

W. M. GROSVENOR.

APPARATUS FOR TREATING FIBROUS MATERIALS.

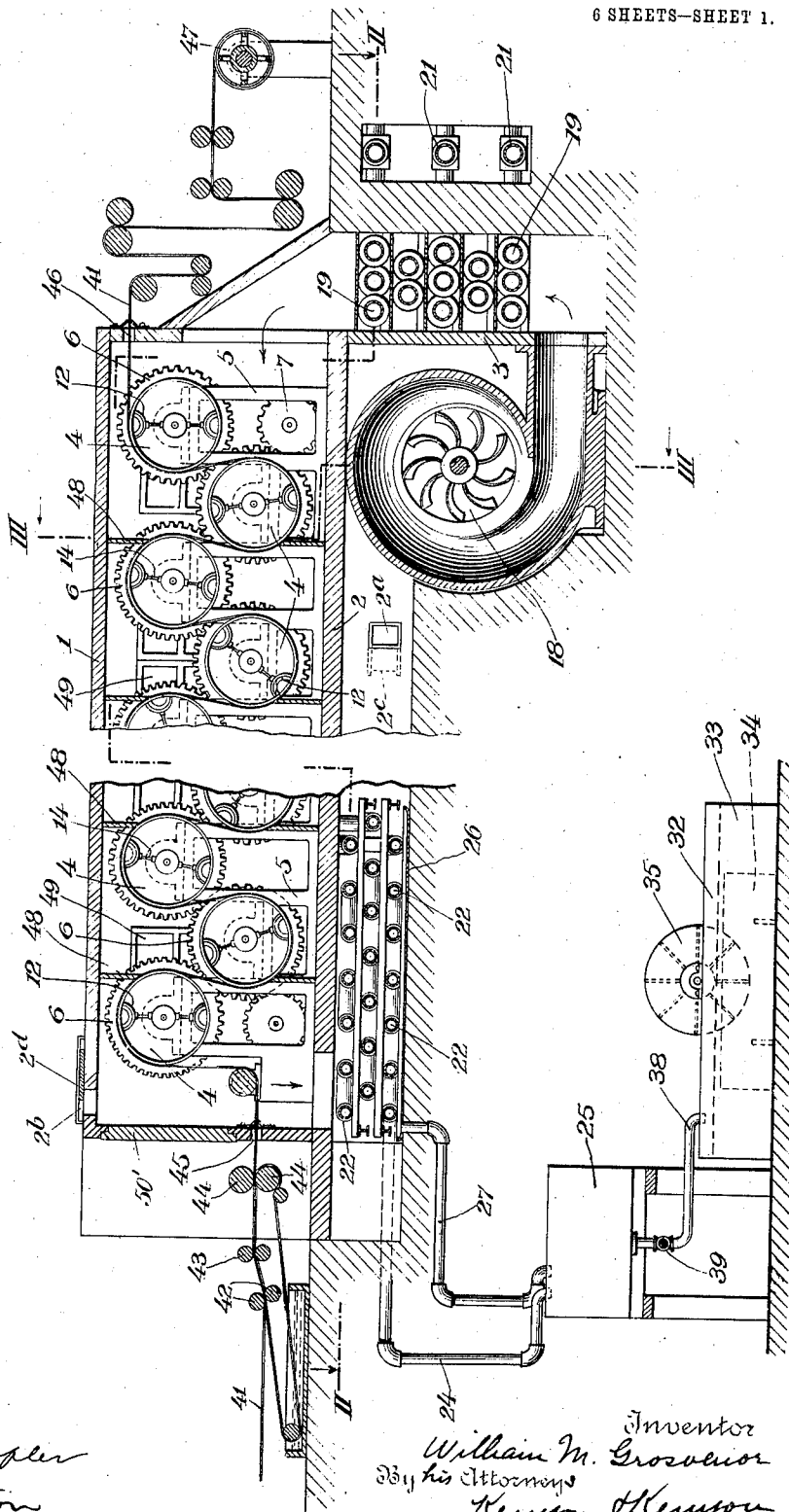
APPLICATION FILED JAN. 25, 1910. RENEWED NOV. 10, 1911.

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Patented Mar. 5, 1912.

