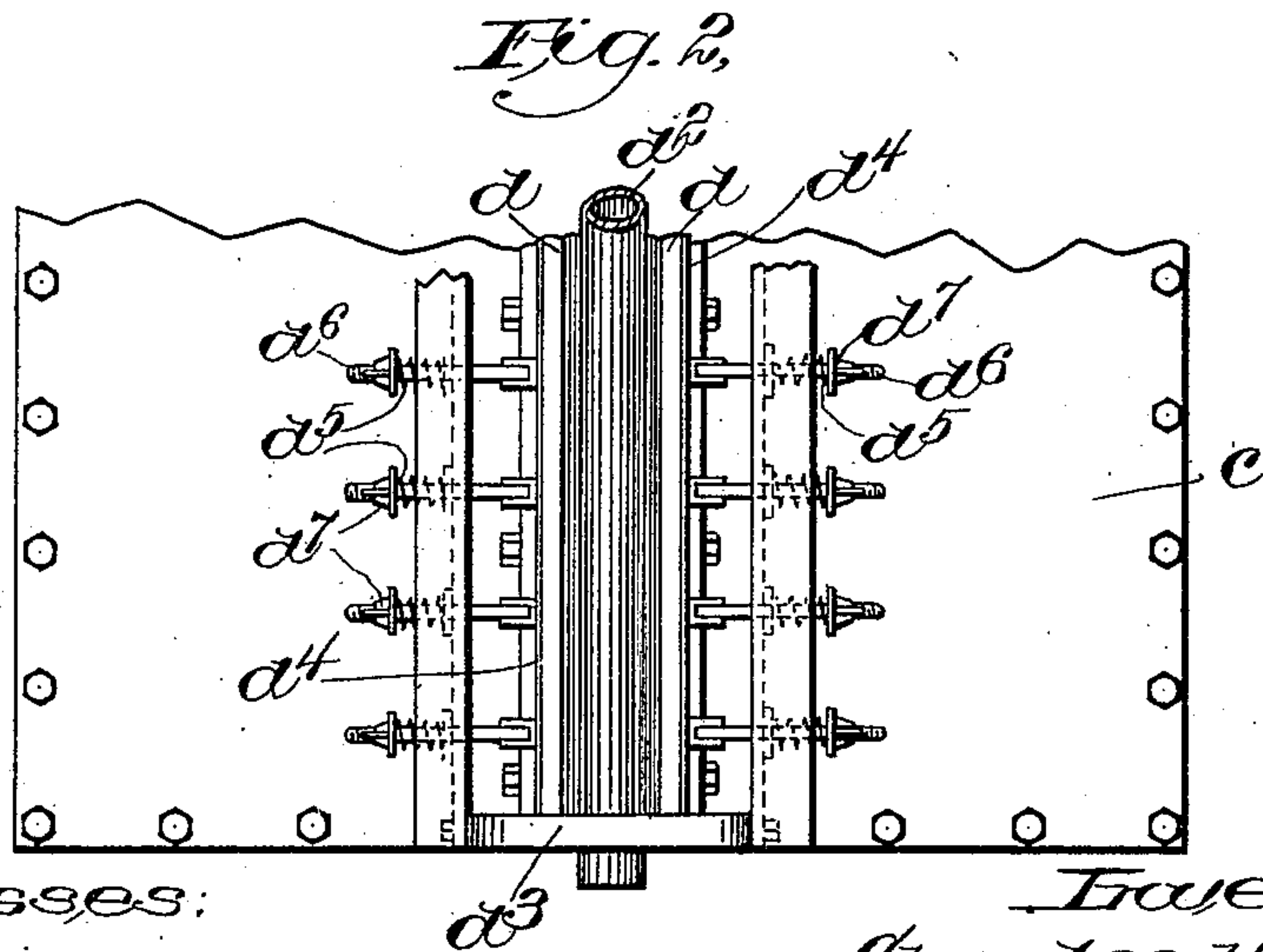
