(No Model.) 4 Sheets—Sheet 1.

T. H. MÜLLER.

CENTRIFUGAL MACHINE.

No. 387,801. Patented Aug. 14, 1888.

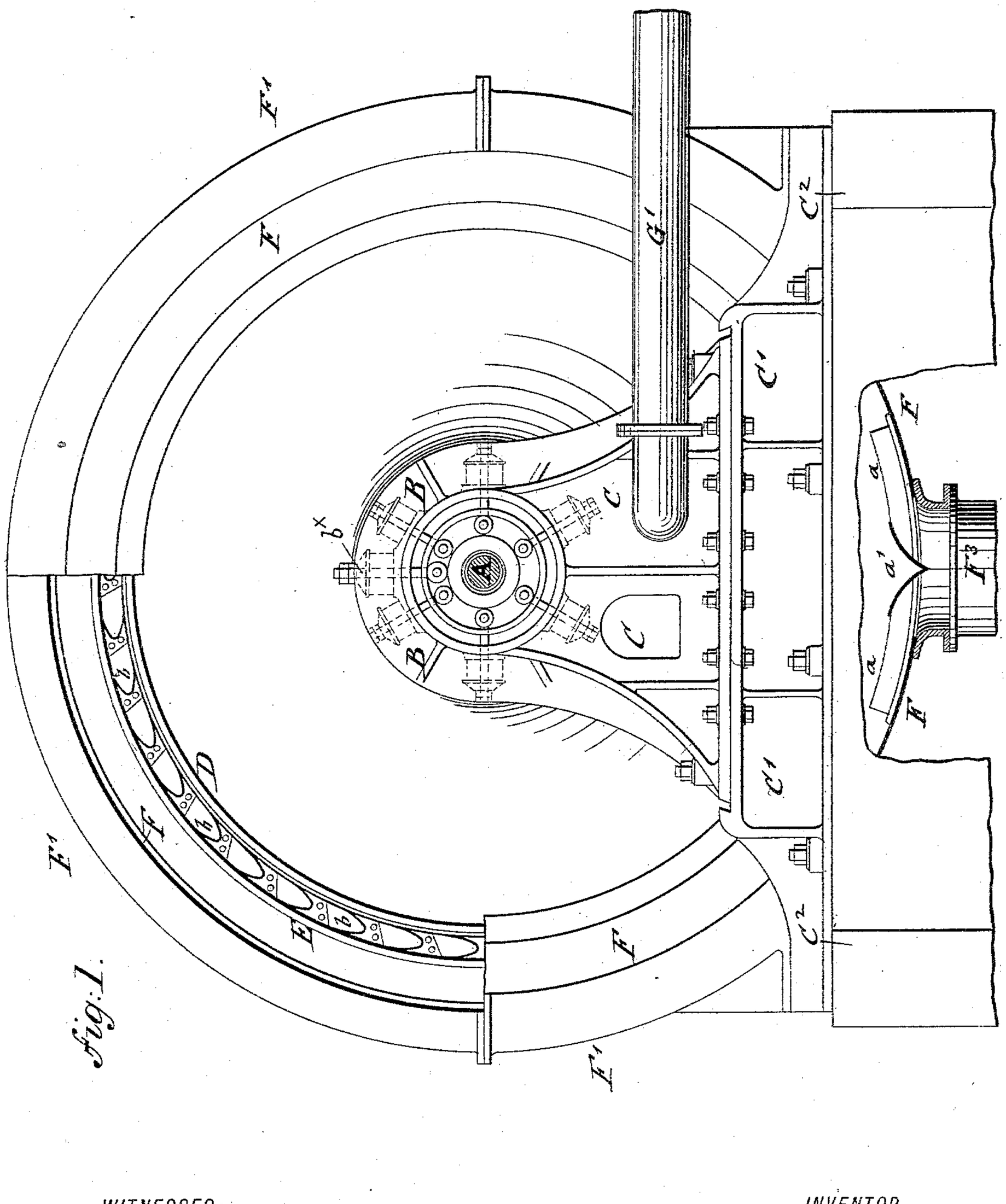

Fig. 1.