6 SHEETS—SHEET 1.

Fig. 1



Witnesses:
John O. Sampler
W. A. Hutton

Inventor
William M. Grosvenor
By his Attorneys
Kempson & Kempson

W. M. GROSVENOR.

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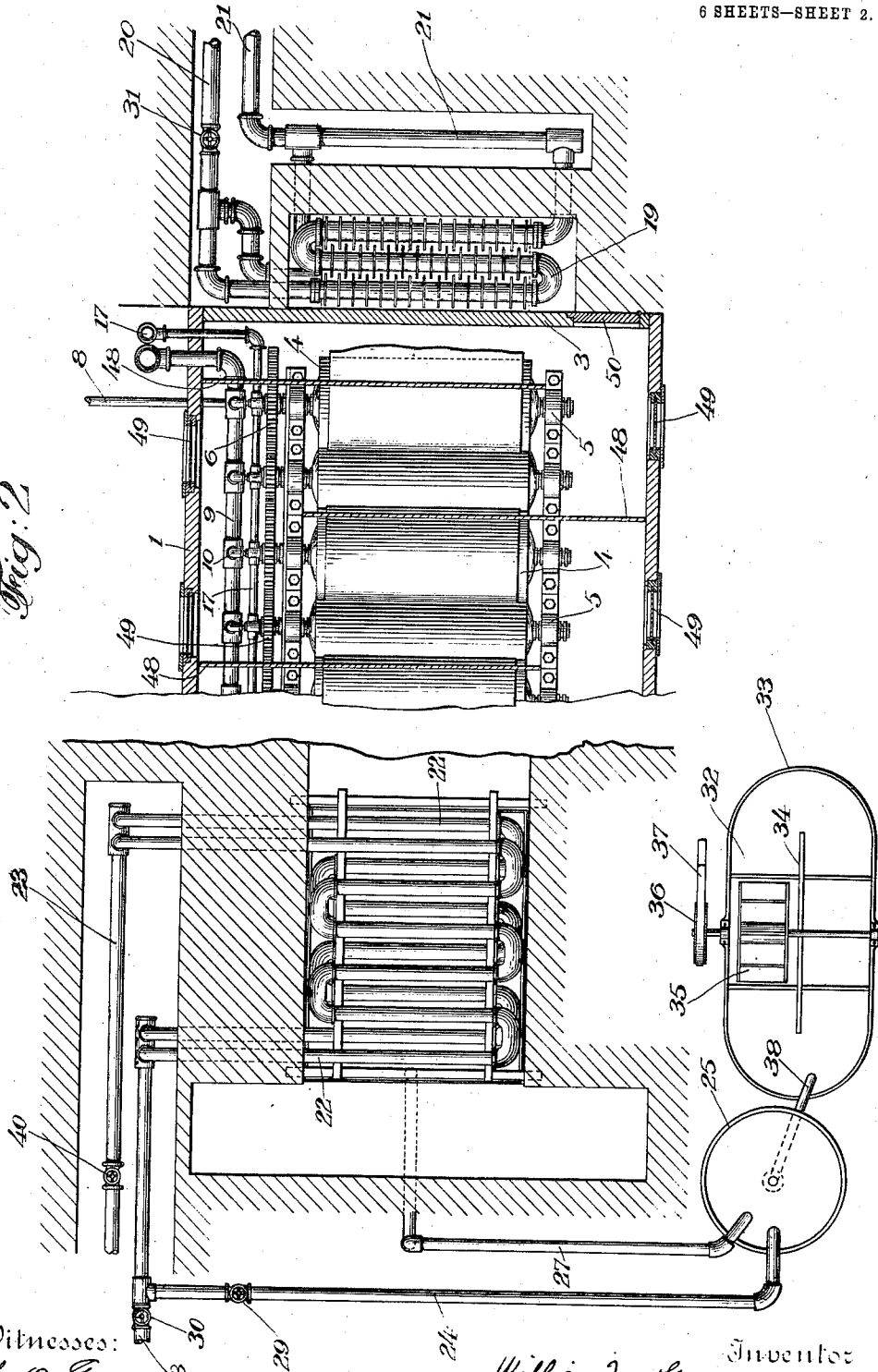
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6 SHEETS—SHEET 2.

Fig. 2



Witnesses:
John O. Gruber
W. A. Hutton

Inventor
William M. Grosvenor
By his Attorneys
Kenyon Kenyon

W. M. GROSVENOR.

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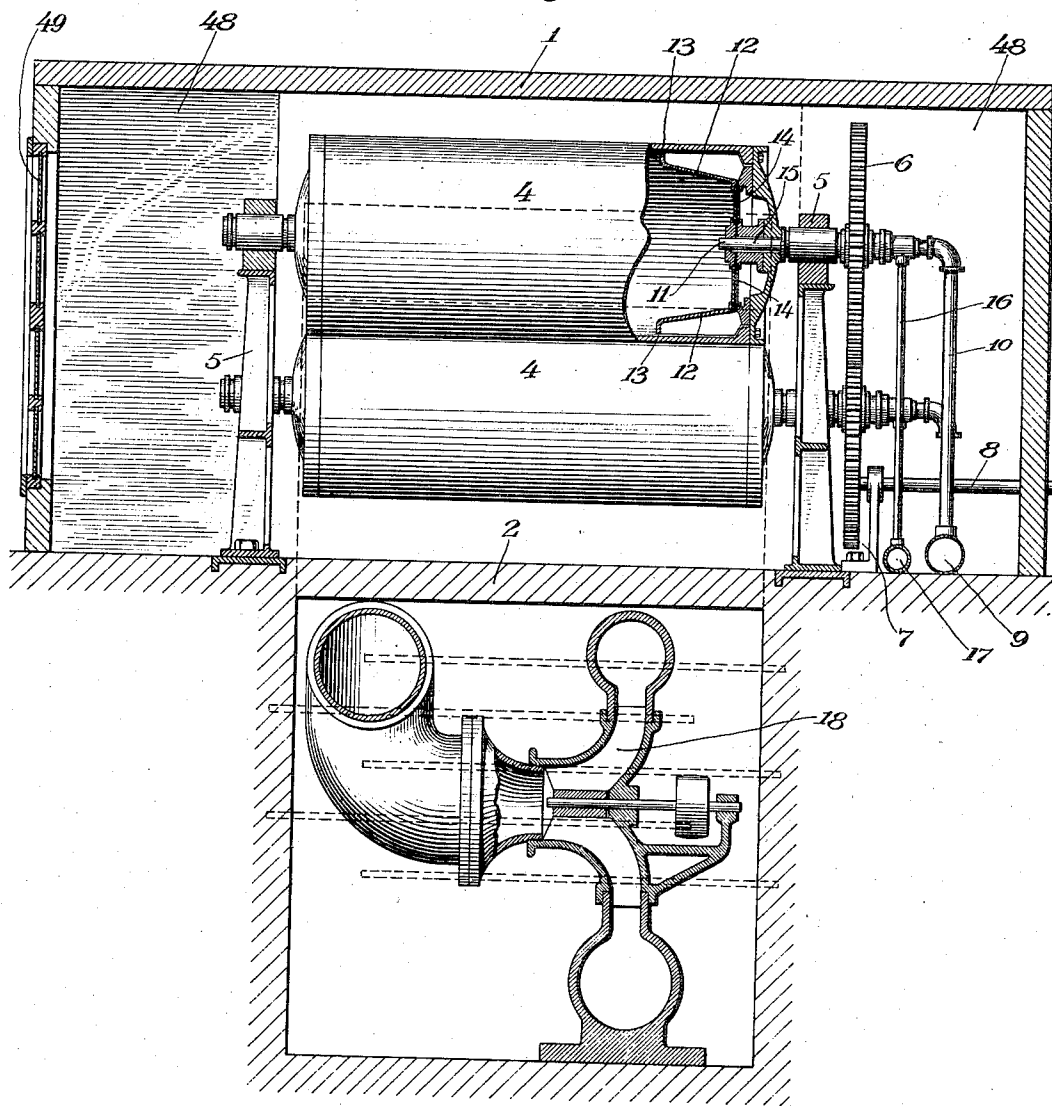
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6 SHEETS—SHEET 3.