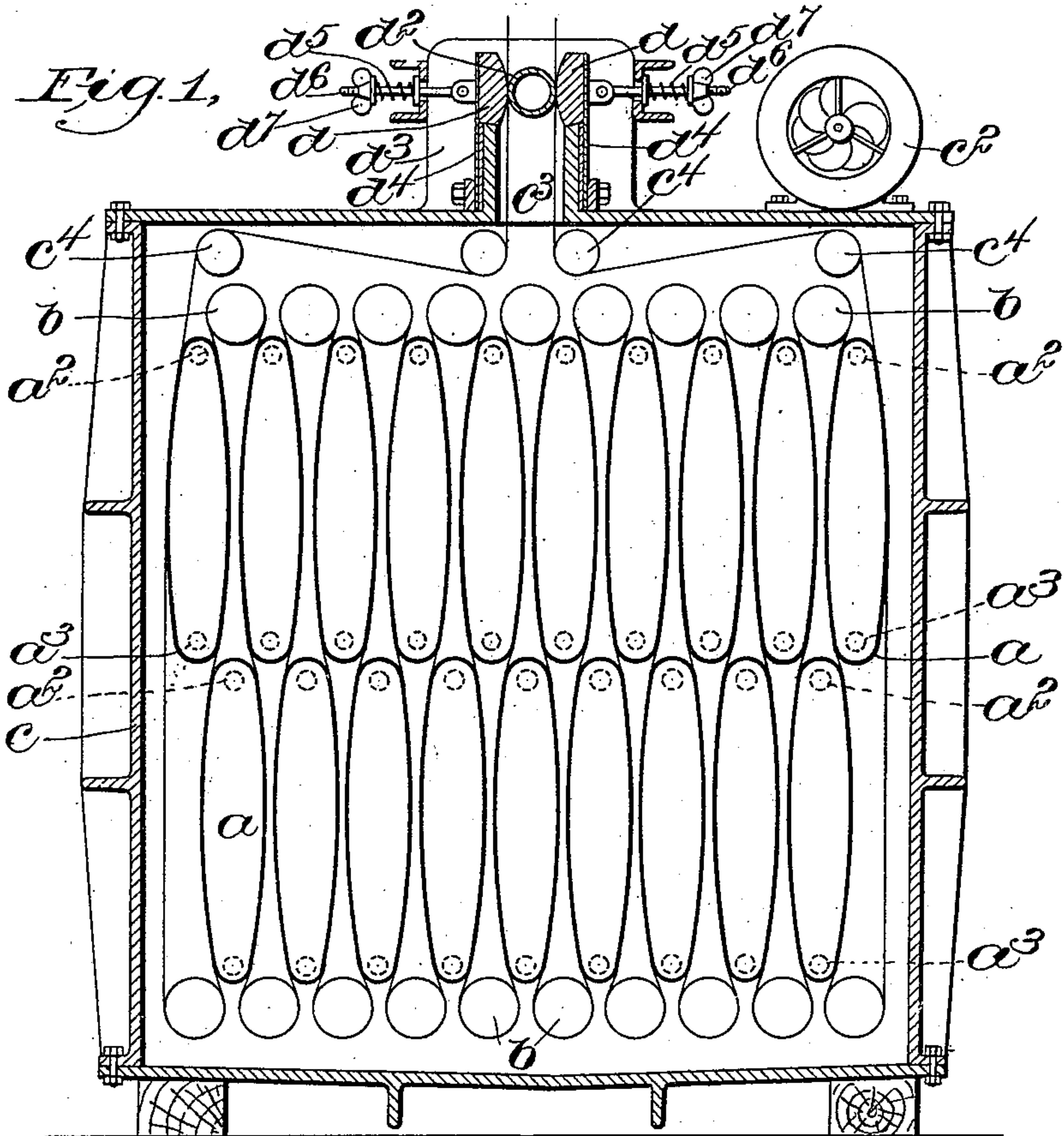


