

No. 829,686.

PATENTED AUG. 28, 1906.

W. M. BARBER.
PAPER DRYING MACHINE.
APPLICATION FILED APR. 23, 1904.

4 SHEETS—SHEET 1.

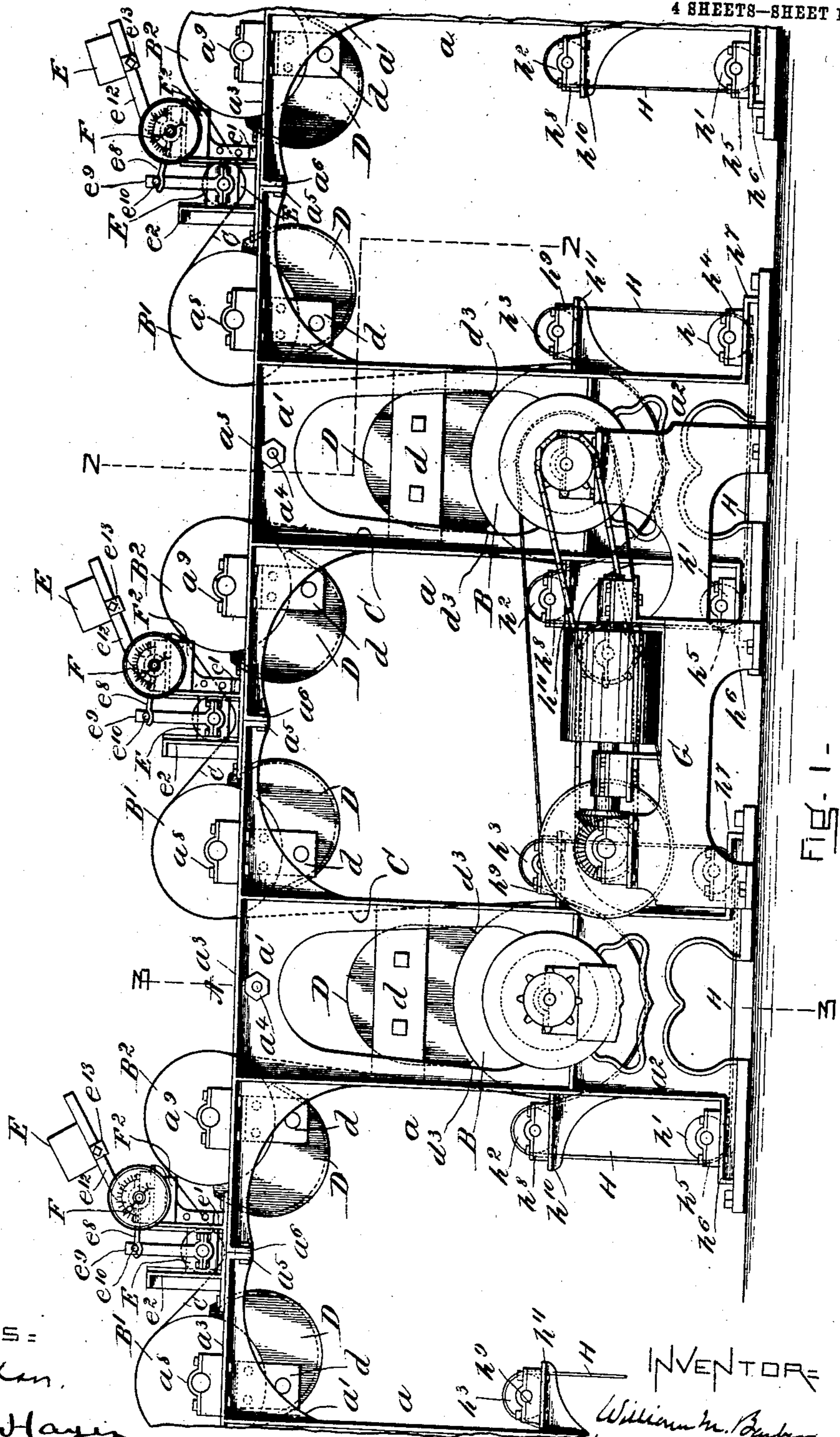


FIG. 1-

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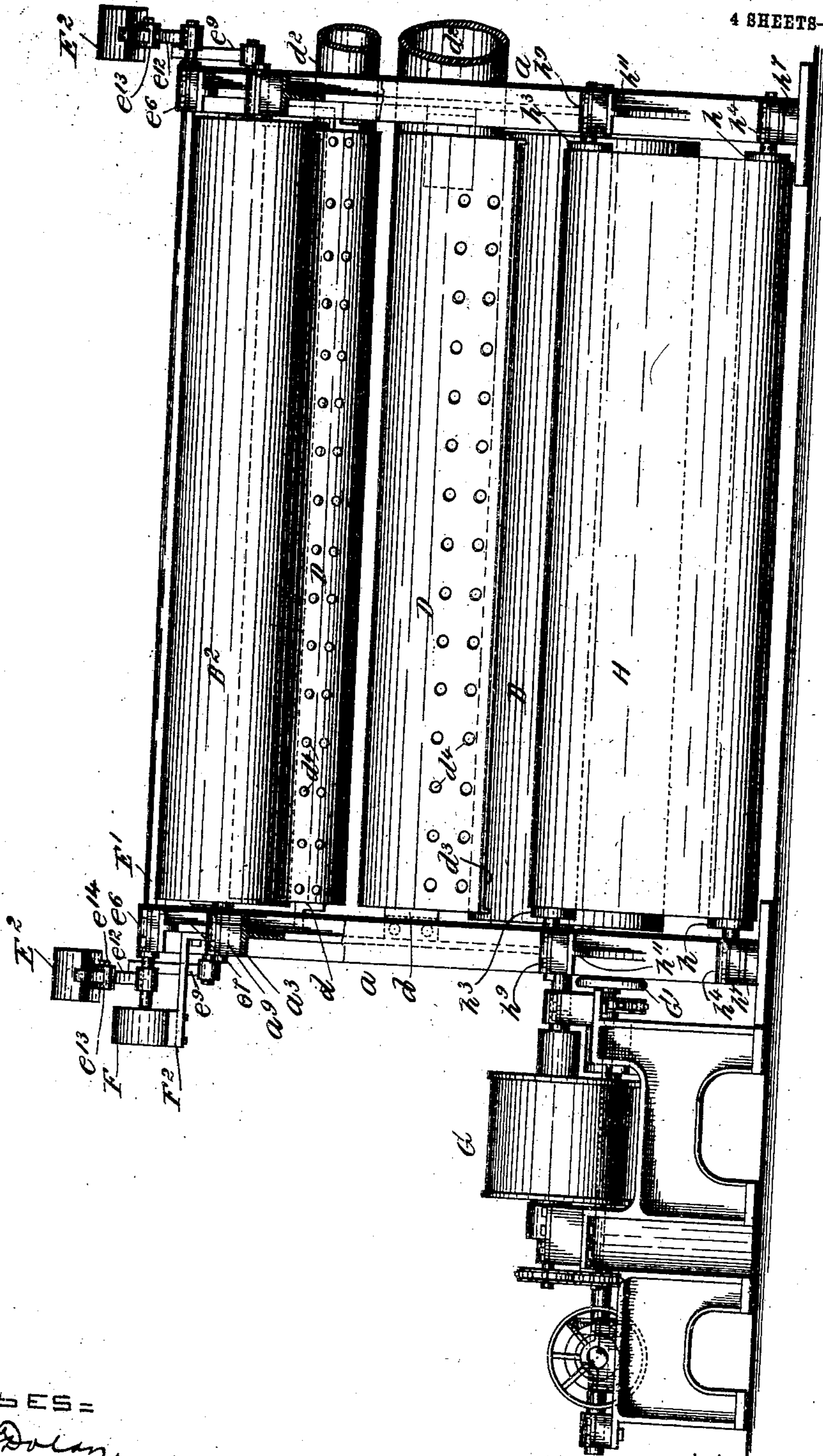
William M. Barber
by Charles M. Barber
his attorney