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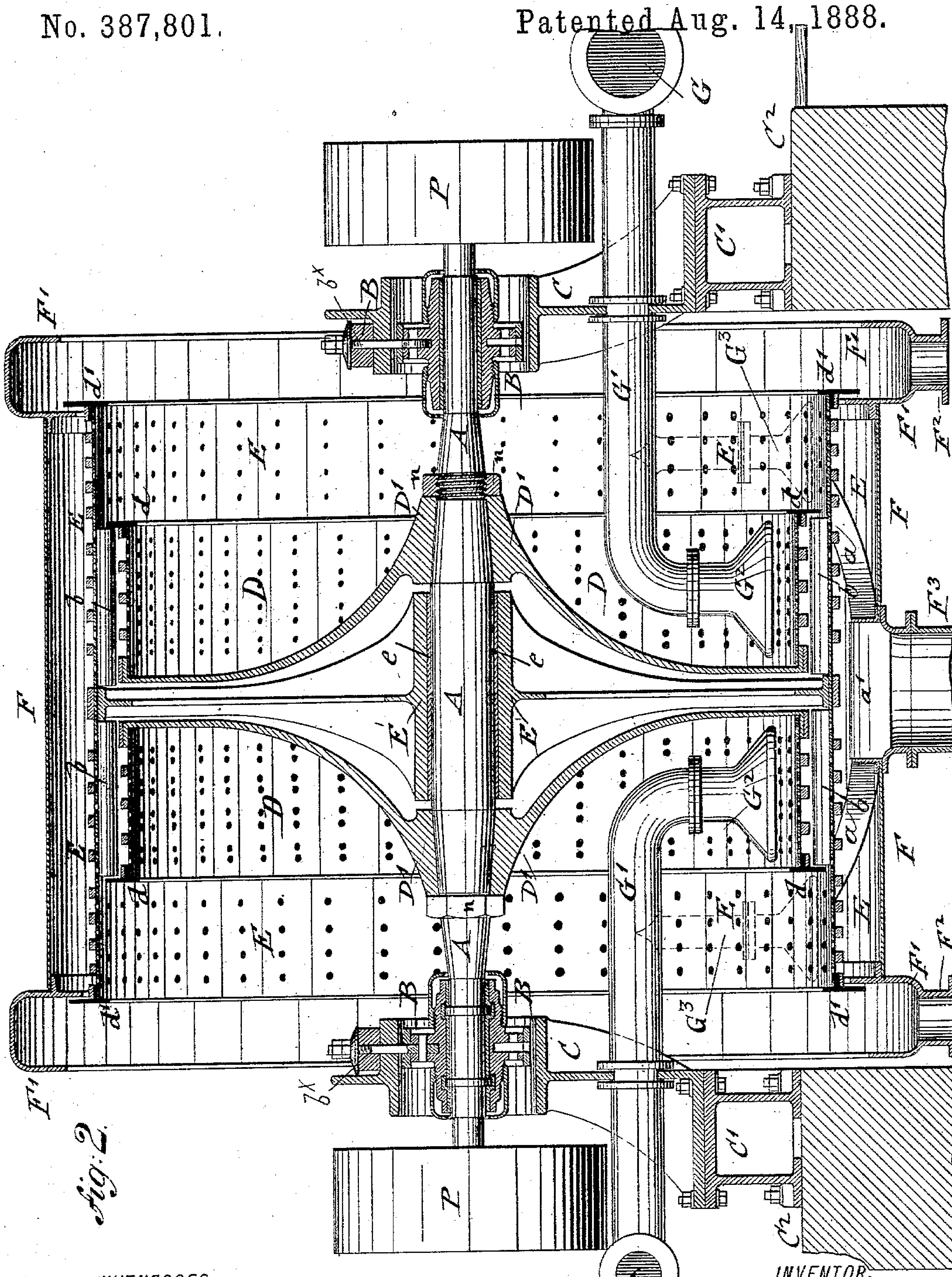

Fig. 2

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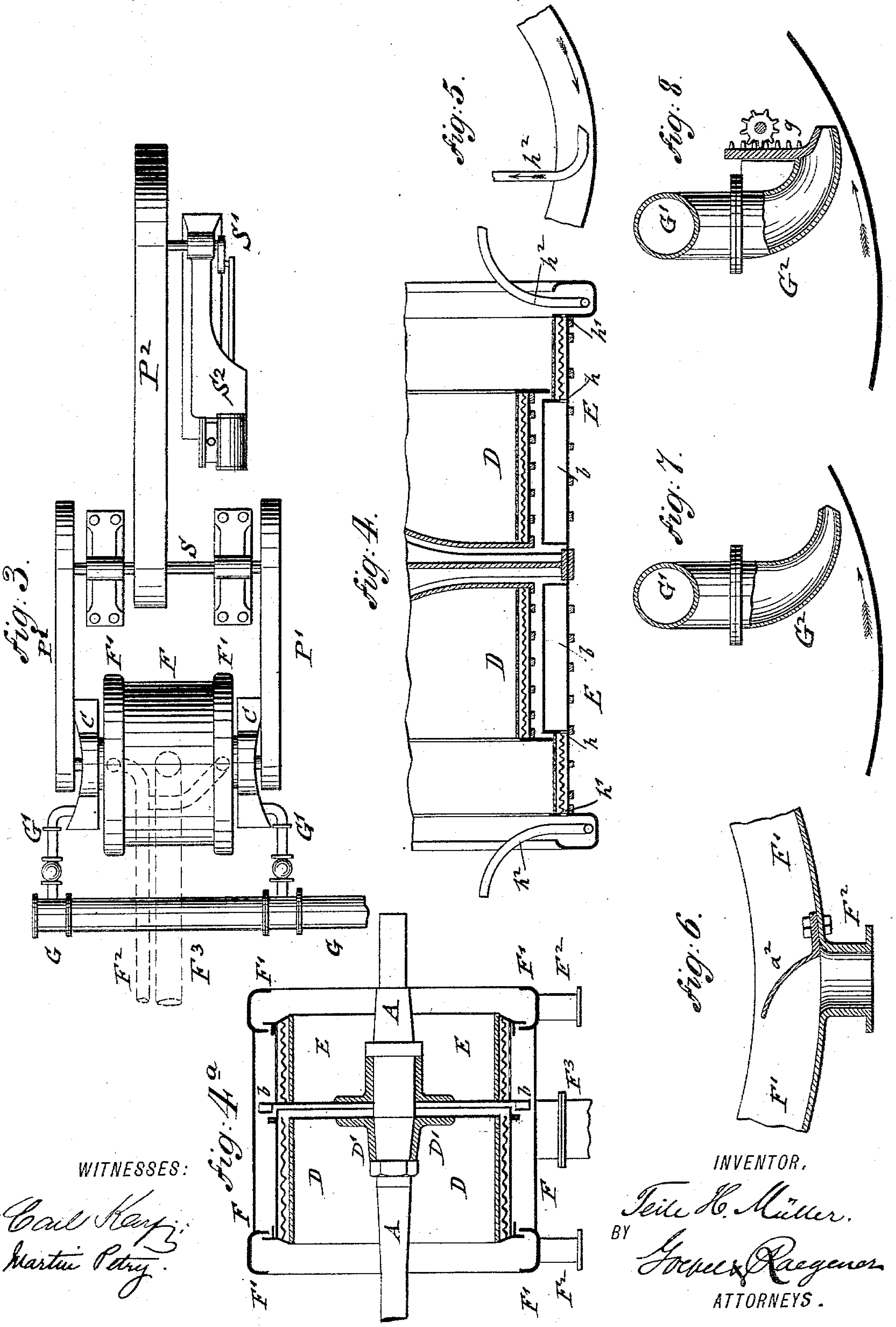