Fig. 3



Witnesses:

John O. Sampler

W. A. Hutton

Inventor

William M. Grosvenor

By his Attorneys

Kempson & Kempson

W. M. GROSVENOR.

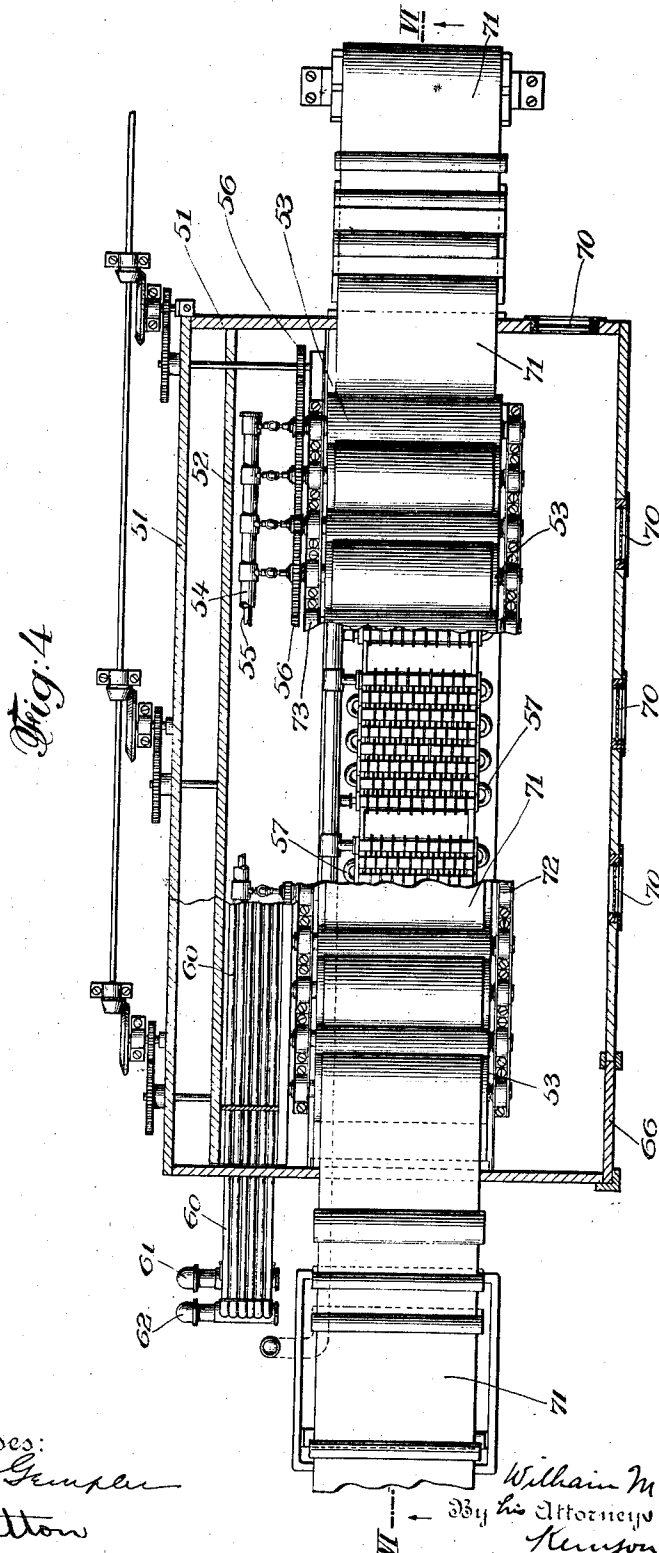
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6 SHEETS—SHEET 4.



Witnesses:
John D. Gump
W. A. Hutton

Inventor
William M. Grosvenor
By *his Attorneys*
Kempson & Kempson

W. M. GROSVENOR.

APPARATUS FOR TREATING FIBROUS MATERIALS.