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4 SHEETS—SHEET 2.



25

WITNESSES=

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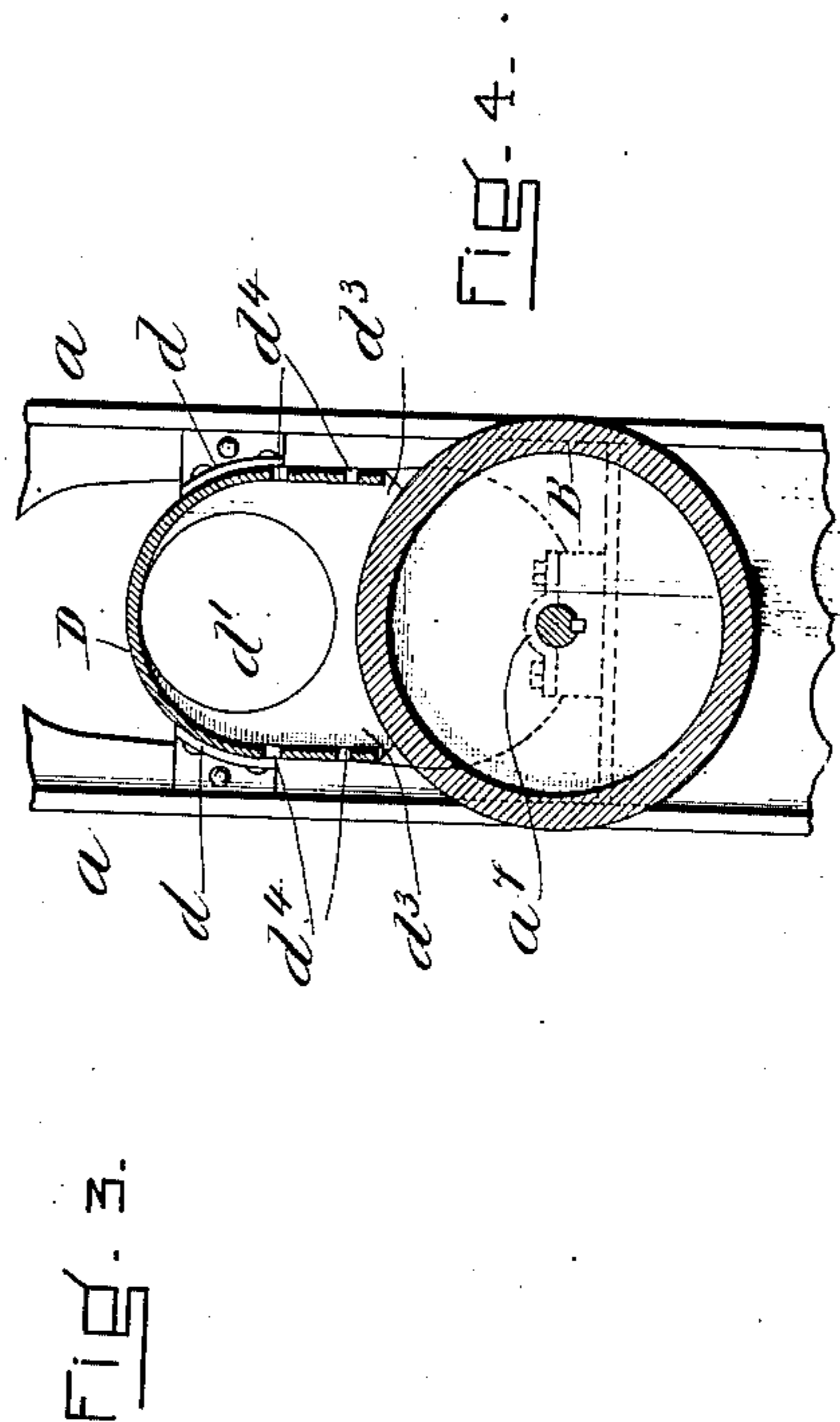
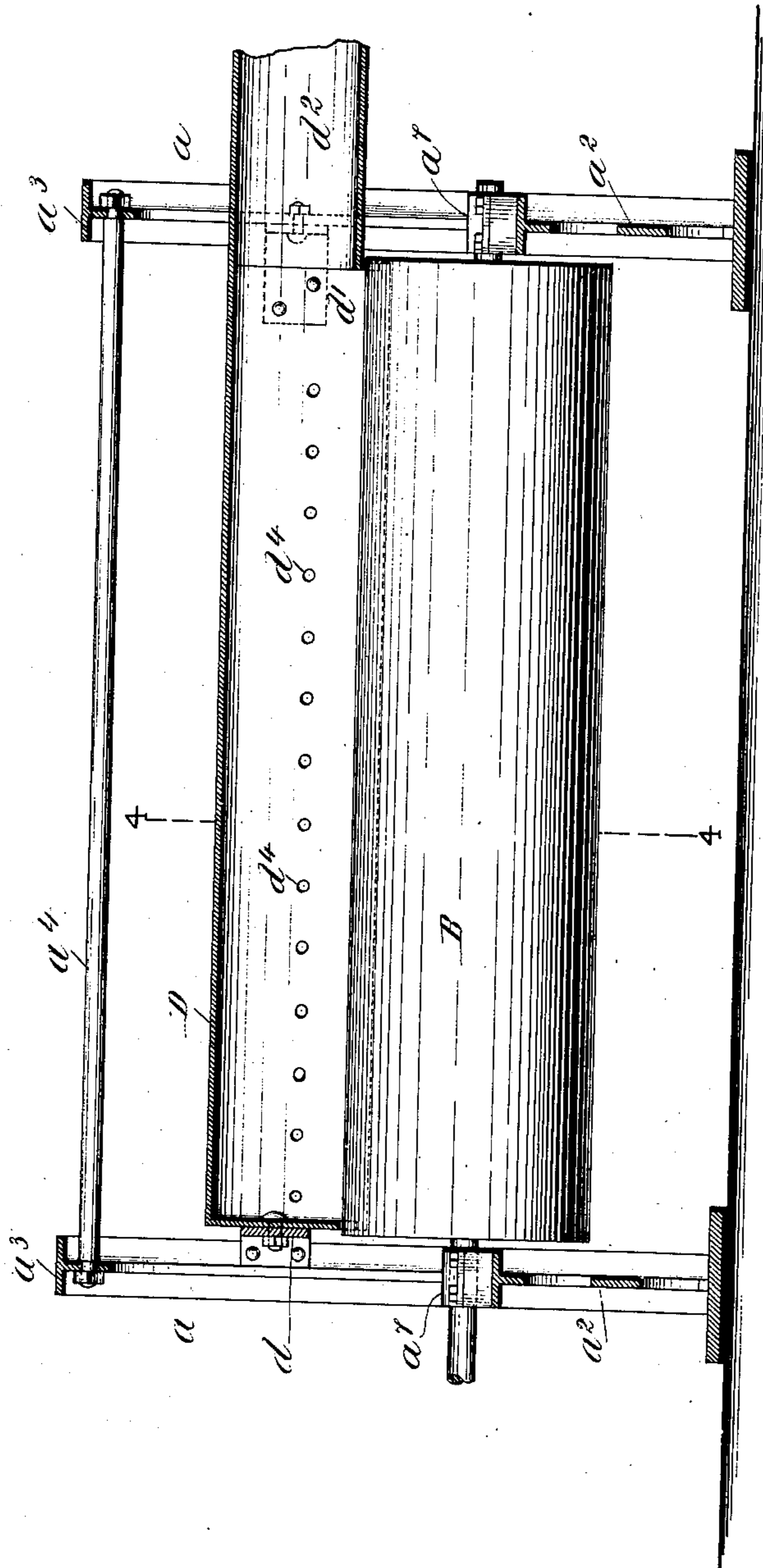
INVENTO
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of Kansas against Owen
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W. M. BARBER.
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4 SHEETS—SHEET 3.