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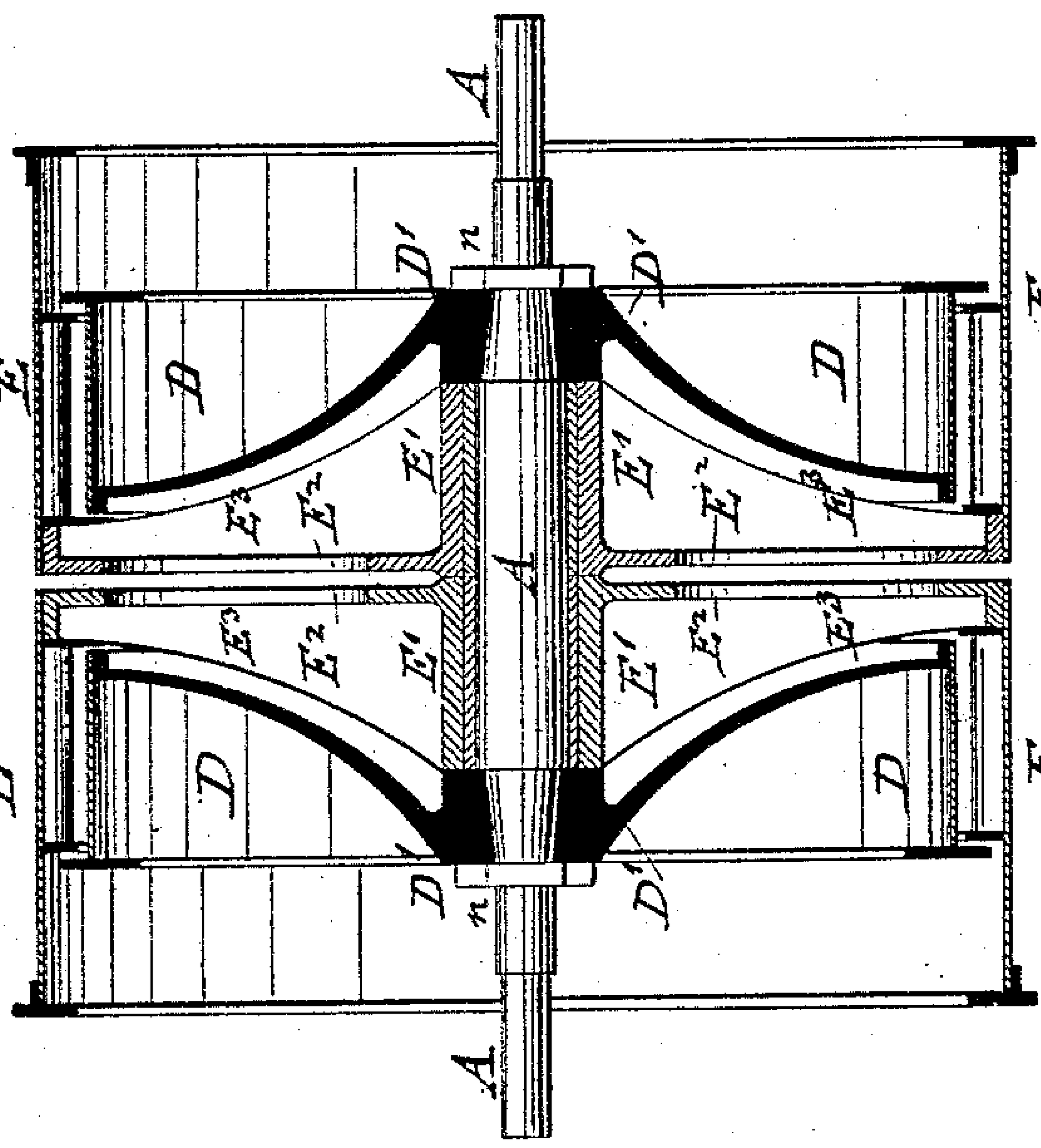

Fig. 11.