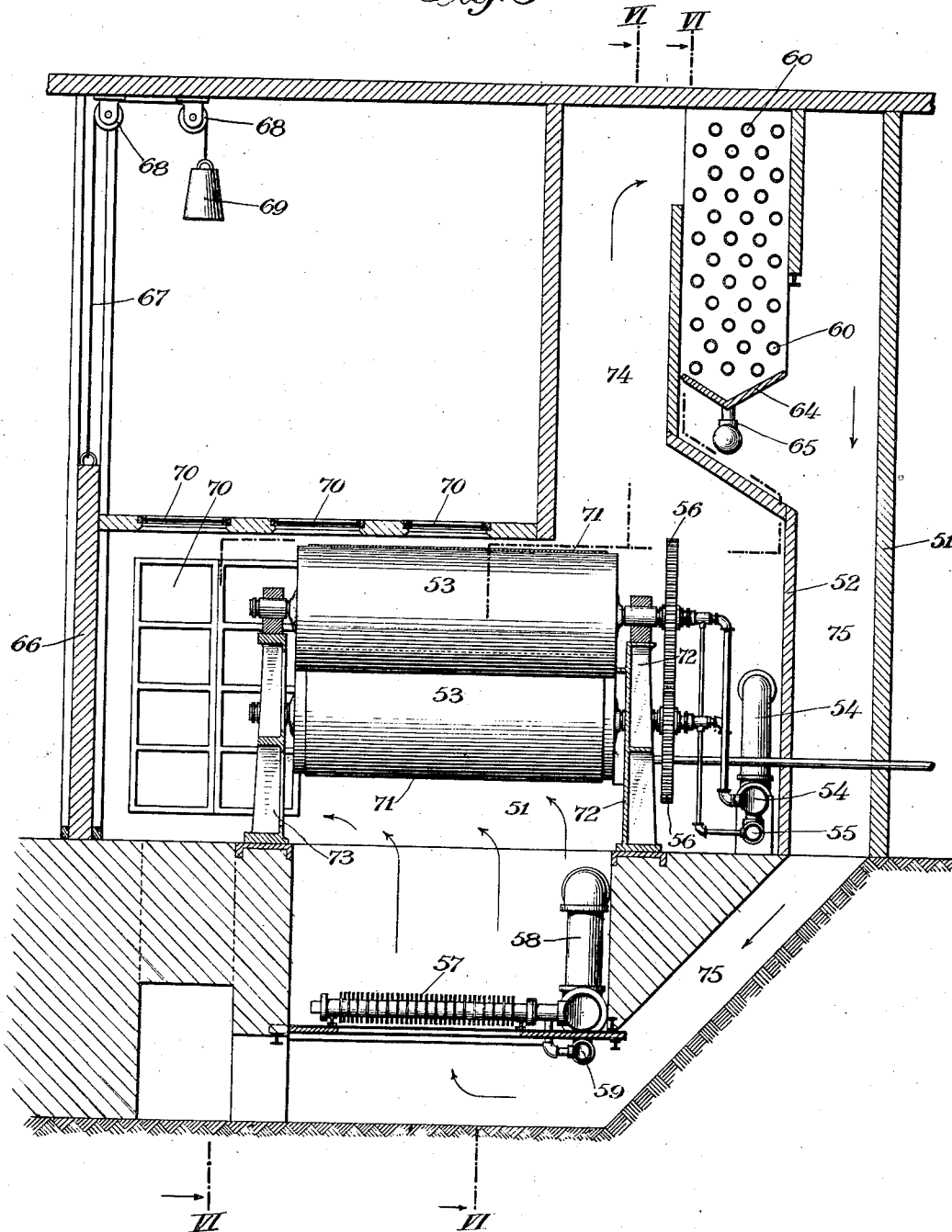
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6 SHEETS—SHEET 5.

Fig. 5



Witnesses:

John O. Gampier

W.A. Hutton

Inventor

William M. Grosvenor

By his Attorneys

Kenyon Kenyon

W. M. GROSVENOR.

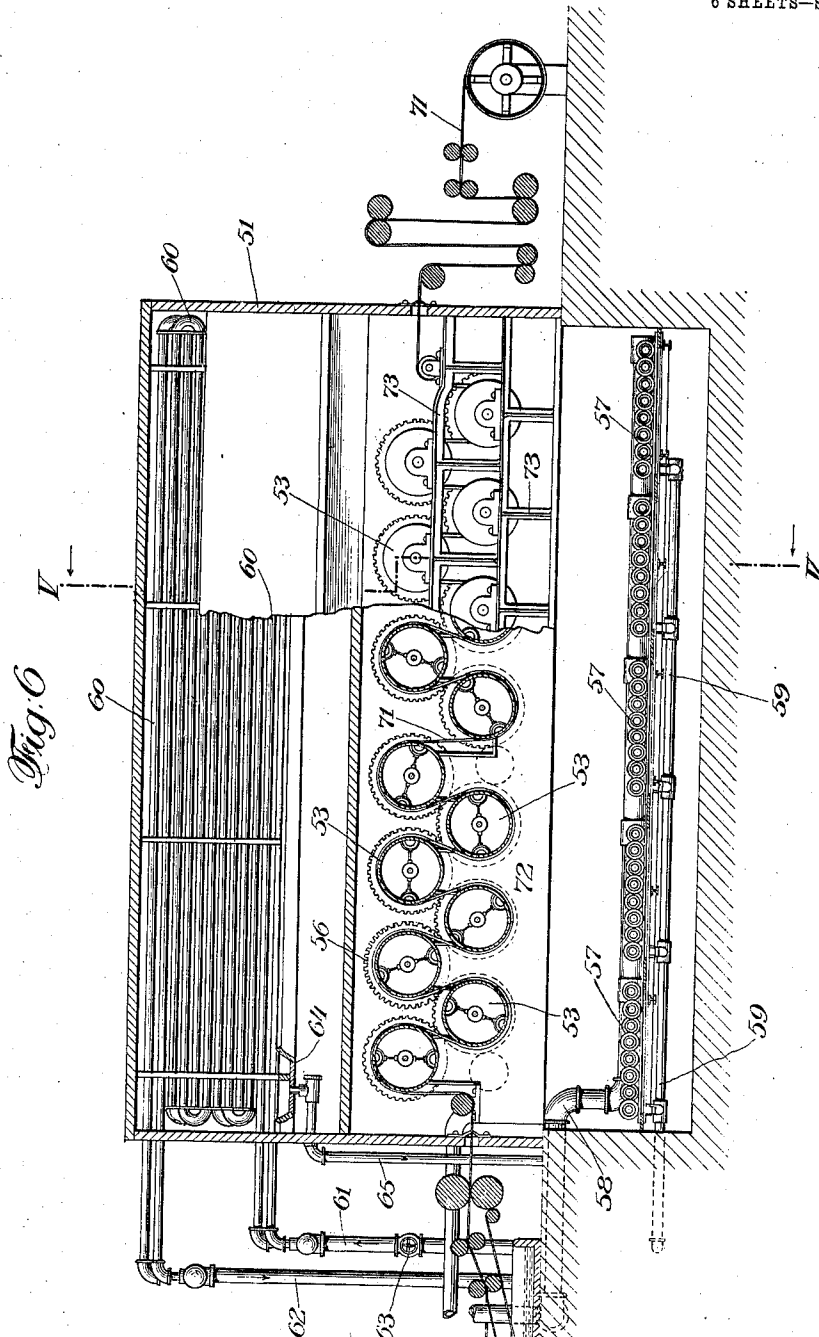
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Patented Mar. 5, 1912.