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No. 829,686.

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4 SHEETS—SHEET 4.

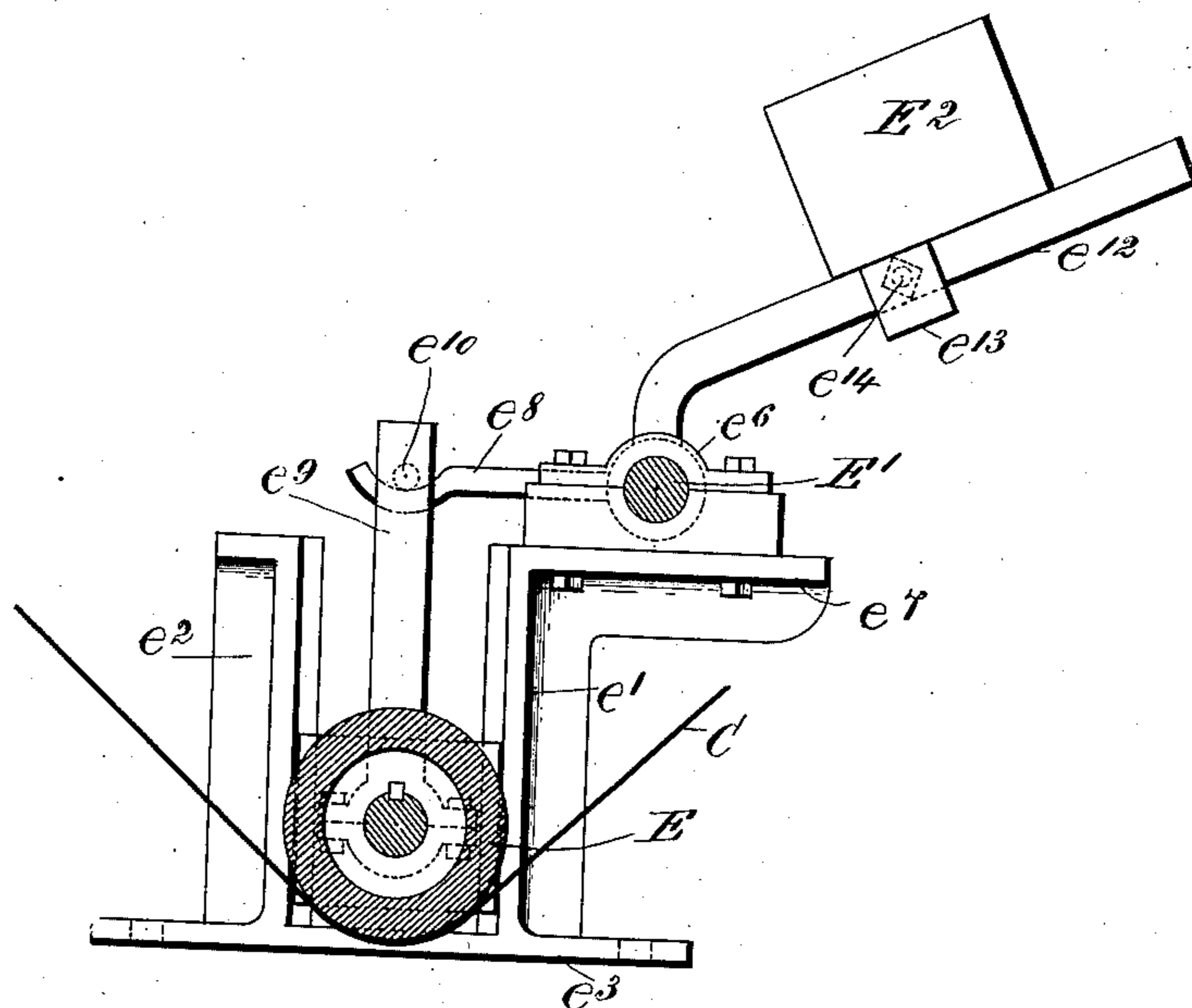


FIG. 5.