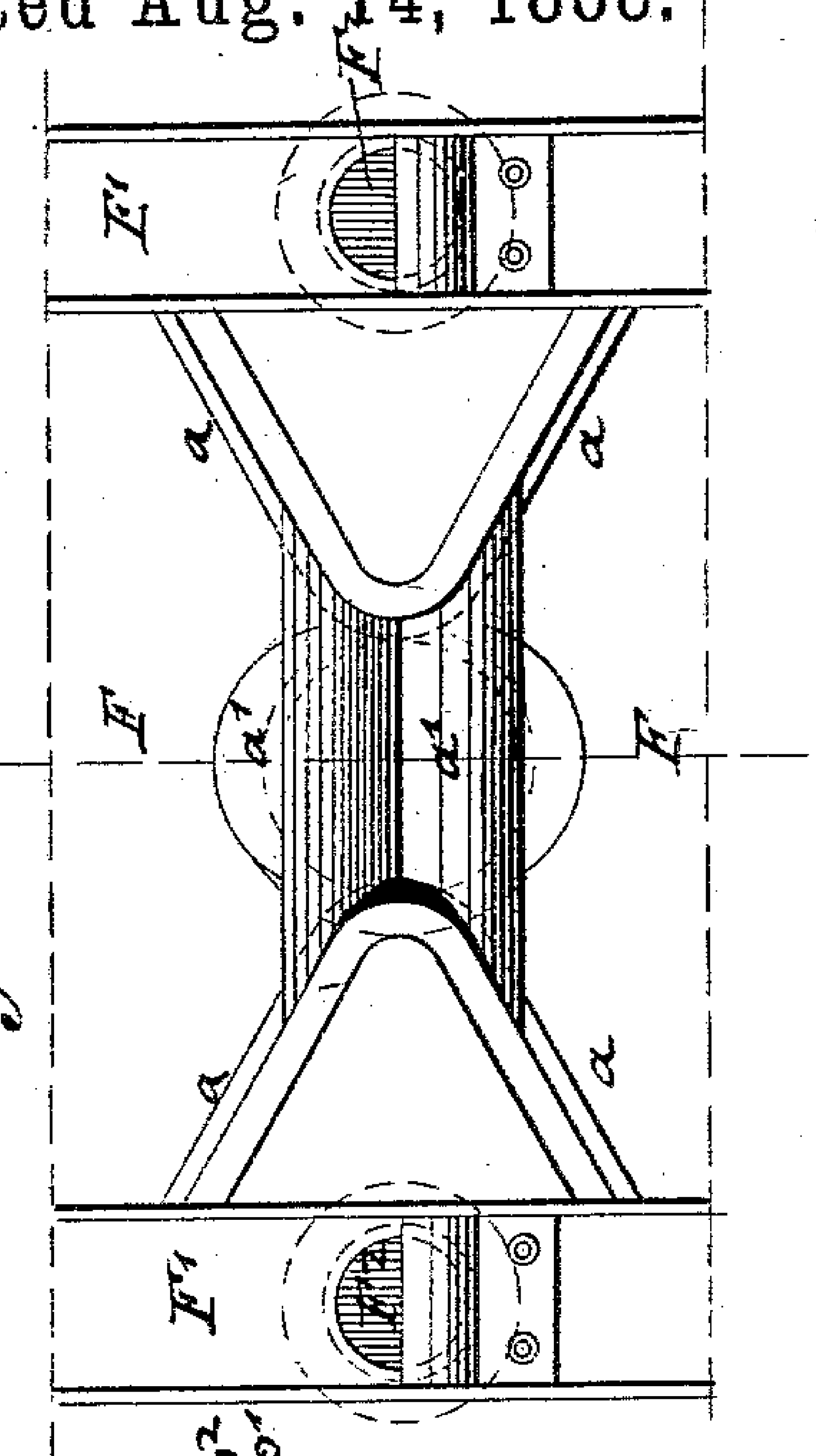

Fig. 9.

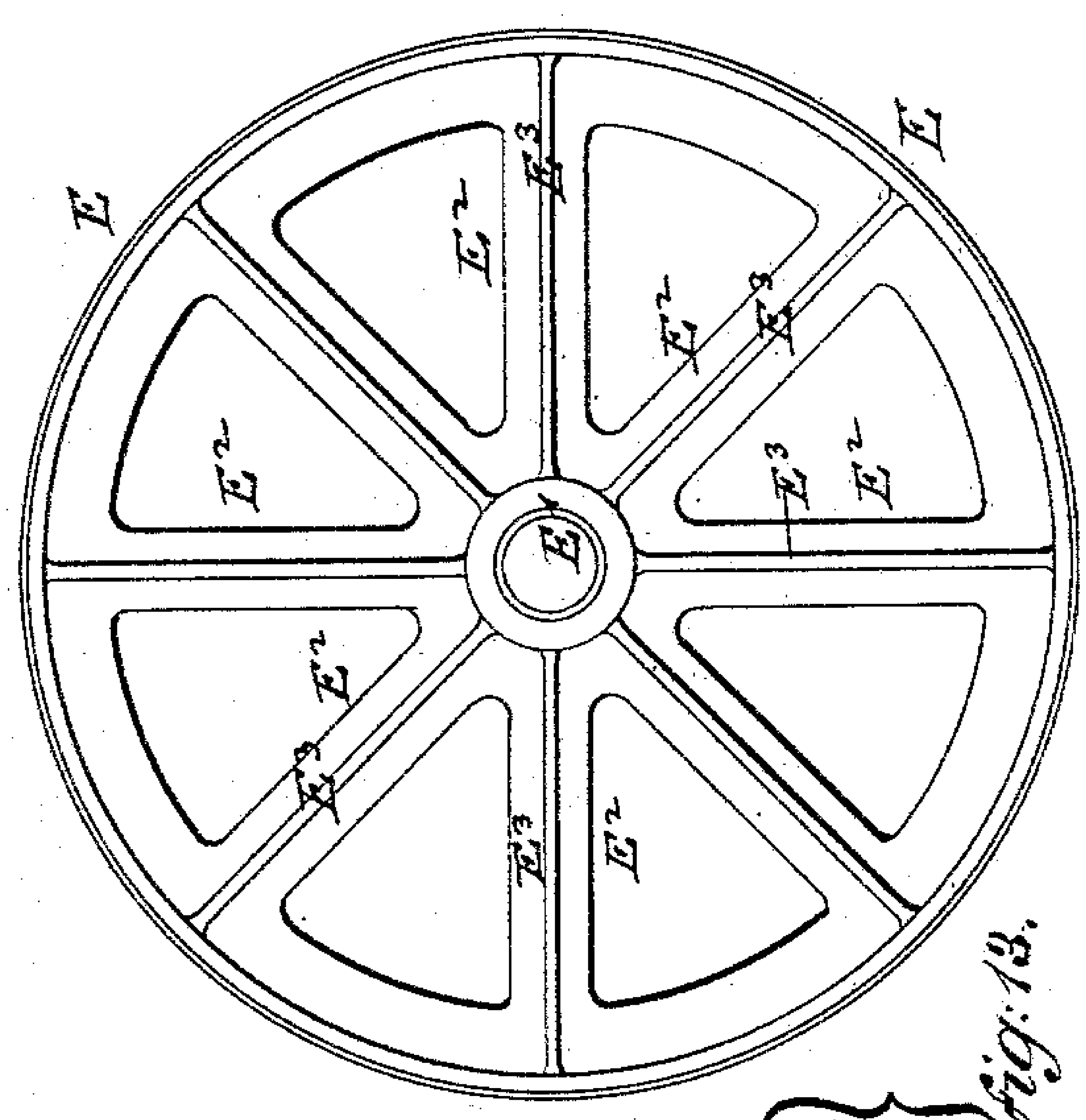

Fig. 10.