C. H. FISH.
DRYING APPARATUS.

(Application filed May 14, 1900.)

(No Model.)

2 Sheets—Sheet 1.



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No. 689,477.

Patented Dec. 24, 1901.

C. H. FISH.
DRYING APPARATUS.

(Application filed May 14, 1900.)

(No Model.)

2 Sheets—Sheet 2.

Fig. 3.

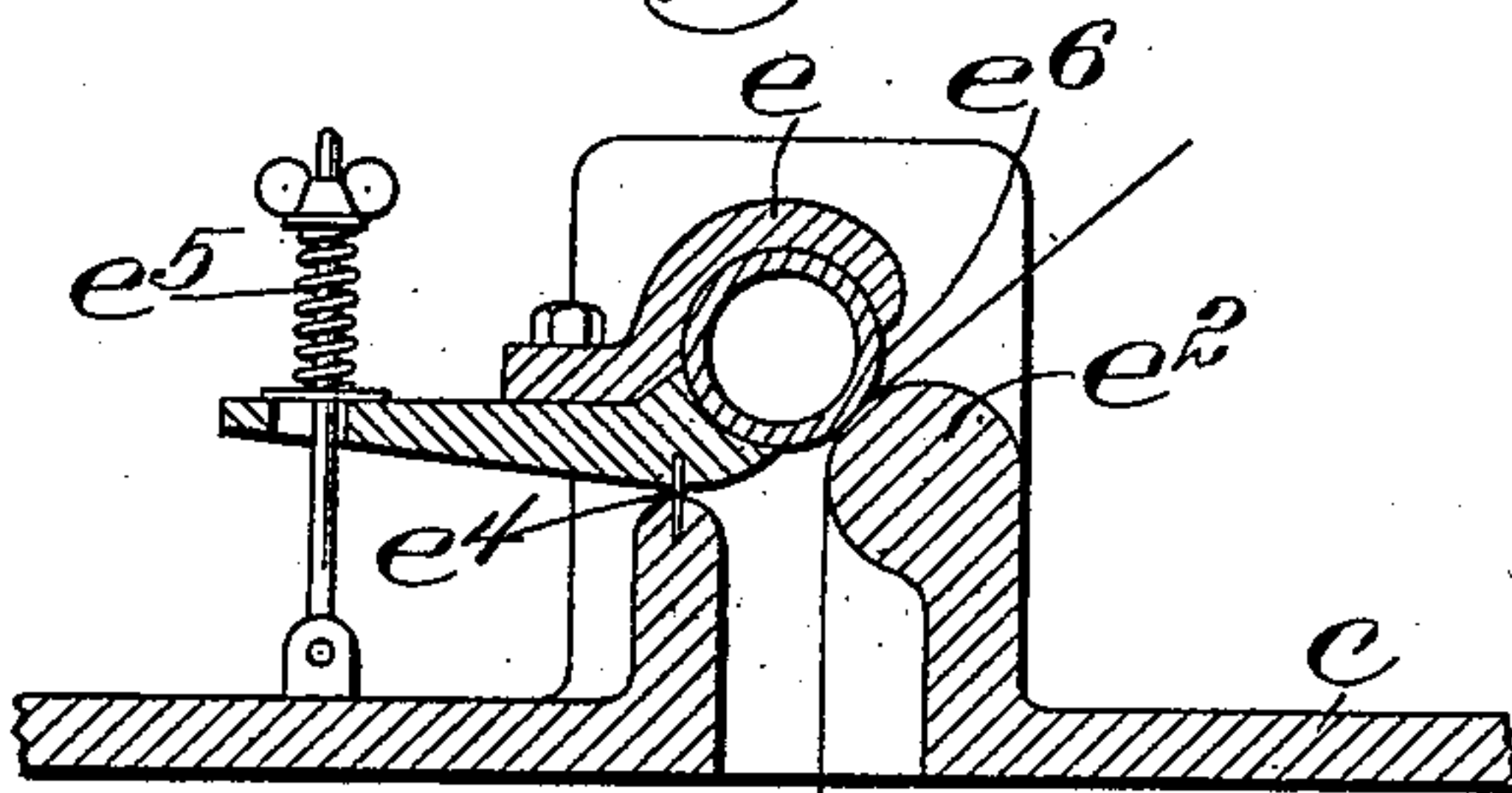


Fig. 4.