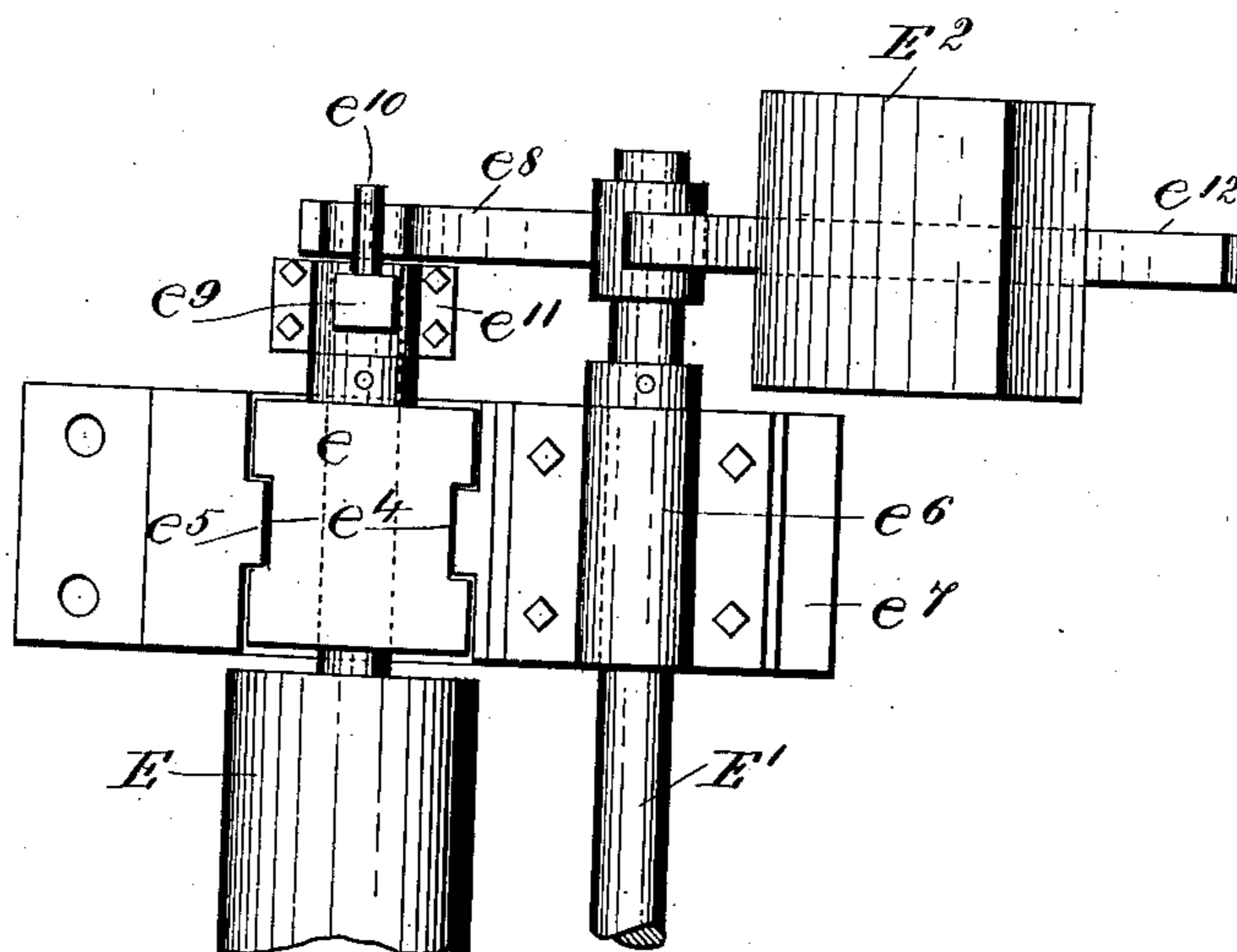


FIG. 6.

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UNITED STATES PATENT OFFICE.

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ONE-HALF TO EDGAR W. ANTHONY, OF BROOKLINE, MASSACHUSETTS.

PAPER-DRYING MACHINE.

No. 829,686.

Specification of Letters Patent.

Patented Aug. 28, 1906.

Application filed April 23, 1904. Serial No. 204,544.

To all whom it may concern:

Be it known that I, WILLIAM M. BARBER, a citizen of the United States, residing at Somerville, in the county of Middlesex and State of Massachusetts, 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.

The invention relates to an improvement in apparatus or machines having drier-rolls for drying paper in a continuous web.

Heretofore in machines having drier-rolls the paper has been dried by the admission of steam into the interior of the rolls under and over the exterior surface of which the paper is passing. The action of live steam, however, among other disadvantages, has been to heat the rolls to a high degree of temperature, with the effect of baking the web of paper or of drying it with such intensity as to destroy its life, especially when the paper is hugged up tight against the rolls by the "felt," so called, which is customarily used in this type of machine. Moreover, when the drier-rolls alone are used those portions of the paper running between the rolls are subjected to no drying influence, with the effect that the paper in the continuous web is not continuously but intermittently acted upon.

By my invention the drier-rolls are heated by a current or blast of hot air directed upon or subjected to their outside surface and which hot air is further directed to flow directly against the sides of those portions of the web of paper passing between the rolls or to and from the same. By this means the paper becomes dried in a manner which does not injure or weaken its textile strength. This results, perhaps more essentially, from the fact that the paper is not subjected to the drying influence of a drier-roll too intensely heated, as when heated by steam, for the hot air applied to heat the roll may be so modified in temperature as to heat the roll to just such degree as will best dry the paper without in any way injuring or weakening its fiber. By the above means also the web of paper is subjected to a continuous drying influence throughout the entire length of its

running with the heated drier-rolls performing the additional function of ironing the paper and keeping it smooth.