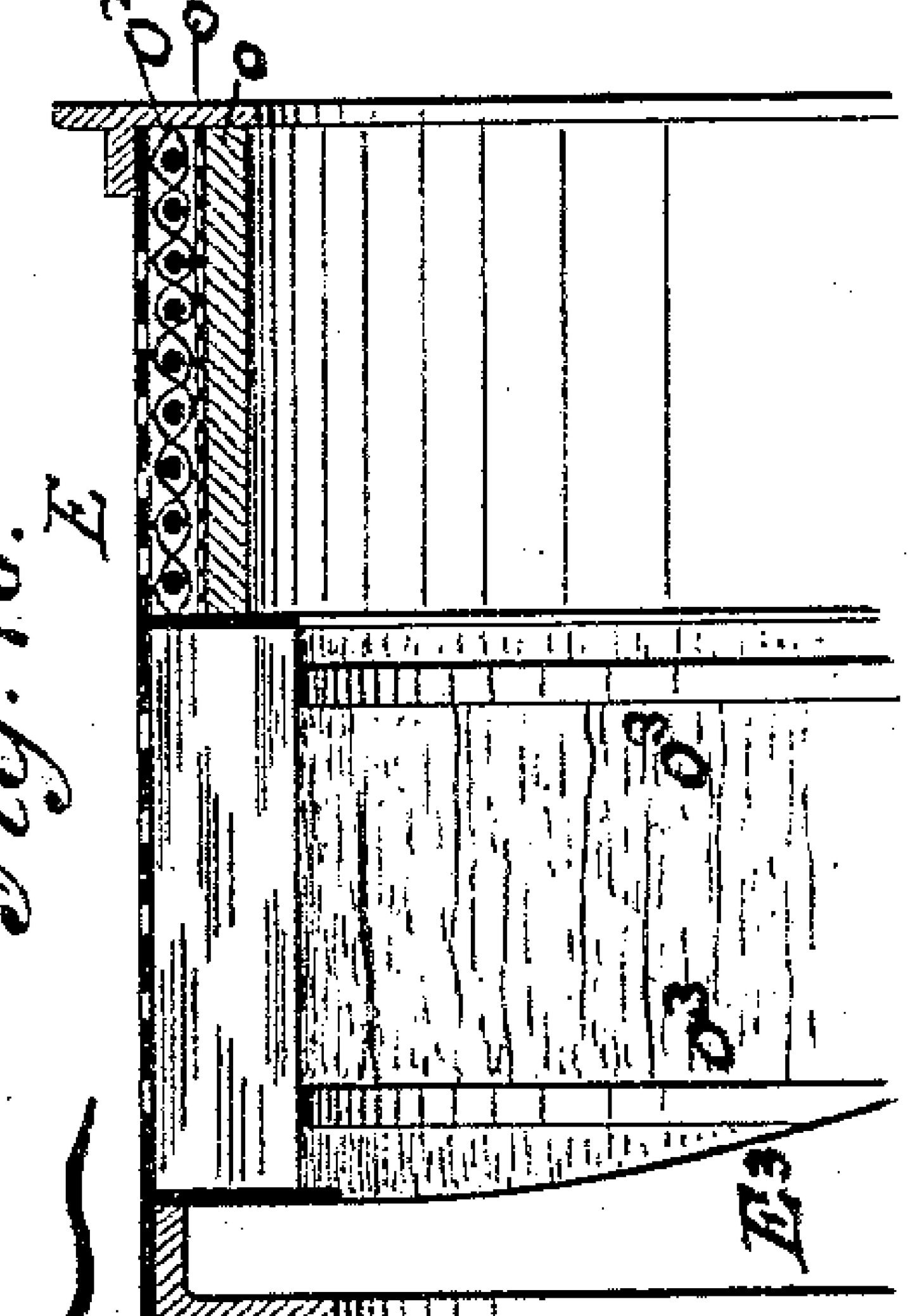

Fig. 16.