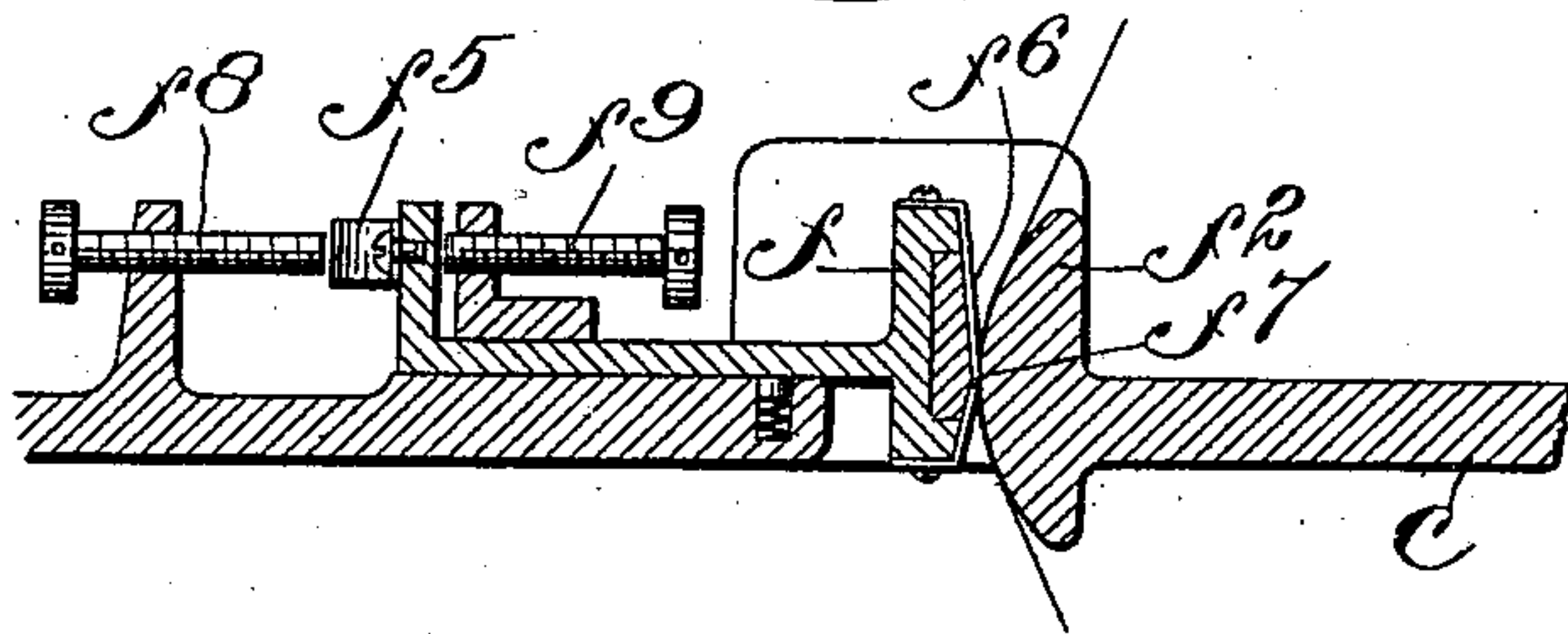


Fig. 5.