My invention pertains also to a coördination of means by which a proper tension of the paper as it is dried may be effected and maintained. In order that the paper may dry smooth, the web of paper must be maintained in the running under tension. This tension varies or should vary for different parts of the machine, depending upon the condition of the paper, for when the web of paper first enters the machine it can stand but very little tension; but as it becomes dry it can bear and should be subjected to some considerable tension in order to obtain the best results. At no point, however, should the tension on the paper be such as to stretch it, and so injure its fiber. Now if there were no further consideration a proper tension of the paper might be easily effected; but it is well known in the art that the paper gradually contracts or shrinks as it dries, and unless the contraction or shrinkage of the paper while running is compensated or provided for the tension of the paper will soon become such that it becomes stretched and its fiber materially weakened. Moreover, this contraction or shrinkage of the paper is not a constant factor, but a variable one, the rapidity of contraction or shrinkage varying in different parts of the machine, at some points the shrinkage or contraction of the paper taking place very fast, depending upon the state or condition of its drying, which depends, among other considerations, upon the kind of paper and the amount or nature of the drying influence to which it is subjected.

By my invention there is embodied in the improved machine means by which the web of paper in all parts of the machine may be maintained at an accurate normal tension, by which also any undue tension on the paper may be met and automatically compensated for, by which means also any tendency to undue or abnormal tension in the web of paper may be immediately shown to the operator or recorded, whereupon, as is further provided, he may vary the speed of any one of a series of rolls, and thereby thus make compensation for a variable contraction or shrinkage of the paper at different

points of the machine and maintain it at a proper variable tension as desired to effect the best results.

My invention further pertains to various details of construction, all of which can best be seen and understood by reference to the drawings, in which—

Figure 1 shows the improved machine in side elevation. Fig. 2 shows a section on the line 2 2 of Fig. 1. Fig. 3 shows a section on the line 3 3 of Fig. 1. Fig. 4 shows in cross-section a roll and combined hood. Fig. 5 is a vertical section showing the tension roll or device, to which reference will hereinafter be made. Fig. 6 is a plan of the same.

Referring to the drawings, A represents the frame of the machine. It is made sectional in character, comprising a series of like units or sectional parts a , and so is capable of indefinite longitudinal extension. Each section a has two sides, each of which, a' , has a base a^2 , resting upon the floor or other support, to which it is bolted. Each section has also a top-surface bearing-plate a^3 . The two sides of each section are connected together by cross-ties a^4 . The sections are connected together or combined by bolting together the flanges a^5 a^6 dependent from the respective ends of their top plates a^3 . Supported to have bearing within each section side of the frame is a pillow-block or other means a^7 , providing journals for the ends of the shaft of a drier-roll B. Upon each of the respective top plates a^3 are borne pillow-blocks or other means a^8 a^9 , providing journals for the ends of the shafts of the drier-rolls B' B².

The arrangement of the rolls is preferably like that shown, which is substantially like the arrangement of the rolls in the well-known Fourdrinier machine, the web of paper C passing over the roll B' downward under the roll B, thence upward over the roll B². As the web of paper passes over and under these respective rolls the rolls are heated and the paper dried by hot air in the following manner:

Each roll is provided with a hood D, placed to conjoin or combine with the naked or exposed portion of its surface or periphery. It is to be observed that as the paper passes around any roll it practically forms a fold, and as the roll turns its entire surface or periphery is not covered by the paper, but a portion thereof remains naked and exposed, and it is with this portion of the surface or periphery of the roll within the fold of the web of paper made by its passing around the roll that the hood is placed to cooperate.

The hood D is in the nature of a casing forming an air-chamber extending longitudinally along over the said surface of the roll or portion of its periphery. In size the hoods may vary, depending somewhat on the relative size of the roll with which they are co-

operating. The hoods or casings are fixed to and between the sides of the frame in any suitable manner, as by angle-irons d , each of the respective hoods being fixed to cooperate with its roll in the manner shown and as before described.

Each hood has an opening d' and pipe connection d^2 for the inlet of hot air. This opening is preferably made at the rear end of the hood, as shown, where hot air may be received into the respective hoods from the back side of the machine.

By means of the hood hot air may be received into the chamber which it forms and be applied directly to the roll with which the hood is in conjunction. Moreover, the hot air in the chamber acts to heat the entire roll, for as the roll rotates every portion of its surface in turn is exposed to the hot-air influence. With a hood or casing thus in conjunction with a roll not only is the hot air in the chamber of the hood utilized and applied for the purpose of heating the roll, and so indirectly drying the paper contacting with it, but the hot air is further utilized for the purpose of drying the paper web directly by application to the sides of the fold of the web of paper with which and between which the hood is located. For this purpose each hood or casing relatively to the roll with which it is in conjunction is so mounted that its edges are not brought into close contact flush up against the surface or periphery of the roll, but are slightly removed from the same, leaving a narrow air-space d^3 on either side, extending the length of the roll and through which passages the hot air in the chamber of the hood escapes and coursing along the surface of the roll outside the confines of the hood on either side comes in contact directly with the respective sides of the fold in the web of paper made by passing around the roll, by which contact the current of hot air is broken or disseminated and made to flow over the surfaces of said sides of the web of paper. To assist further in this operation, I prefer also to make narrow slits or openings d^4 in the sides of the hood for the hot air to pass through; but these openings should of course not provide such egress for the escape of hot air as to prevent its properly heating the roll.

While I have referred to the fact that each one of the rolls of the machine is provided with a hood furnishing a hot-air chamber, of course any one or more rolls may be provided with such hood. I prefer, however, to furnish each roll of the machine with a hood, for then not only does each roll act to dry the paper and iron it, but with the rolls arranged as they are their hoods would conjoin with them in such manner that the hot air escaping from their respective chambers, as before explained, would be applied to both surfaces

of the web of paper, especially those sides or portions running between the rolls B' and B and B and B².

Referring to Fig. 1, it will be seen that for every section of the machine the hot air in the hood conjoining with the roll B' would not only act to heat the roll, but the hot air escaping would flow from one side onto that side or portion of the web of paper approaching said roll and from the other side of the hood would flow upon the outer surface of that portion or side of the web of paper running between the rolls B' and B. On the other hand, the hot air in the hood conjoining with roll B would not only effect the heating of the roll, but escaping on the one side would be applied to the inner surface of that portion or side of the web passing between the rolls B' and B, and from the other side of the hood the air would be applied to the inner surface of that portion or side of the web of paper passing between the rolls B and B², while the hot air in the hood in conjunction with the roll B² would not only heat the roll, but escaping on the one side would be applied to the outer surface of the side or portion of the web of paper passing between the rolls B and B² and from the other side would be applied to that portion or side of the web of paper passing from said roll B² and onward to the next section of the machine, where the same operation would be repeated.