6 SHEETS—SHEET 6.



Witnesses:

John O. Gimpler
W. A. Hutton

Inventor
William M. Grosvenor
By his Attorneys
Kenyon Kenyon

UNITED STATES PATENT OFFICE.

WILLIAM M. GROSVENOR, OF GRANTWOOD, NEW JERSEY.

APPARATUS FOR TREATING FIBROUS MATERIALS.

1,019,319.

Specification of Letters Patent.

Patented Mar. 5, 1912.

Application filed January 25, 1910, Serial No. 539,919. Renewed November 16, 1911. Serial No. 680,684.

To all whom it may concern:

Be it known that I, WILLIAM M. GROSVENOR, a citizen of the United States, and a resident of Grantwood, Bergen county, and State of New Jersey, have invented certain new and useful Improvements in Apparatus for Treating Fibrous Materials, of which the following is a specification.

My invention relates to improvements in systems and apparatus for treating fibrous materials and is more especially directed to improvements in apparatus for drying paper and preparing the pulp for the same.

Various objects of my invention are to provide an apparatus in which the drying operation may be carried out much more economically and thoroughly and much more efficiently and to also provide an arrangement in which some of the energy and material which would otherwise be lost in the drying operation may be utilized in the preparation of the pulp of the material.

Further objects, features and advantages will more clearly appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification.

Referring to the drawings, Figure 1 is a vertical section of an apparatus embodying one form of my invention. Fig. 2 is a horizontal section of the same taken on the line II—II of Fig. 1. Fig. 3 is a vertical section taken at right angles to that shown in Fig. 1, along the line III—III of Fig. 1. Fig. 4 is a plan of a modified form of apparatus embodying certain features of my invention, certain parts being broken away to more clearly show the same. Fig. 5 is a vertical cross-section taken on the line V—V of Fig. 6. Fig. 6 is a longitudinal vertical section taken on the lines VI—VI of Figs. 4 and 5.

In order that the principles of my invention may be clearly ascertained and that others skilled in the art may readily construct a satisfactory apparatus of my invention I will now describe in detail the specific apparatus which is illustrated in the drawings.

Referring to Figs. 1, 2 and 3, 1 represents a suitable chamber having therein dividing walls 2 and 3, so that a suitable and substantially closed cyclic path is formed for the drying medium. In the upper part of the chamber 1, I place a series of suitable heating members which in the particu-

lar embodiment of my invention illustrated are shown as cylindrical rolls 4, supporting the paper and rotatably mounted in the framework 5. The rolls 4 have pinions 6 secured to their axles, which pinions are geared together and are driven by a pinion 7 driven by any suitable source of power from a shaft 8.

For heating the rolls 4 I provide a pipe 9 which supplies steam to the various pipes 10, one each of which connects with one of the rolls 4 through the inlets 11, (see Fig. 3); that is, steam is admitted to the interior of the cylindrical rolls 4 from the pipe 9 through the pipes 10 and through the bearings and trunnions of the rolls, these being made hollow for this purpose. In order that the exhaust may be taken away from the interior of these rolls they are provided on their interior with plates 12 under which the condensed moisture collects the moisture or water running thereunder through the spaces 13. From under the plates 12 the moisture passes toward the center of the rolls through pipes 14, to spaces 15 around the inlet ducts 11. From the spaces 15 the moisture passes outwardly and is carried away through pipes 16 to the main exhaust pipe 17.

In the lower compartment of the chamber is situated a fan 18 which may be of any well known form and which forces the drying medium about the cyclic path in the drying chamber in the direction indicated by the arrows. At the right of the fan 18 and adjacent the wall 3 is a plurality of heating pipes 19 supplied with steam or other suitable heating medium through a pipe 20. The exhaust from the heating means 19 is carried away through pipes 21. At the left of the fan 18 and in the lower compartment of the drying chamber is a suitable condenser consisting of pipes 22 supplied with cold water from the pipe 23. The exhaust from the pipes 22 is taken away through the pipe 24 which enters into a suitable tank 25. Below the condensing pipe 22 is situated a pan 26 in which the condensate withdrawn from the drying medium collects. This condensate is drawn off from the pan 26 by means of a pipe 27 and also deposited in the tank 25. If desired the exhaust from the pipes 22 may be carried away to other places, through a pipe 28. Valves 29 and 30 regulate the proportion of exhaust water from the condensing pipe 22 which is deposited

within the tank 25. The amount of heat supplied to the drying medium by means of the heating coils 19 may be adjusted by means of a valve 31.