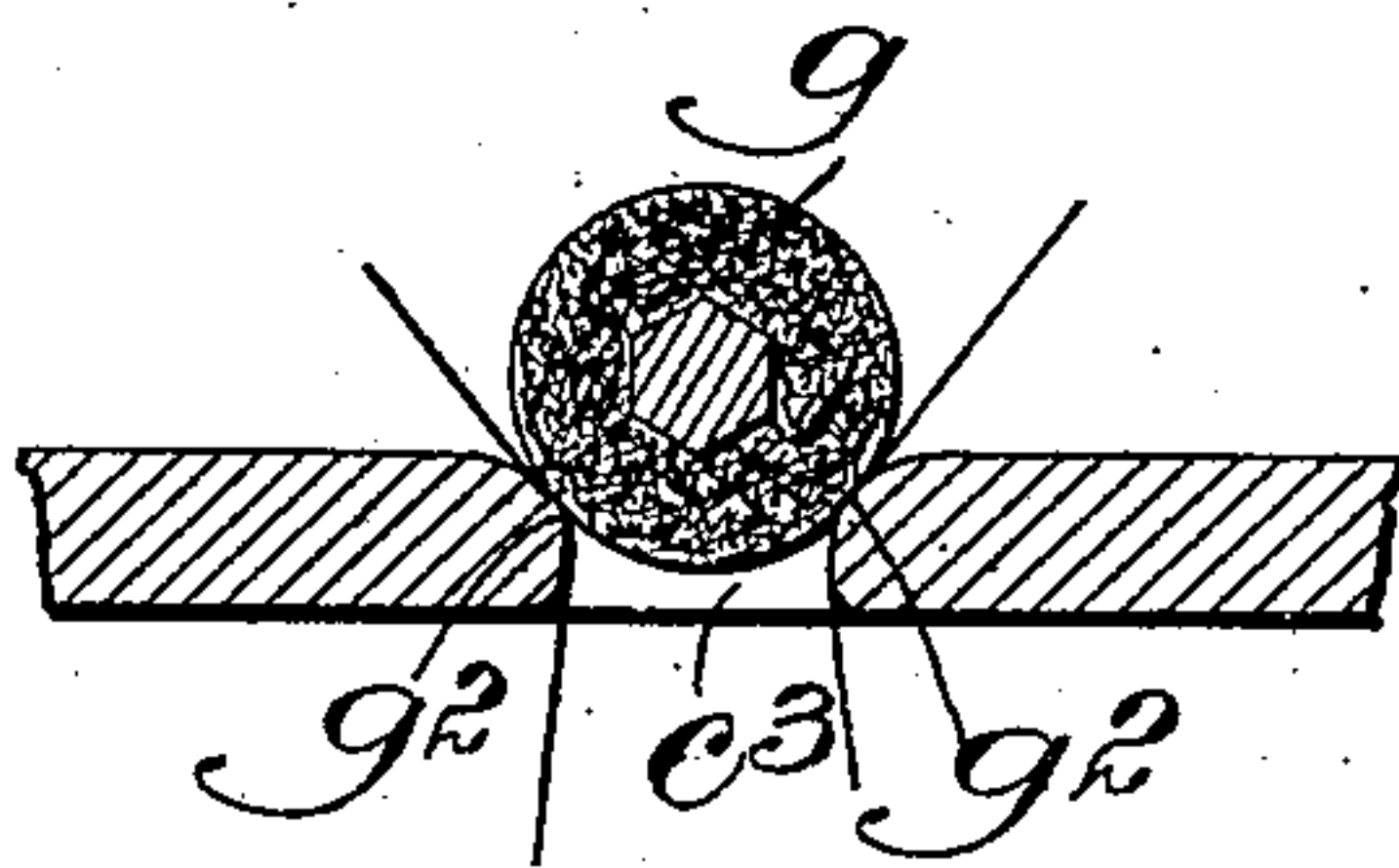
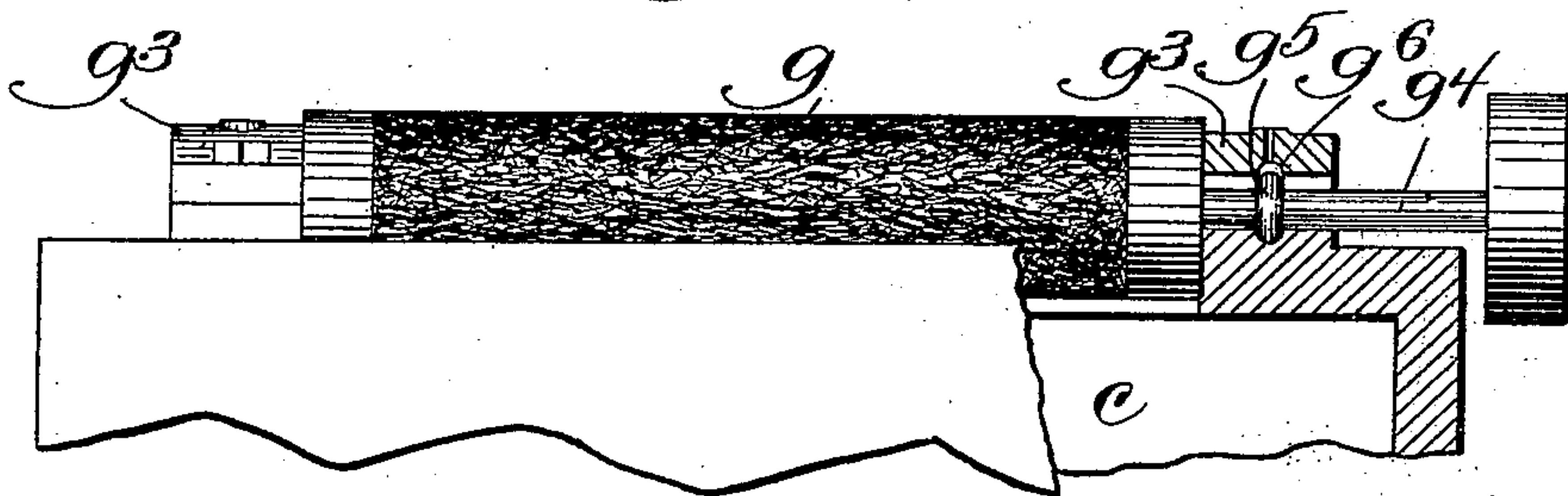


Fig. 6.



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DRYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 689,477, dated December 24, 1901.

Application filed May 14, 1900. Serial No. 16,664. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. FISH, of Dover, county of Strafford, and State of New Hampshire, have invented an Improvement
5 in Drying Apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present invention relates to a drying
10 apparatus for drying a continuous web of material—such as cloth, paper, or the like—by causing the same to travel in contact with heated surfaces and to a new organization and novel features of construction embodied
15 in said apparatus.

The objects of the invention are to obtain a large extent of drying-surface relatively to the size of the apparatus, to utilize substantially the whole of such drying-surface, to facilitate the removal of water of condensation when steam is employed as the heating element, and generally to increase the efficiency of the apparatus and reduce the cost of operation.