It is unnecessary to refer in further detail to the utility of this mode of drying the paper. By the use of the hood not only are the rolls heated by hot air and not by steam, but the paper is also dried by direct application of hot-air influence applied for the most part to both of its sides or surfaces. This makes a practically continuous drying operation, with the rolls performing the additional function of smoothing the paper and imparting a gloss to it. It is also to be taken into consideration that this element of the hood affording a means for hot-air application to the drier-rolls and web of paper may be applied to machines already in use having steam-heated drier-rolls without any material changes made in the structure of the machines. It affords, in other words, a means by the application of which to old machines their drying capability may be very materially increased, affording a safe mode of drying the paper without injuring its fiber.

Having thus provided for drying the web of paper, my invention further pertains, as I have already stated, to a coördination of means by which its proper tension may be effected and maintained, by which means also any undue tension on the web of paper occasioned by its contraction or shrinkage in drying may be met and automatically compensated for, by which means also any tendency to undue or abnormal tension in the web of paper, occasioned as aforesaid, may

be immediately shown to the operator or recorded, whereupon, as is further provided, he may vary the speed of any one of a series of rolls, and thereby thus make compensation for a variable contraction or shrinkage of the paper web at different points in the machine and maintain it also at such proper variable tension as will effect the best results. For these purposes I have shown a series of compensating or tension rolls E, under each of which rolls by a fold the web of paper is adapted to run. For the particular type of machine shown I prefer to arrange these rolls on the frame between the drier-rolls B² and B' of its adjacent sections. Each roll E has bearings to turn at each end of its shaft in pillow-blocks *e* or other means, providing journals therefor. Each of the pillow-blocks *e* is mounted between standards *e'* *e''*, disposed on the respective top bearing-plates *a* of adjacent sections of the frame, to which the standards are bolted or otherwise secured by a base-plate *e'''*. The respective pillow-blocks are also retained to move up and down or to have vertical play between their respective standards by grooves *e⁴* in the sides of said blocks, into which grooves fit tenons *e⁵*, extending from the standards.

With a tension-roll thus movably mounted and with the web of paper forming a fold to pass under it the effect is for the paper by its tension or stress to lift the roll as it shrinks or contracts—that is, if the roll be properly graduated in weight or counterbalanced, so as not to resist too much the contracting or lifting stress or tension of the paper. In other words, the weight of the roll may be so graduated or the roll so counterbalanced that it will not be moved by any normal and proper tension of the web of paper for any part of the machine, and so will act to maintain the web of paper at such normal and proper tension; but immediately upon the tension of the paper having a tendency to increase by the contraction or shrinkage of the paper then the resistance of the roll is immediately overcome and the undue or abnormal tension is instantly and automatically compensated for. For the purpose, therefore, of graduating the resistance of each roll E to the lifting stress of the paper I have provided it with a counterbalancing means, as follows: There is arranged at one side of the roll a rock-shaft E'. This shaft turns in pillow-blocks or other bearings *e⁶*, which are mounted, preferably, upon brackets *e⁷*, extending, respectively, from the standards *e'*, fixed to the top plate of the frame, as before explained. Projecting from one side of the rock-shaft E' at either end thereof are arms *e⁸*, from which hang links *e⁹*, the respective arms catching around pins *e¹⁰*, fixed in the sides of said links. These links *e⁹* connect with the ends of the shaft of the tension-roll E outside its respective pillow-blocks or bearings and in a man-

ner not to interfere with its rotation, on which account the respective links e^9 are provided with boxes e^{11} , in which boxes the ends of the shaft of the tension-roll are adapted to turn.

5 From the other side of the rock-shaft there extends one or more arms e^{12} , preferably two, as shown, one at each end of the shaft on either side of the machine. Upon each of the arms e^{12} there is arranged to slide or be ad-

10 justed a counterbalancing-weight E^2 . This weight has depending from it a sleeve e^{13} , arranged to slip up the arm e^{12} , and is provided with a binding-screw e^{14} , the engagement of which with the side of the arm acts as a stop

15 and holds the counterbalance at any point of adjusted position. This means just described practically forms a lever having an adjustable counterbalance upon one side thereof for partially overbalancing or offset-

20 ting the weight of the tension-roll, and it is mechanically obvious that the counterbalance E^2 may be set at such point of adjusted position that through the intervening arms of the rock-lever and connecting-links the weight

25 of the roll E may be offset to a greater or less degree, depending upon the position of the counterbalance, with the effect that the roll will not be affected by any normal or proper tension of the web of paper, be it little or

30 much, on which account the roll properly counterbalanced may act to define the normal and proper tension of the paper in any part of the machine where it is placed; but immediately upon the tension of the paper

35 web having a tendency to increase by the contraction or shrinkage of the paper in drying then the resistance of the roll is overcome. The roll is then lifted by the tensional stress of the web of paper, and the abnormal

40 tension is automatically relieved or compensated for. This variable compensating or graduating of the weight of the tension-roll by the position of its counterbalance is of importance by reason of the fact that when the

45 web of paper begins first to be acted upon by the driers it is extremely delicate and it can be maintained under very little tension, this necessitating that the weight of the tension-roll E at this point of the machine should be

50 nearly offset by its counterbalance, whereby it will readily respond to and be lifted by the web of paper under the least degree of stress or abnormal tension. As the web of paper dries, however, it can stand and should be

55 given more tension in order that it may run and dry smooth. Accordingly by properly offsetting the weight of the roll E at another point or points in the machine by the position of the counterbalance the roll or rolls may be

60 graduated to resist an increasing tensional stress, and so the web of paper be maintained, depending upon its condition, at an increasing normal or proper tension; but, as said before, immediately upon the tension of

65 the web of paper becoming undue or exces-

sive then the roll will be lifted and the tension immediately relieved.

Any tendency to undue or abnormal tension in the web at any point is immediately shown to the operator and recorded by 70 means of an indicator-hand F , arranged on the end of the rock-shaft E' . This indicator-hand shows on a dial F' , supported by a bracket F^2 , fixed to the side of the frame. The operation is that when a tension-roll E 75 at any point in the machine is lifted by any undue tension of the web of paper at such point then the rock-shaft by the lifting of the tension-roll is overcome by the weight of the counterbalance, with the effect that the hand 80 on the end of the rock-shaft is likewise turned and shows on the dial not only that the tension-roll is lifted and that the web of paper at this point is undergoing shrinkage or contraction, and so a tendency to undue or abnormal 85 tension, but the hand also shows by the lifted position of the roll that further means for relieving the tension on the paper should at once be resorted to before the tension-roll will have been lifted to a point where it is no 90 longer of avail to relieve the tension, it being at the most a temporary expedient.