5 Below the drying apparatus above described is situated a pulp beating apparatus 32 which may be of any well known form, but, which as shown, consists of a
10 suitable tank 33 having a longitudinal position 34 therein with a paddle wheel 35 arranged on one side of the same. The paddle wheel 35 is driven in any suitable manner by means of pulley 36 and belt 37. The tank 25 is used as a supply for warm water to be used in the pulp beater 32. For this
15 purpose a pipe 38 connects the tank 25 with the pulp beater 32 and a valve 39 is arranged therein to regulate the amount of flow to the pulp beater. A valve 40 is arranged in the pipe 23 to regulate the amount
20 of cold water supplied to the condenser and thereby regulate the amount of humidity of the drying medium.

In operation the paper or web of pulp 41
25 is fed in at the left hand end of the apparatus as indicated, passing between rolls 42, 43 and 44 and through an aperture 45 in the chamber 1. The web then passes over and about the cylindrical surfaces of the various heating members or rolls 4, some
30 on one side of the paper and others on the other side of the paper, as clearly shown. By the particular arrangement of rolls shown the web is given an up and down path through the apparatus and passes out
35 through an aperture 46 at the right hand end of the chamber 1. Then it passes over suitable rolls and may be wound upon a reel 47.

40 As the paper passes over the rolls 4 it comes into contact with the heated cylindrical surfaces thereon, which surfaces have been heated by the steam admitted thereto as above described. This hardens the fibrous
45 material in a well known way. While the web of paper or other fibrous material is thus passed through the apparatus the drying medium is circulated in a counter-direction thereto, by means of the fan 18. The
50 drying medium is heated in its cyclic passage by means of the heating coils 19 and after passing over the web of pulp and absorbing the moisture therefrom this moisture is condensed out of the same by means
55 of the condensing coils 22.

In order that the drying medium may come into very thorough contact with all portions of the web of fibrous material I have provided baffles 48 extending alternately from either side of the chamber 1,
60 so that the drying medium is caused to pass alternately back and forth in a transverse direction over the surface of the material. These baffles only extend a short distance
65 beyond the edges of the paper so that ample

space is given for the passage of the drying medium around their ends.

In order that the operation of the apparatus may be closely watched and any trouble therewith easily located I have provided suitable windows 49 in the sides of the chamber 1. Doors 50 and 50' are also provided in the ends of the apparatus for easy access thereto.

When light stock is being dried and the liability of breakage is great, more space for instance may be left between the sides of the chamber and the rolls 4. Also the use of condenser coils where water is scarce may be wholly or partially obviated by the introduction of a small portion of fresh air into the circulating medium at certain points, as at the opening 2^a, and the removal of portions of highly saturated or exhausted air at other points, as at the opening 2^b, as it will be appreciated that in any case the action of the condensers does not remove all the moisture from the atmosphere passing over them and that one of the principles of the present improvement consists in the drying of paper in a re-circulated atmosphere having a high temperature and carrying considerable moisture in order to prevent the harsh and excessive drying which renders the paper brittle and is the cause of so many breakages, both in the drying machine and later in the modern high speed pressers. The openings 2^a and 2^b may be wholly or partially closed by covers or doors 2^c and 2^d.

From the above it will appear that the apparatus described is especially economical and efficient for treating fibrous materials such as paper pulp, etc., since it causes the drying medium to come into very thorough contact with the material, utilizes at least most of the same medium over and over again, thereby avoiding disturbances due to climatic changes and substantially prevents the access of foreign matter to the apparatus. Furthermore, the system and apparatus, by drying the pulp in a moist atmosphere produce a tougher paper; reducing loss and delay by breakage in the drier and press. Also they are especially efficient since the condensing water and also the condensate withdrawn from the drying medium which would otherwise go to waste are deposited in a suitable receptacle so that they may be used in the pulp beater 32. Thus certain constituents used to prepare the material for the drying process are derived from the condensing action of that process.

Referring to Figs. 4, 5 and 6 I there show a modified form of apparatus. In these figures 51 represents a suitable chamber constructed to form a substantially closed cyclic path for the drying medium by means of a partition 52. Suitably arranged within the chamber 51 is a series of hardening rolls

53 which are constructed and arranged in the same manner as the rolls 4 previously described. These rolls are also supplied with steam for heating the same by means of a supply pipe 54 and exhaust pipe 55 in exactly the same manner as the rolls 4 are supplied. The rolls 53 are also driven in the same manner by means of gears 56. Arranged directly beneath this series of rolls 53 is a plurality of heating coils 57 which are supplied with steam through a pipe 58 and the exhaust from which is carried away by means of a pipe 59. In the upper part of the chamber 51 are arranged condensing pipes 60 supplied with cold water or other cooling fluid through inlet pipes 61, which fluid flows away from the coils 60 through outlet pipes 62. Valves 63 are provided in the pipes 61 in order to regulate the amount of cooling and thereby the amount of moisture left in the drying medium. A drip pan 64 is provided below the condensing coil 60 which collects moisture condensed from the drying medium and a pipe 65 leads from this drip pan and may connect with a suitable tank and pulp beater as already described with respect to Figs. 1, 2 and 3. A suitable valve may be included in the inlet pipe 58 in order to properly regulate the amount of steam admitted to the heating coils 57 as already described. A suitable door 66 is provided on one side of the apparatus in order that easy access may be had thereto. This door may be lifted or opened by means of a cable 67 passing over pulleys 68 and having a weight 69 attached to its other end, as clearly shown in Fig. 5. Suitable windows 70 are also provided in the sides and top of the apparatus in order that easy inspection of the operation of the apparatus may be had. In operation, the drying medium is heated by the heating coils 57, which, due to its expansion, passes upwardly and comes into contact with the under surfaces of the web of paper 71, which passes through the machine in the same manner as described with respect to Figs. 1, 2 and 3. The framework 72 on the right hand side of the rolls is made solid so that the drying medium is prevented from passing above the web of paper on that side of the rolls. The drying medium is thus forced about the edge of the paper on the left hand side, as shown in Fig. 5. For this purpose the framework 73 is made open, as clearly shown in Fig. 6, so that no material obstruction is placed in the way of the drying medium on this side. The drying medium then passes over the upper surface of the paper in a transverse direction to the right hand side of the apparatus. This causes the drying medium to come into thorough contact with both surfaces of the web of material. The drying medium then passes upwardly through the