25 To these ends the invention consists, mainly, in utilizing stationary heaters or heated surfaces, which may be the surfaces of steam-heated cells, and so shaping and arranging the said surfaces that the web may be drawn
30 along the same from one to another and held snugly in contact therewith without undue friction, at the same time coming in contact with nearly the whole extent of the heating-surface. As herein shown, this is accomplished by utilizing convex surfaces for heating in conjunction with carrying-rolls, there being one or more heaters between the rolls so situated that substantially the entire heaters' effective heating-surface lies beyond the
40 plane in which the material leaves one roll and arrives at the next roll. It is advantageous, although not essential, to employ two or more rows of such heaters placed one above the other and offset or staggered, so that the
45 web can be drawn along and in contact with the surface of one heater at one side thereof in one direction and then along and in contact with the opposite side of the next heater in the same direction and then drawn in the
50 opposite direction along and in contact with the opposite side of the same heater, from which it passes to the surface of the next

heater, and so on. Substantially the entire heating-surface of each heater is thus utilized, and since the heaters are stationary the
55 steam-outlets, if steam-heated cells are employed, may be at or near the bottoms of the cells, so that no water of condensation will collect, this being a great advantage over rotating drying-cylinders in which the water
60 must be removed at the axis.

While it is obvious that the stationary cells or heaters above described may be utilized in connection with any suitable or usual method of drying by contact with heated surfaces,
65 they are especially useful in apparatus for drying in a vacuum, since the use of the stationary heaters obviates the necessity of using bearings or journals for rotatable plates or cylinders and the consequent necessity of
70 packing the same; and the invention further relates to novel features of construction and arrangement of a vacuum drying apparatus, more especially to the means for controlling the ingress and egress of the web to exclude
75 the air and maintain the vacuum.

Figure 1 is a vertical section of an apparatus embodying the invention. Fig. 2 is a partial top plan view of the same. Figs. 3 and 4 are sectional details showing modifications
80 in the feeding device, and Figs. 5 and 6 are details showing different views of a further modification of the same.

The heaters *a* are shown as consisting of plates or cells the heating-surfaces of which
85 are stationary and so arranged that when the web is drawn along the surface of any plate the pull upon the web, which causes the same to travel along, will also cause it to lie snugly against the said surface. As shown in Fig.
90 1, a number of cells or plates *a* are arranged in rows or tiers, one above the other, and the cells in one tier are staggered or offset with relation to the cells in the other tier, so that the web which passes along one side of one
95 of the cells may be drawn from the surface thereof into contact with the opposite side or surface of the adjacent cell in the next tier. To assist in guiding and drawing the web along the surfaces of the heaters, the apparatus is provided with mechanically-driven carrying-rolls *b*, over which the web is passed
100 at intervals, the said rolls not only tending to carry the web along, but also serving as

pulleys to change the direction of movement of the web, so that it can be carried from one set of drying-surfaces to the next. The rolls are so arranged with relation to the heaters
 5 interposed between them that substantially the entire surface of any heater projects through or beyond the plane in which the material meets the rolls, so that the web is in contact with substantially the entire ef-
 10 fective heating-surface throughout.

While the shape and arrangement of the heaters a may be widely varied without departing from the invention, it is desirable that they should be shaped and arranged
 15 substantially as shown in Fig. 1, the adjacent ends of the heaters in the different rows or tiers being slightly wider than the opposite ends and the convexity of the heating-sur-
 20 faces being such that the web in passing from one to the other will be substantially at a tangent to each surface at its first and last points of contact therewith. By making the
 25 other ends of the heaters smaller the carrying-rollers b can be brought closer to the heaters, thereby reducing the extent of web which is out of contact with the heaters while
 30 passing over the rollers. These stationary heaters may consist advantageously in steam-heated cells, said cells having inlets and out-
 35 lets a^2 and a^3 , (dotted lines,) the outlets being near the bottom of the cells, so as to keep the cells free from water of condensation. It is immaterial, so far as relates to this feature
 40 of the invention, whether the cells are located in the open air and subject to atmospheric pressure or within a vacuum-chamber, where the pressure is materially lowered for
 45 the purpose of reducing the boiling-point and hastening the drying process. As herein shown, however, the heaters and carrying-
 50 rollers are located within a vacuum-chamber c , provided with vacuum-producing means, such as a fan or pump c^2 ; and the invention further relates to novel means for controlling
 55 the feed-openings, through which the web is drawn into and out of the chamber.

As indicated in Fig. 1, the web is drawn into and out of the chamber c through an opening c^3 and guided toward the heaters a by
 50 means of pulleys c^4 . To control the said opening and admit the web without admitting any substantial amount of air, the said opening is provided in accordance with the invention
 55 with what may be conveniently termed "cushion-gates," comprising the members d and d^2 , between the surfaces of which the web enters and passes out from the chamber c . It is desirable that the said members should be held
 60 in yielding contact with the web between them, so as not to retard the progress of the said web when knots or imperfections of any kind occur along the web. It is further desirable that when the apparatus is in opera-
 65 tion the members should be continuously held in close contact with each other or with the web between them, so as to form a substantially air-tight joint, and the proper degree of

contact-pressure may be provided for in various ways.