For the further relief of the tension on the web of paper I provide a means for varying the speed of each one of the rolls B . For 95 this purpose each roll B is separately driven direct off a speed-changing device G . This device should be one by which the speed of the roll may be varied with much delicacy, and for this purpose I prefer to use a speed- 100 changing device like that described in my pending application, Serial No. 196,804, filed March 7, 1904. Each device G , as shown, is controlled by a hand-wheel G' . By varying through the medium of the speed- 105 changing device the speed of any one or more of the rolls B the tension on the web of paper may be relieved at any point in the web, so making compensation for a variable contraction or shrinkage of the paper at different 110 points, as shown by the indicator, or slack may be taken up in any particular portion of the web and the web of paper maintained at such proper variable tension, depending upon the condition of the paper, as 115 will effect the best results.

With reference now to other improvements embodied in the machine, inasmuch as it is arranged to vary the speed of each one of the rolls B and inasmuch as a felt is 120 preferably used with the rolls for holding the web of paper pressed against the same each roll is accordingly provided with a separate felt H . The felt H is in the nature of an endless belt, and it is arranged to run upon a series of rolls h h' and h^2 h^3 , arranged on the 125 respective sides of the machine. The rolls h h' turn in pillow-blocks h^4 h^5 , resting on bearings h^6 h^7 , extending from the sides of the frame, and above the rolls h^2 h^3 turn in pil- 130

low-blocks h^8 h^9 or other journals, said pillow-blocks resting upon brackets h^{10} h^{11} , also extending from the sides of the frame.

With respect to the tensional rolls or devices it is very evident that they may be adapted to any machine where the paper is dried in the continuous web. The means also for regulating the devices may also be varied in detail without departing from the essence of my invention, these changes depending upon the circumstances or conditions under which the said devices are used.

By the term "hot air" as used in this specification I wish to be understood as meaning any air or elastic fluid sufficiently hot or heated to induce heat in the drier-rolls.

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

1. In a device for drying paper in the continuous web, a drier-roll over which the web of paper passes, and combined therewith means whereby hot air may be directed and applied to the naked surface of said roll before being applied to said web of paper passing onto and off the same.

2. In a device for drying paper in the continuous web, a drier-roll over which the web of paper passes, and combined therewith a chamber or receptacle for receiving hot air, whereby it may be applied to the naked surface of said roll before being applied to the web of paper passing onto and off the same.

3. In a device for drying paper in the continuous web, a drier-roll over which the web of paper passes, and combined therewith means whereby hot air may be applied to the naked surface of said roll and maintained in immediate contact therewith before being released to be applied to the web of paper passing onto and off the same.

4. In a device for drying paper in the continuous web, a drier-roll over which the web of paper passes, and combined therewith a chamber or receptacle for receiving hot air, whereby it may be applied to and maintained in immediate contact with said roll.

5. In a device for drying paper in the continuous web, a drier-roll over which the web of paper passes, and a hood in conjunction with the side thereof, forming a hot-air chamber by which the roll may be heated.

6. In a device for drying paper in the continuous web, a drier-roll over which the web of paper passes, a hood in conjunction with the naked or exposed surface or periphery thereof, forming a hot-air chamber for heating said roll, and affording means whereby the hot air from said chamber may be applied directly to the paper web as it passes onto and off said roll.

7. In a device for drying paper in the continuous web, a drier-roll over which the web of paper passes, a hood or casing in conjunction with the said roll within the fold of the

paper web passing onto and off the same, and forming a hot-air chamber for heating the roll, said hood being located with edges separated from the surface or periphery of the roll, by which air-passages leading from said air-chamber of the hood may be obtained on either side thereof for the purposes specified.

8. In a device for drying paper in the continuous web, a drier-roll over which said web of paper is caused to travel, and a hood in conjunction with said roll having an inlet or opening for the ingress of hot air, substantially as and for the purposes set forth.

9. In a device for drying paper in the continuous web, a series of drier-rolls over and under which, respectively, said web of paper is caused to travel, a hood in conjunction with each of said rolls within the fold of the paper web passing onto and off the same, each of said hoods forming a hot-air chamber for heating its respective roll, and outlets in the sides of each of said hoods whereby the hot air from the respective chambers may be applied to adjacent sides or portions of the web of paper.

10. In a device for drying paper in the continuous web, rolls or devices over which the paper is caused to travel, and a series of means for maintaining a yielding stress on said web of paper varying for different parts thereof, the stress of said means on the web of paper remaining constant whatever the position of the same may be.

11. In a device for drying paper in the continuous web, rolls or devices over which the paper is caused to travel, and a series of adjustable means for maintaining a yielding stress on said web of paper varying for different parts thereof, the stress of said means on the web of paper remaining constant whatever the position of the same may be.

12. In a device for drying paper in the continuous web, rolls or devices over which the web of paper is caused to travel, and means for defining the normal or proper tension of said web of paper varying for different parts or portions thereof, which means is adapted to give instant automatic relief to said web of paper upon tendency to any undue or abnormal tension in said parts or portions.

13. In a device for drying paper in the continuous web, rolls or devices over which the web of paper is caused to travel, and in combination therewith a tension roll or device under which by a fold said web of paper is adapted to pass, means for mounting said tension-roll to be lifted by said web of paper upon any undue or excessive tension thereof, and means for partially counterbalancing the weight of said roll.

14. In a device for drying paper in the continuous web, rolls or devices over which the web of paper is caused to travel, and in combination therewith a tension roll or device against which by a fold the web of paper is

adapted to travel, means for mounting said tension roll or device to be lifted by said web of paper upon occasion, and means for varying or graduating the relative resisting weight of said tension-roll to the lifting stress or tension of said web of paper.

15. In a device for drying paper in the continuous web, rolls or devices over which the web of paper is caused to travel, and in combination therewith a tension roll or device under which by a fold said web of paper is adapted to travel, bearings for the shaft of said roll, ways in which said bearings are retained to slide whereby said roll may be made to yield to any excessive or undue tension in said web of paper traveling under and against the same and counterbalancing means for partially overcoming the weight of said tension roll or device against the tensional stress of the web of paper traveling under and against the same whatever the elevated condition of said tension-roll may be.