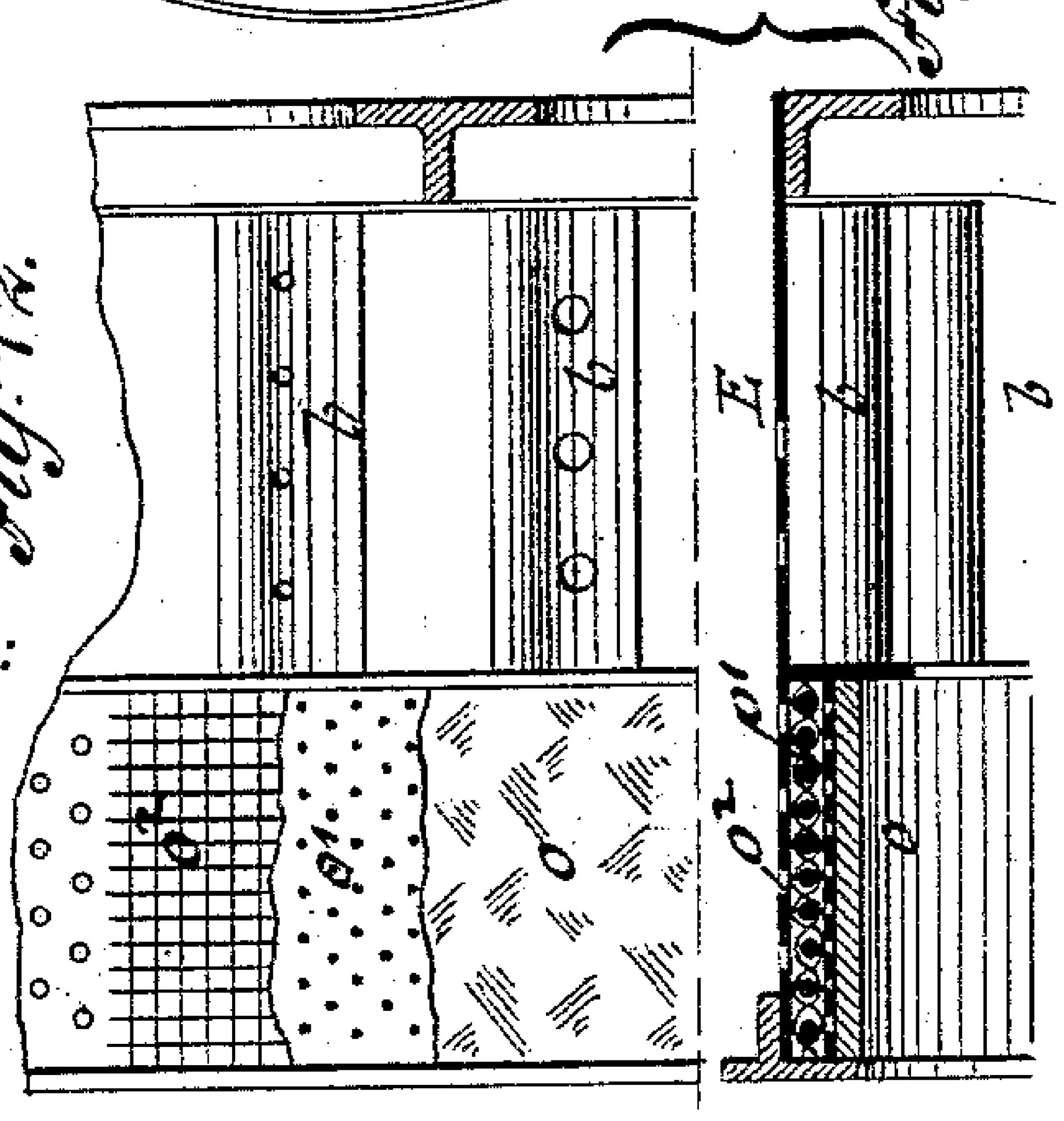

Fig. 12. Fig. 13.

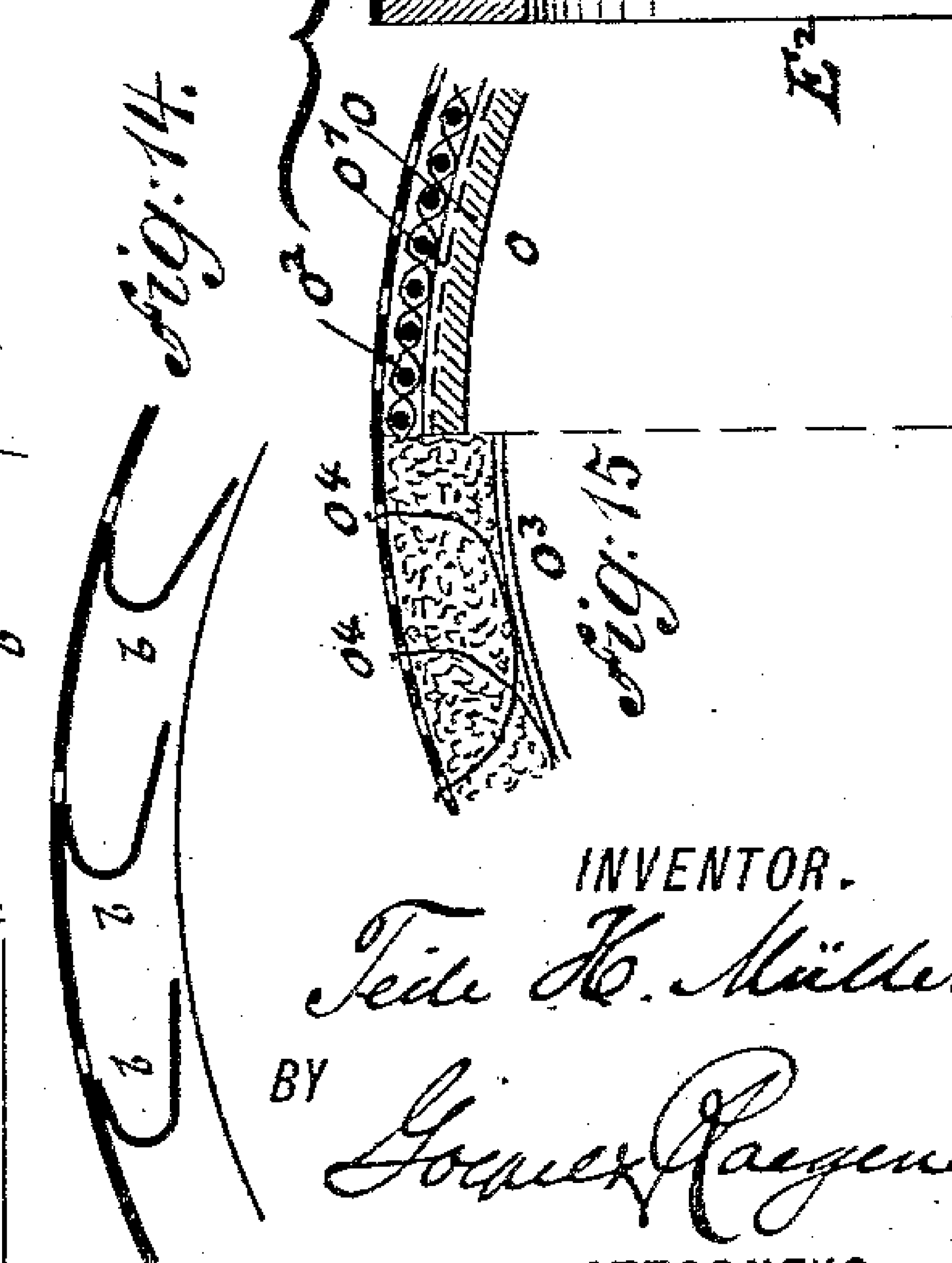

Fig. 14. Fig. 15.