passage 74 and comes into thorough contact with the condensing pipes 60. The drying medium is thereupon cooled so that it becomes heavier and sinks downwardly through the passage 75 until it again comes into contact with the heating pipes 57 and is again heated. This cycle of operations is continually repeated as long as desired, the differences in specific gravity due to the heating and cooling of the medium causing its circulation about the cyclic passage.

The apparatus and system shown in Figs. 4, 5 and 6 may be provided with suitable connections to the pulp beating or other preparing apparatus so that the otherwise waste cooling liquid may be conducted thereto and utilized therein as well as the entire moisture condensed and collected in the pan 64.

From the above it will appear that the apparatus and system described is especially efficient and economical in that the drying medium is brought into thorough contact with the material to be dried and that the same drying atmosphere may be used over and over again and so that the operation of the system is not subjected to the detrimental effects of climatic variations. Furthermore, the apparatus is so arranged and so constructed that easy access may be had to all parts thereof and the operation may be readily inspected without interfering therewith, and workmen are not subjected to trying atmosphere conditions, and troublesome condensation on roofs and ceilings is avoided.

Although I have described my improvements in great detail, nevertheless I do not desire to be limited thereto except as specified hereinafter in the claims, since many modifications and changes may be made without departing from the spirit and scope of my invention. But

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

1. In a drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path for the drying medium, a plurality of suitable supports therein over which the material to be dried passes, means for independently heating each support, means for heating the drying medium in said cyclic path, means for cooling the drying medium in said path and mechanical means for forcing the drying medium around said cyclic path.

2. In a drying apparatus, the combination of a suitable chamber forming a cyclic path for the drying medium, a plurality of members therein over which the material to be dried passes, some on one side of the material and others on the other side of the material, means for heating said members, said means including a source of heat inside each

member, means for heating the drying medium in said cyclic path and means for removing moisture from said cyclic path.

3. In a drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path for the drying medium, suitable rolls therein over which the material to be dried passes, means for heating said rolls, said means including a source of heat inside the rolls and parts arranged to cause a circulation of the drying medium about said cyclic path.

4. In a drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path over which the drying medium is caused to circulate, a series of members in said path over which the material to be dried passes, and means for independently heating each of said members to heat the members, whereby each member will independently heat the material.

5. In a drying apparatus for fibrous material, the combination of a chamber forming a cyclic path for the drying medium, means in said path for conveying the material, means for internally heating said conveying means to provide heated surfaces for the material to rest upon and parts arranged to cause the drying medium to circulate around said cyclic path.

6. In a drying apparatus for fibrous material, the combination of a chamber forming a substantially closed cyclic path for the drying medium, a series of members in said cyclic path over which the material to be dried passes, means for heating said conveying members to provide heated surfaces for the material to rest upon, independent means for heating the drying medium in said cyclic path, means for cooling the drying medium in said cyclic path and mechanical means for forcing the drying medium around said cyclic path.

7. In a drying machine, the combination of a chamber forming a substantially closed cyclic path for the drying medium, a series of members in one portion of said path over the surfaces of which the material to be dried passes, baffling means adjacent said members arranged to deflect the drying medium transversely across the surface of the material to be dried as it passes over the members, heating means for the drying medium in another portion of said path and cooling means for the drying medium in another portion of said path.

8. In a drying machine, a plurality of rolls for conveying the material to be dried through the apparatus, means for independently heating each roll to provide heated surfaces for heating the material to be dried, and means for circulating a drying medium over the material to be dried as it passes over said rolls and removing the same to remove moisture from the material to be dried.

9. In a drying machine, a plurality of members for supporting the material to be dried in the apparatus, means for independently heating each member to provide heated surfaces for heating the material to be dried, and a plurality of baffles arranged to cause the drying medium to travel back and forth transversely of the web of material to be dried as it passes over said rolls.

10. In a drying apparatus for fibrous material, the combination of a chamber forming a substantially closed cyclic path for the drying medium, means in said path for conveying the material, means for heating said conveying means, to provide heated surfaces for the material to rest upon, a plurality of baffles arranged to cause the drying medium to travel back and forth transversely of the material and conveying means and parts arranged to cause the drying medium to circulate around said cyclic path.

11. In a drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path for the drying medium, suitable rolls therein over which the material to be dried passes, a plurality of baffles arranged to cause the drying medium to travel back and forth transversely of the material to be dried as it passes over the rolls, means for heating said rolls, means for heating the drying medium in said cyclic path, means in said path for cooling the drying medium in said path and mechanical means for forcing the drying medium around said cyclic path.

12. In a paper drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path for the drying medium, a series of members therein over which the paper passes, a plurality of baffles arranged to cause the drying medium to travel back and forth transversely of the paper as it passes over the members, means for heating the drying medium in said cyclic path and means in said cyclic path for cooling the drying medium before it engages the heating means.