As indicated in Fig. 1, the member d^2 , 70 which may advantageously be cylindrical in shape, is connected with a suitable support or frame d^3 , and the members d are mounted on springs d^4 so positioned as normally to keep the said members d in contact with the
 75 surface of the member d^2 . In the arrangement shown in Fig. 1 it will be seen that owing to the fact that the air is exhausted from the chamber c there will be an unbalanced atmospheric pressure tending to force
 80 the members d into close contact with the member d^2 , and such pressure, if in excess of that which is needed, is objectionable, for the reason that it offers too much frictional re-
 85 sistance to the passage of the web. It is desirable, therefore, to counteract the said pressure to a certain extent, and for this purpose each of the members d is provided with a num-
 90 ber of adjustable controlling-springs d^5 , the tendency of which is to draw the said member away from the member d^2 . As herein shown, each of the members d is pivotally con-
 95 nected with one or more stems d^6 , screw-threaded at their ends and each provided with thumb-screws d^7 , the springs d^5 being thread-
 100 ed on the said stems and bearing at one end against a portion of the frame d^3 and at the other end against the said thumb-screws d^7 . By turning the thumb-screws, therefore, the
 105 strength of the springs can be varied until the proper adjustment is reached. To pass the web into and out of the chamber prepara-
 110 tory to operating the machine, the members d may be moved away from the member d^2 , making an opening wide enough to pass the
 115 web in freely, the chamber being usually provided with hand-holes through which the web can be reached and carried along over the several plates and feed-rolls and then out
 120 of the chamber before the drying process is started. The hand-holes of course are provided with air-tight covers to close the cham-
 125 ber when the apparatus is in use. These parts are not illustrated in the drawings, since they form no part of the present invention.

The surfaces of the "cushion-gate" mem-
 130 bers, as they may be called, are of any suitable material which will not afford any substantial frictional resistance to the passage of the web. In the construction shown in Fig. 1 a single
 135 member d^2 serves to control both the ingress and egress openings for the web, it being obvious that if it is desirable to have the said openings at a distance from each other there may be two members d^2 —one for each opening.

In the construction shown in Fig. 3 the member e^2 corresponds to the member d^2 in Fig. 1 and is shown as a portion of the casing which forms the chamber c , while the member e , which is pivotally supported upon
 140 the said casing, is held in contact with the member e^2 by atmospheric pressure, as before, said pressure being counterbalanced by an adjustable spring e^5 , the operation of

which is substantially the same as that of the spring d^5 . The member e may be connected with the casing by means of a spring e^4 , which affords the necessary pivotal connection without any opening for the ingress of air. The surface portion of the member e is indicated as a pneumatic tube e^6 , which may be made of rubber or other suitable material and inflated, so as to retain its shape. This construction assists in maintaining the surfaces in yielding but substantially air-tight contact with the web, as is necessary for the proper operation.

In the construction shown in Fig. 4 the member f^2 is part of the casing which forms the chamber c , and the member f is mounted upon the said casing and movable toward the member f^2 , the said member f being shown as provided with a framework to support a surface portion f^6 of any suitable material and so shaped as to come in contact with the surface of the member f^2 at f^7 . The pressure upon the member f in this case is balanced, and the said member is held in yielding contact with the web by means of a spring f^5 , adjustable by means of a thumb-screw f^8 , there being another adjusting-screw f^9 to limit the movement of the member f toward the member f^2 . The movable member can be moved away from the stationary member to open the gate, as in the constructions hereinbefore described, in order to insert the web into the chamber, and when the apparatus is ready to be started can be adjusted to the proper tension.

In Figs. 5 and 6 the chamber c is shown as provided with a single opening c^3 , as in the construction shown in Fig. 1, the said opening extending along the top of the chamber and affording two stationary feed members g^2 , there being in this instance but one yielding member g . The said yielding member is shown as a cylindrical roll mounted at the ends in bearings g^3 , in which it is free to rotate, the said bearings being so arranged that when the said roll is supported therein it will lie in close contact with the members g^2 , while the weight of the said roll and the atmospheric pressure are mainly borne by the said bearings, so that the roll will not fit too tightly to admit of the easy entrance and egress of the web. As indicated, the web is carried in between one member g^2 and the roll g at one side of the opening and out between the other member g^2 and the roll at the other side of the opening. To keep the roll in position longitudinally, the journals g^4 are provided with flanges g^5 , fitting channels g^6 in the bearing portions, the opening for the journal, as well as the channel for the flange, being extended above the said journal and flanges to permit the roll to yield upwardly, if necessary, in the passage of the web. To assist in the feed of the web, the roll may be rotated by power during the operation of the machine, and in any event it is free to rotate in response to the frictional resistance of the fabric.