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TEILE H. MÜLLER, OF NEW YORK, N. Y.

CENTRIFUGAL MACHINE.

SPECIFICATION forming part of Letters Patent No. 387,801, dated August 14, 1888.

Application filed May 2, 1887. Serial No. 236,793. (No model.)

To all whom it may concern:

Be it known that I, TEILE H. MÜLLER, of the city, county, and State of New York, have invented certain new and useful Improvements in Centrifugal Machines, of which the following is a specification.

In centrifugal machines of the usual construction, whether they be arranged with a vertical or horizontal spindle, the materials to be treated are placed in a basket which is revolved on its axis at a high degree of velocity. This naturally requires that the material to be treated shall have the same velocity as the circumference of the basket. To impart this velocity to the material requires the larger or even the largest part of the power expended in running the machine. The liquids that leave the basket constitute frequently a large part of the charge, so that all the force stored in the discharged liquid is uselessly expended on the outside of the casing, causing only violent waves and currents in the casing of the machine and interfering with the proper flow of liquids through the discharge-pipe.

The object of this invention is to furnish an improved centrifugal machine by which the power heretofore lost is effectively utilized and employed in driving a secondary basket, whereby a machine with double effect is obtained, which, when a third or even a fourth basket be used, can be increased to a triple or even quadruple effect, so that all the power stored up in the liquid is utilized.

The invention consists of a centrifugal machine in which a primary basket is applied to a driving-spindle and worked in connection with a secondary basket that is placed loosely on the spindle of the primary basket and driven by the power of the liquid discharged from the same. The secondary basket is provided with buckets that receive the impact of the liquid from the primary basket. The secondary basket is provided with an independent draining-surface outside of the buckets and surrounded by an exterior casing having annular overflow-gutters and a bottom discharge-pipe provided with current-deflectors. The liquid to be drained is supplied by inlet-pipes having enlarged nozzles curved in the direction of the rotation of the basket. The primary basket, as well as the secondary basket, is provided with circumferential rims, which are extended in inward and outward directions for regulating the liquid charged in the baskets, and preventing by the outer rim the mixing of the drained and undrained liquids.

The invention consists, further, of certain modifications and details of construction, which will be fully described hereinafter, and finally be pointed out in the claims.

In the accompanying drawings, Figure 1 represents a side elevation of my improved centrifugal machine with parts in section and other parts broken away. Fig. 2 is a vertical transverse section of the same; Fig. 3, a plan on a smaller scale, showing the disposition of the machine in connection with the engine for driving the same, and with the supply and discharge pipes. Figs. 4 and 4ª are vertical transverse sections of different modifications of the machine. Fig. 5 is a detail side view of the eduction-pipe shown in Fig. 4. Fig. 6 is a detail section of the casing, showing one of the discharge-pipes and its deflector. Figs. 7 and 8 are detail partly-sectional side views of a portion of the inlet-nozzles. Fig. 9 is a top view of a portion of the bottom of the casing, showing the deflectors. Fig. 10 is an end view of the secondary basket, showing the radial arms and re-enforcing ribs. Fig. 11 is a vertical transverse section of a centrifugal machine, showing each primary basket surrounded by a separate secondary basket. Figs. 12 and 13 are details showing the construction of the buckets and draining-surface of the secondary basket. Fig. 14 is a detail transverse section of the buckets. Figs. 15 and 16 are details showing the substitution of fibrous material for the buckets.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents a preferably horizontal spindle, which is supported in two elastic bearings, B B, that are supported on the ring-shaped ends of the standards C, which are bolted to a bed-plate, C′, secured by suitable foundation-bolts to the base-frame C² of the machine. The journals of the spindle A turn in bearings or shells, which are suspended by radial bolts $b^{\times}$ from the ring-shaped ends of the standards C C, the heads of said bolts being supported on washers and rubber springs, as shown clearly in

Figs. 1 and 2. These elastic bearings serve to take up lateral and radial vibrations and render the motion of the machine smooth and easy. Elastic bearings of any approved construction may be used for supporting the horizontal spindle. I do not confine myself to the construction shown in the drawings.

The inner part of the spindle A, between the elastic bearings B B, is gradually increased in thickness, the central part being made cylindrical, while the portions next adjoining the central part are made conical and serve for receiving the hubs D′ D′ of two primary baskets, D D, which hubs are retained in position on said conical shaft portions by means of screw-nuts *n n*, that serve to screw the hubs of the primary baskets tightly home on the conically-tapering portions of the spindle C, as shown clearly in Fig. 2. The bottoms of the primary baskets D D face each other, while their open ends face the elastic bearings B B. On the cylindrical central portion of the spindle A is placed the hub E′ of a secondary basket, E, said hub being connected to the basket by radial arms E², re-enforced by tapering ribs E³, as shown in Fig. 10. Between the hub E′ and spindle A is interposed a sleeve-shaped bushing, *e*, so that the hub of the secondary basket can freely rotate on the spindle A. The secondary basket E extends in both directions over the primary baskets D D, though this is not absolutely necessary, as each primary basket may be surrounded by a separate secondary basket, each of which is connected by radial arms with an independent hub turning loosely on the spindle A, as shown in Fig. 11. To the ends of the spindle, outside of the elastic bearings B B, are applied pulleys P P, to which motion is imparted by two belts, P′, from a countershaft, S, that is driven by a main belt, P², from the driving-shaft S′ of the steam-engine S², as shown clearly in Fig. 3. This figure also shows the disposition of the main supply-pipe G, with its valved branch pipes G′, that lead into the primary baskets, and the overflow and discharge pipes in dotted lines.

