision is accordingly made that the paper shall run slack between the sets of pipes and rolls carrying the same as above noted and this is accomplished by independently controlling the speed of each of the rolls 11 and 12 so that the web may be maintained to run slack between these rolls and also by drawing the web from the machine no faster than it is carried by the last of the rolls 12.
75 In this connection it will be observed that according to the arrangement of the rolls 13 and 14 these rolls and especially the roll 14 will operate to prevent a too free withdrawal of the web from the machine on account of the frictional contact between the web and the fixed roll. Accordingly tension will be developed in the web after leaving the machine while that portion of the web running between the last of the rolls 12 and the rolls 13 and 14 may run slack.
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Reference will now be made to the mechanism for driving and controlling the speed of the respective rolls 11 and 12. Power is first applied to the machine by application to a pulley 25 (see Fig. 5). This pulley is fixed to a constant speed shaft 26 of a cone pulley 27 and is arranged to turn in bearings 28 secured to bases of support 29 located in the rear of the machine. Coöperating with the cone pulley 27 to be driven thereby, is a cone pulley 30 of like form and size as the pulley 27 but reversely arranged. The two cone pulleys 27 and 30 are connected by a
100 belt 31, coöperating with one another to form a well known type of speed-changing device through shifting of the belt 31 thereon which may be accomplished by any suitable mechanism (not shown). The cone pulley 30 is supplied with a shaft 32 arranged to turn in bearings 33 secured to the bases 29. This shaft extends forward and is arranged to turn also in bearings 34 mounted upon brackets 35 secured to uprights or standards 36. Fixed to the shaft 32 is a pulley 37. This pulley drives a pulley 38 by a belt 39 connecting the pulleys, which belt is a crossed belt in order that the pulley 37 and pulley 38 driven by it may
105 turn in reverse directions. The pulley 38 is secured to a shaft 40 arranged to turn in and between bearings 41 mounted upon brackets 42 secured to uprights 43. Secured to the shaft 32 between the bearings 34 is a cone
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pulley 45. Secured to the shaft 40 is a cone pulley 46. These pulleys like the pulleys 37 and 38, respectively, operating to drive the same, are turned in reverse directions. Above the cone pulley 45, in vertical alinement with one another, are a series of other cone pulleys 47. Each of these cone pulleys is fixed to a shaft 48 arranged to turn in bearings 49 mounted upon a bracket 50 secured to the upright or standard 36. All of the cone pulleys 45 and 47, respectively, are connected to turn simultaneously in the same direction by means of gears 51 fixed to the shafts of the respective pulleys and connecting with one another by interposed pinions 52 carried by brackets 53 secured to the uprights or standards 36. Above the cone pulley 46, in vertical alinement with one another, are a series of other similar cone pulleys 55, respectively. Each of these pulleys is provided with a shaft 56 to which the pulley is secured. These shafts turn in and between bearings 57 mounted upon brackets 58 secured to the uprights or standards 43. In order that the pulleys 46 and 55 may be turned simultaneously in the same direction there is arranged upon the shafts 40 and 56, respectively, of these cone pulleys, gears 59 connected by interposed pinions 60 mounted upon brackets 61 secured to the standards 43.

It is from the cone pulleys 45, 47, 46 and 55 that the rolls 11, 12 are driven, the rolls 11 and 12 at one side of the machine being driven from the pulleys 45 and 47, and the rolls 12 on the other side of the machine being driven from the pulleys 46 and 55. This is accomplished in a manner whereby each of the rolls 11 and 12 may not only be driven, but the speed thereof independently varied or controlled. All of the rolls are provided with cone pulleys 63 fixed to the shafts 15 thereof. The pulleys 63 are driven for turning the rolls from the cone pulleys 45, 47, 46 and 55 through belt connections 64, these connections being established as shown in Fig. 3. In this connection it will be observed that the cone pulleys 63 with relation to the pulleys 45, 47, 46 and 55 operating to drive the same are reversely arranged, thereby establishing together with the belts 64 connecting the same, separate speed-changing devices whereby the speed of each of the pulleys 63 and rolls operated by them are independently changed dependent upon the relative position of the belt on the pulleys as is common in this type of speed-changing device.

For changing the running positions of the belt 64 on the pulleys, each of the rolls is provided with a belt-shifting device. This consists of a rod 65 extending loosely through the shafts 15 of the respective rolls, which shafts are made hollow for receiving these rods. At the front of the machine each of the rods is provided with a wheel 66 by

which they may be turned. At the rear end of the machine the rods extend beyond the ends of the shafts 15 and pulleys 63 carried by them and into bearings 67 mounted upon bracket 68 secured to uprights or standards 69. The bearings 67 for the ends of the rods admit of the rods turning therein and the rods are held as against longitudinal movement by nuts 70 affixed to and engaging the opposite sides of the respective bearings. That portion of each of the rods 65 between the pulleys 63 and bearings 67 is made threaded and upon this threaded portion of the rods is arranged a belt-shifting device 71 comprising a hub 72 threaded upon the rod and a bent arm 73 extending to cooperate with the belt by a guide 74 engaging the belt to shift or vary the running position thereof with respect to the pulleys connected thereby depending as the hub 72 is moved outwardly or inwardly along the rod. This movement of the hub is effected simply by turning the rod by turning the wheel 66 when the hub 72 will run along the same in one direction or the other depending upon the direction the rod is turned, by reason of the fact that the hub is held against turning on the rod by the weight of the bent arm 73 connecting therewith and the guide 74 carried by the arm cooperating with the belt as aforesaid.