Having thus described my invention, what I claim is—

1. An apparatus for continuous drying of a web of material, comprising rows of carrying-rolls which constitute guides for the material, and heaters arranged between said rows of rolls, the heaters presenting a substantially continuous surface, each heater being provided with a convex heating-surface constituting substantially the whole of one side of the heater, the convexity of which projects beyond the plane in which the material leaves one roll and arrives at the next roll, whereby the material as it travels from one roll to the next is retained in effective heating proximity to said heating-surface throughout substantially the entire width of the heater, as set forth.

2. An apparatus for continuous drying of a web of material, comprising in combination with a chamber and means for exhausting air therefrom, rows of carrying-rolls which constitute guides for the material, and heaters arranged between said rows of rolls, the heaters presenting a substantially continuous surface, each heater being provided with a convex heating-surface, substantially the entire extent of said surface being beyond the plane in which the material leaves one roll and arrives at the next roll, whereby the material as it travels from one roll to the next lies in effective heating proximity to substantially the entire heating-surface of the heater, as set forth.

3. An apparatus for drying in the web continuously such materials as cloth, paper and the like, comprising a series of stationary heated cells; and means for drawing the web of fabric through the apparatus, and guiding the same so that it will travel along and in contact with both sides of each heater of a series, as set forth.

4. An apparatus for drying in the web or sheet continuously such materials as cloth, paper and the like, comprising a series of stationary heaters or heated cells, each of which is oval in cross-section, said cells being arranged in tiers, those in one tier being staggered or offset with relation to those in the next; and means located between adjacent cells in the same tier for drawing the web along and in contact with the surfaces of the several cells.

5. A vacuum drying apparatus for continuous drying of webs of fabric or other material comprising a chamber provided with heated drying-surfaces, a feed-opening to said chamber and a cushioned gate controlling said feed-opening, comprising non-rotatable closing members, the surfaces of which are of such nature as to permit the web to slip easily along or past the same, the said members being yieldingly pressed one toward the other and thereby held against the web between them.

6. In a vacuum drying apparatus for a web of fabric or other material, the combination with a vacuum-chamber provided with an

opening for the web, of a gate for closing said opening having two members, one of which is yieldingly pressed toward the other, so that both will be in close contact with the web between them, and means for adjusting the contact-pressure, as set forth.

7. In a vacuum drying apparatus, the combination with a chamber provided with means for exhausting the air therefrom, of stationary heaters within said chamber, and means for drawing a web of fabric through said chamber and guiding the same so that it will travel along and in contact with substantially the entire surface of said stationary heaters, the openings for the ingress and egress of the web being suitably controlled to prevent the admission of air.

8. An apparatus for continuous web drying which comprises stationary heaters arranged in a series of rows, the heaters in one row being adjacent to the heaters in the next row and one surface at one side of a heater in one row forming in conjunction with the surface at the opposite side of a heater in the next row a substantially continuous surface having the form of a double or reverse curve, whereby the web will pass in a substantially straight line from one heater to the next and in contact with substantially the entire side of each; and carrier-rolls beyond and between adjacent heaters in the outer rows so arranged that the web in passing from the heater-surface to the roll-surface will be in alinement with the former substantially at the end thereof, as set forth.

9. An apparatus for continuous web drying which comprises in combination with a chamber and means for exhausting air therefrom, a plurality of stationary heaters arranged in a series of rows, the heaters in one row being adjacent to the heaters in the next row and one surface at one side of a heater in one row forming in conjunction with the surface at the opposite side of a heater in the next row a practically continuous surface, said surface having the form of a double or reverse curve whereby the web will pass in a substantially straight line from one heater to the next and in contact with substantially the entire side of each; and carrier-rolls beyond and between adjacent heaters in the outer rows so arranged that the web in passing from the heater-surface to the roll-surface will be in alinement with the former substantially at the end thereof, as set forth.

10. In a drying apparatus, the combination of elliptical drying cells or heaters arranged in two series with the major axes of those of one series in planes intermediate those of the other series; and carrying devices, constituting guides, located at the outer ends of both series of cells, intermediate the proximate cells of the series.

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

CHARLES H. FISH.

Witnesses:

MARTHA E. VICKERY,
SARA C. HAMILTON.