16. In a device for drying paper in the continuous web, rolls or devices over which the web of paper is caused to travel, and in combination therewith a roll or device under which by a fold said web of paper is adapted to travel, means for mounting said roll or device whereby it may yield to the tensional stress of said web of paper against the same, and a lever provided with an adjustable counterbalancing-weight on one side thereof for partially overcoming the weight of the tension roll or device against the tensional stress of the web of paper traveling under and against the same whatever the elevated position of said tension-roll may be.

17. In a device for drying paper in the continuous web, rolls or devices over which said web of paper is caused to travel, means for drying said web of paper, tensional means for maintaining said web of paper at a proper or normal tension automatically yielding to any undue or excessive tension therein, said means comprising a series of tension rolls or devices under which by a series of folds said web of paper is adapted to travel, means for mounting said rolls whereby they may yield to any undue or excessive tension in said web of paper, and means for counterbalancing each of said rolls whereby they may be provided with a variable resistance to the tensional stress of said web of paper at different parts thereof.

18. In a device for drying paper running at a tension in the continuous web, a tension device adapted to be overcome by the tensional strain of said web, for automatically and temporarily relieving the same, and means for regulating the running speed of said web of paper for different portions thereof, whereby the tension of the web may be permanently relieved and its influence upon the tension device suspended.

19. In a device for drying paper running at

a tension in the continuous web, a tension device adapted to be overcome from a normal operative position by the tensional strain in said web, for automatically and temporarily relieving the same, and means for regulating the running speed of said web of paper for different portions thereof, whereby the tension of the web may be permanently relieved and said tension device restored to its normal position.

20. In a device for drying paper running under tension in the continuous web, a tension device adapted to exert a yielding bearing stress upon said web of paper, and means whereby the amount of bearing stress of said tension device upon said web of paper may remain constant as said tension device yields to the tensional stress of said web of paper.

21. In a device for drying paper running under tension in the continuous web, a series of tension devices adapted to exert a variable yielding bearing stress upon said web of paper for different portions thereof, and means whereby the amount of bearing stress of each of said tension devices may remain constant as said device yields to the tensional stress of said web of paper.

22. In a device for drying paper running under tension in the continuous web, a series of tension devices adapted to exert a variable yielding bearing stress upon said web of paper for different portions thereof, means whereby the amount of bearing stress of each of said tension devices may remain constant as said tension device yields to the tensional strain of said web of paper, and means whereby the amount of said bearing stress of each of said tension devices may be regulated.

23. In a device for drying paper running under tension in the continuous web, a tension device adapted to exert a yielding bearing stress upon said web of paper, for automatically and temporarily relieving the tension of the same, means whereby the amount of bearing stress of said tension device may remain constant as said tension device yields to the tensional strain of said web of paper, and means for regulating the running speed of said web of paper for different portions thereof, whereby the tension of the web may be permanently relieved and its influence upon the tension device suspended.

24. In a device for drying paper running under tension in the continuous web, a tension device adapted when in normal position to have bearing stress upon said web of paper, said tension device also being made yielding, whereby it may be overcome by the tensional strain of said web, for automatically and temporarily relieving the same, and means whereby the bearing stress of said tension device upon said web of paper may remain constant for different positions thereof.

25. In a device for drying paper running under tension in the continuous web, a ten-

sion device adapted when in normal position to bear with stress upon said web of paper, said tension device also being made yielding, whereby it may be overcome by the tensional strain of said web of paper, for automatically and temporarily relieving the same, means whereby the bearing stress of said tension device upon said web of paper may remain constant for different positions thereof, and means for regulating the running speed of said web of paper for different portions thereof, whereby the tension of the web may be permanently relieved and said tension device restored to its normal position.

26. In a device for drying paper in the continuous web, a series of devices for maintaining said web of paper at proper variable tension for different portions thereof, a series of indicators for showing any undue or excessive tension in said different portions of the web, and means operated upon by said web of paper upon any undue or excessive tension in said different portions of the web for operating said indicators.

27. In a device for drying paper in the continuous web, a tension roll or device against which by a fold said web of paper is caused to travel, means for mounting said roll to yield to any undue or excessive tension in said web of paper, a rock-shaft and mounting therefor, a counterbalancing-weight, means connecting said tension roll or device and said rock-shaft whereby upon any yielding movement in said tension-roll said counterbalancing-weight may act to turn said rock-shaft, and indicating means connected with said rock-shaft to be operated thereby.

28. In a device for drying paper in the continuous web, a tension roll or device under which by a fold said web of paper is caused to travel, means for mounting said tension-roll or device to yield to the bearing stress of said web of paper upon any undue or excessive tension therein, a rock-shaft and mounting therefor, means connecting said rock-shaft with said tension-roll, an arm oppositely extending from said rock-shaft, a counterbalancing-weight adjustably mounted upon said arm, and an indicating-hand connected to be operated by the turning of said rock-shaft.

29. In a device for drying paper in the continuous web, a series of rolls under and over which said web of paper is caused to travel, a series of tension rolls or devices under which by a corresponding series of folds said web of paper is likewise caused to travel, means for mounting each of said rolls whereby it may automatically yield to any excessive or undue tension in said web of paper, means operated upon thereby for indicating the yielding of such roll, and means for varying the speed of any one or more of the said first-mentioned series of rolls.

30. In a device for drying paper in the continuous web, a series of rolls over and under which said web of paper is caused to travel, means for drying said web of paper, a series of tension rolls or devices under which by a corresponding series of folds said web of paper is likewise caused to travel, means for mounting each of said rolls to yield automatically to any excessive or undue tension in said web of paper, means for varying the yielding resistance of said tension-rolls to the tensional or bearing stress of the web of paper, and means for varying the speed of any one or more of the first-mentioned series of rolls.

31. In a device for drying paper in the continuous web, a series of rolls under and over which said web of paper is caused to travel, means for drying said web of paper, a series of tension rolls or devices under which by a corresponding series of folds said web of paper is likewise caused to travel, means for mounting each of said rolls to yield automatically to any excessive or undue tension in said web of paper, means for varying the yielding resistance of said tension-rolls to the tensional or bearing stress of the web of paper, indicating means connected to be operated upon the yielding of any one of said tension-rolls for showing the tensional stress of said web of paper, and means for varying the speed of any one or more of said first-mentioned series of rolls in consequence thereof.

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Witnesses:

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