13. In a drying machine, a plurality of rolls for conveying the material to be dried through the apparatus, means for heating said rolls to provide heated surfaces for heating the material to be dried, and means for circulating a drying medium, over the material to be dried, in a counter direction to the movement of the material to be dried and in a cyclic path and removing the drying medium therefrom to remove moisture from the material to be dried.

14. In a drying apparatus for fibrous material, the combination of a chamber forming a substantially closed cyclic path for the drying medium, means for conveying the material in said path, means for heating said conveying means directly adjacent

the conveying means to provide heated surfaces for the material to rest upon, and parts arranged to cause the drying medium to circulate around said cyclic path in a direction counter to the movement of the material.

15. In a drying apparatus for fibrous material, the combination of a chamber forming a substantially closed cyclic path for the drying medium, a series of members in said cyclic path over which the material to be dried passes, means for admitting a heating fluid to the inside of said members to provide heated surfaces for the material to rest upon, a condenser in said path for cooling the drying medium, and parts arranged to cause the drying medium to circulate around said cyclic path.

16. In a drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path for the drying medium, suitable rolls therein over which the material to be dried passes, means for independently heating each roll, and parts arranged to cause a circulation of the drying medium about said cyclic path, said chamber being provided with a window in its wall for easy inspection of the drying process, and with a door for easy ingress and egress thereto.

17. In a drying apparatus, a chamber forming a suitable path for the drying medium, a plurality of rolls in said chamber for conveying the material therethrough, means for admitting a heating fluid to the interior of said rolls, and means for circulating the drying medium over the material in said path.

18. In a drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path for the drying medium, a plurality of suitable supports therein over which the material to be dried passes, means for admitting a heating fluid to the interior of said supports to heat the supports and means for forcing the drying medium around said cyclic path, and means for heating the drying medium in said cyclic path.

19. In a drying apparatus, the combination of a suitable chamber forming a substantially closed cyclic path for the drying medium, a series of hollow members therein over which the material to be dried passes, means for admitting a heating fluid to the interior of said members to heat the members, means for forcing the drying medium around said cyclic path, means for cooling the drying medium in said cyclic path and means for heating the drying medium in said cyclic path after the drying medium has been cooled by said cooling means and before it engages the material to be dried.

20. In a paper making machine, the combination of hardening rollers, means for

admitting steam to the inside of said rollers, an auxiliary heater, a condenser and means for circulating the atmosphere surrounding the rollers over the heater and condenser.

21. In a drying apparatus for fibrous material, the combination of a chamber forming a cyclic path for the drying medium, means for conveying the material in said path, means for admitting a heating fluid to the inside of said conveying means to provide heated surfaces for the material to rest upon, and parts arranged to cause the drying medium to circulate around said cyclic path.

22. In a system for treating fibrous material, the combination of means for beating up the pulp for said material, a suitable chamber in which the material may be dried by a drying medium, means for cooling the drying medium and means for conveying the heat absorbed in said cooling to the pulp beating means to be utilized therein.

23. In a system for treating fibrous material, the combination of means for beating up the pulp for said material, a suitable chamber in which the material may be dried by a drying medium, means for cooling the drying medium to condense therefrom moisture taken from the material being dried, and means for conveying said moisture to the pulp beating means to be utilized therein.

24. In a system for treating fibrous material, the combination of means for beating up the pulp for said material, a suitable chamber in which the material may be dried by a drying medium, means for cooling the drying medium to condense therefrom moisture taken from the material being dried, means for conveying said moisture to the pulp beating means to be utilized therein, and means for conveying the heat absorbed in said cooling to the pulp beating means to be utilized therein.

25. In a system for treating fibrous material, the combination of means for beating up the pulp for said material, a suitable chamber in which the material may be dried by a drying medium, means in the drying chamber having surfaces on which the material rests, means for heating said surfaces to harden the material, means for cooling the drying medium and means for conveying the heat absorbed in said cooling to the pulp beating means to be utilized therein.

26. In a system for treating fibrous material, the combination of means for beating up the pulp for said material, a suitable chamber in which the material may be dried by a drying medium, means in the drying chamber having surfaces on which the material rests, means for heating said surfaces to harden the material, means for cooling the drying medium to condense

therefrom moisture taken from the material being dried, and means for conveying said moisture to the pulp beating means to be utilized therein.

5 27. In a system for treating fibrous material, the combination of a pulp beater therefor, a suitable drying chamber for a drying medium, a condenser for condensing the moisture absorbed from the material, 10 out of the drying medium, and means for conveying the condensate to the pulp beater to be utilized therein.

28. In a system for treating fibrous material, the combination of a pulp beater 15 therefor, a suitable drying chamber for a drying medium, a condenser for condensing the moisture absorbed from the material out of the drying medium, and means for conveying the condensing liquid to the pulp 20 beater to be utilized therein.

29. In a system for treating fibrous material, the combination of a pulp beater therefor, a suitable drying chamber for a

drying medium, suitable rolls for conveying the material through the chamber, means 25 for admitting a heating fluid to the inside of said rolls, a condenser for condensing the moisture absorbed from the material out of the drying medium, and means for conveying the condensing liquid to the pulp beater 30 to be utilized therein.

30. In a system for treating fibrous material, a drying chamber for a drying medium, means for preparing the material to be dried for the drying chamber, a con- 35 denser for the drying medium having connections with said preparing means whereby a constituent of the material in the preparing means is derived from the condenser.

In testimony whereof, I have signed my 40 name to this specification, in the presence of two subscribing witnesses.

WILLIAM M. GROSVENOR.

Witnesses:

GORHAM CROSBY,
EDWIN SEGER.