With the mechanism thus far described all of the rolls 11 and 12 are simultaneously driven for carrying the web of paper upon the application of power to the pulley 25. In order that slack may be developed in those portions of the web running between the rolls and to which the air is applied, the speed of each roll may be controlled to provide or compensate for any slackening in the web in the portions above noted and which is accomplished through the belt-shifting device with which each roll is equipped. After the machine is in operation the speed of all the rolls is so controlled as to insure the continuance of slack in the running portions of the web. The speed of the machine or that of all the rolls and web carried by them may be increased or diminished as a whole simply by the shifting of the belt 31 along the pulleys 27 and 30 forming a speed-changing device as above described.

Of course the web of paper is carried through the machine by frictional contact between the web and the surfaces of the respective rolls 11 and 12 over and around which the web passes. To prevent the web from slipping upon the rolls as it might otherwise do owing to the slack developed in the web and to insure the development and continuance of slack in the running portions thereof between the rolls, one or all the rolls 11, 12 carrying the web of paper may be provided with a bearing roll 75 resting thereon. These rolls may be supported in

any suitable manner. A convenient method, as shown, resides in equipping each of these rolls with a shaft extending beyond the ends of the roll and retained by forked ways 76 secured to the bearings 16 which support the shafts 15 of each of the bearing rolls.

The bearing rolls besides performing the function of preventing the slipping of the web as above noted, perform also the additional function of keeping the web smooth, or, in other words, of eradicating cockles which might develop in the web as it became dry. For this reason the bearing rolls 75 may be made of some considerable weight.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States:—

1. In a machine for drying paper in a continuous web, series of air distributing pipes arranged in adjacent lines and between which the web runs, said pipes being provided with opening by which air compressed therein may be directed to issue therefrom against said web, means for supplying air under compression to said pipes, and means for carrying said web to run slack between said lines of pipes.

2. In a machine for drying paper in a continuous web, series of air distributing pipes arranged in adjacent lines and between which lines of pipes the web runs, said pipes being provided with openings by which air compressed therein may be directed to issue therefrom against said web, means for supplying air under compression to said pipes, driven rolls by which said web is carried and directed to pass between said lines of pipes, and means for controlling said rolls whereby said web may run slack between said lines of pipes.

3. In a machine for drying paper in a continuous web, series of air distributing pipes arranged in adjacent lines and between which lines of pipes the web runs, said pipes being provided with openings by which air compressed therein may be directed to issue therefrom against said web, means for supplying air under compression to said pipes, driven rolls by which said web is carried and directed to pass between said lines of pipes, means for controlling said rolls whereby said web may run slack between said lines of pipes, and other means located between said lines of pipes for supporting the slack portion or portions of said web.

4. In a machine for drying paper in a continuous web, series of air distributing pipes arranged in adjacent lines and between which lines of pipes the web runs, said pipes being provided with openings by which air compressed therein may be directed to issue therefrom against said web, means for supplying air under compression to said pipes, driven rolls by which said

web is carried and directed to pass between said lines of pipes, and means whereby the speed of each of said rolls may be controlled.

5. In a machine for drying paper in a continuous web, series of air distributing pipes arranged in adjacent lines and between which lines of pipes the web runs, said pipes being provided with openings by which air compressed therein may be directed to issue therefrom against said web, means for supplying air under compression to said pipes, driven rolls at opposite ends of the machine by which said web is carried and directed to pass between said lines of pipes, means for controlling said rolls whereby said web may run slack between said lines of pipes, and means co-operating with said rolls whereby said web passing around the same may be prevented from slipping thereon and the slack in said running portions of the web by thereby maintained.

6. In a machine for drying paper in a continuous web, series of air distributing pipes arranged in adjacent lines and between which the web passes, said pipes being provided with openings by which air compressed therein may be directed to issue therefrom against said web, means for supplying air under compression to said pipes, driven rolls by which said web is carried and directed to pass between said lines of pipes, means for controlling the speed of each of said rolls whereby said web may run slack between said lines of pipes, and means for compressing and smoothing the paper as it becomes dried.

7. In a machine for drying paper in a continuous web, an elongated air receiving receptacle or chest, series of air receiving pipes arranged in adjacent lines connecting therewith whereby air compressed within said receptacle may enter said pipes, said pipes being provided with openings by which air therein may be directed to issue therefrom into the space between the lines of pipes, means for compressing air within said chest, and means for carrying said web to run slack between said lines of pipes.

8. In a machine for drying paper in a continuous web, series of air distributing pipes arranged in adjacent lines and between which lines of pipes the web passes, said pipes being provided with openings by which air compressed therein may be directed to issue therefrom against said web, means for supplying compressed air to said pipes, driven rolls by which said web is carried and directed to pass between said lines of pipes, means for controlling the speed of each of said rolls whereby the web may run slack between said lines of pipes, and bearing rolls coöperating with said driven rolls or a portion thereof and be-

tween which bearing rolls and driven rolls the web passes.

9. In a machine for drying paper in a continuous web, an elongated air receiving
5 receptacle or chest, series of air distributing pipes arranged in adjacent lines and between which the web passes connecting with said chest whereby air compressed therein may enter said pipes, said pipes being provided also with openings by which air there-
10 in may be directed to issue therefrom into the space between said lines of pipes against said web, means for compressing air within

said chest, driven rolls by which said web is carried and directed to pass between said
15 lines of pipes, means for controlling the speed of each of said rolls whereby the web may run slack between said lines of pipes, and bearing rolls cooperating with all or a
20 portion of said driven rolls and between which bearing rolls and driven rolls the web passes.

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