The secondary basket E is surrounded by a fixed casing, F, which is provided at both ends with annular overflow-gutters F′, that communicate with the discharge-pipes F², as shown in Fig. 2 and in dotted lines in Fig. 3. At the bottom part of the casing is arranged a discharge-pipe, F³, which is provided at both sides with angular current-deflectors *a*, that communicate with the V-shaped deflectors *a′*, as shown in Figs. 1, 2, and 9. The discharge-pipes F² are also provided with deflectors *a²*, whereby the discharge of the liquid is properly guided to the discharge-pipes, as shown in Fig. 6. The liquid to be drained is conveyed from the main supply-pipe G to the interior of the primary baskets by branch pipes G′, having enlarged nozzles G², that are either plain, as shown in Fig. 7, or provided with discharge-gates *g*, set by a rack and pinion, as shown in Fig. 8. The enlarged nozzles G² are curved in the direction of the flow of the liquid, so that the stream enters the machine with as much velocity as can be obtained from the available head of the liquid and produces as little disturbance as possible on the liquid in the basket. The baskets D and E are strongly bound with hoops to resist the severe strain exerted on them by the high velocities employed. They are suitably perforated, and also provided at the circumference of their open ends with flanges or rims *d d′*, which extend inwardly as well as outwardly from the cylindrical surface of the baskets. The inward extension of the rims *d d′* determines the amount of liquid which is held by the basket, while the outward extension of the rims serves as a guard to prevent the mixing of the drained and undrained liquids. The secondary basket E may be supplied with liquid from separate nozzles G³, that communicate with the inlet-pipes G′, as shown in dotted lines in Fig. 2. In most cases, however, these can be dispensed with and all the liquid be delivered to the primary baskets, and the overflow from the same passed over their rims *d d* to the draining-surface of the secondary basket. The liquid to be acted upon by the secondary basket, which may be raw liquor or unfiltered water, is thus supplied to the filtering or draining surface of the secondary basket either directly by the nozzles G³ or in the form of an overflow from the primary baskets over the rims *d d*, according to the nature of the liquid. This latter arrangement is preferred, though it causes a loss of power whenever it is desirable to send a strong current through the machine for washing off the draining-surface and preventing the too quick drying of the solids contained in the liquids, or in order to prevent a too large accumulation of the parts to be removed from the liquids, such as impurities, &c.

The liquid supplied through the nozzles to the primary baskets acquires quickly the velocity of the inside surface of the same and passes through the perforations of the primary basket into the secondary basket. The secondary basket is provided at that part surrounding the primary baskets with buckets *b b*, which are riveted to the cylinder of the same, and which serve for driving the secondary basket at nearly the same speed as the primary basket by the force stored up in the liquid passing through the latter. It will thus be seen that the power stored up in the liquid that passes off from the draining-surface of the primary basket can be utilized to perform the work required in draining the liquid through the independent draining-surface of the secondary basket exterior to the primary basket. The liquid passes from the buckets of the secondary basket and the perforations in front of each bucket and the perforated draining-surfaces at the ends of the secondary basket to the casing of the machine and is collected at the bottom of the same. The liquid which is thrown off in streams,

owing to the velocity by which it escapes from the draining-surface of the secondary basket, is collected at the bottom of the exterior casing and conveyed by the current-deflectors at both sides of the discharge-pipe to the curved deflectors a', extending across the same and thence to the discharge-pipe F^3.

It will be seen that it depends entirely upon the proportion of the surface of the primary basket to the entire surface presented for draining whether all the liquid can be drained by the draining-surfaces of the secondary basket or whether a third or even a fourth basket can be used to advantage. If only two baskets are used, the primary draining-surface has to be so large that the liquid from the first basket will be sufficient to impart the proper velocity to the entire liquid placed upon the draining-surface of the second basket, solid and liquid parts included. The surface of the primary basket has therefore to be somewhat larger than one-half of the entire draining-surface of the secondary basket.

In case a primary basket and a secondary and tertiary basket are used, driven directly by the engine, said primary basket should contain more than one-third of the draining-surface than the secondary, and the secondary more draining-surface than the third. The exact proportions of the draining-surfaces of each basket have to be determined by the amount of the solid matter contained in the liquid supplied to the machine. The larger the amount of the solid matter the smaller has to be the proportion of the draining-surface contained in the secondary basket to that of the primary basket. The liquid drawn off from the surface of the last basket performs no useful work, and all the power still stored up therein is lost, said lost power constituting, together with the resistance of the air to the motion of the baskets and the friction of the spindle in its bearings, the power required for driving the machine, and furnishing thereby a means to determine the question whether a tertiary or quaternary basket should be provided.

The draining-surface of the basket may be constructed in different ways, according to the material to be treated in the machine—as, for instance, a layer of felt, o, spread over a finely-perforated plate or fine wire-netting, o', which is again placed on a coarse wire-netting, o^2, as shown in Figs. 12, 13, 15, and 16. In place of the layer of felt a layer of loose cotton or wool on a suitable backing—charcoal, sand, gravel, or other loose matter supported in boxes—may be used, which is retained by centrifugal force or held in position by suitable means. In cases where the contact of air with the liquid in the machine is objectionable the modified construction shown in Fig. 4 may be used with advantage. In this case the secondary basket is made with perforations and on the same placed a coarse wire-netting, which separates the draining material from the basket proper. The liquid conveyed to the buckets is then discharged through openings h in the rim of the same to the outer ends of the secondary basket, and again through openings h' in the rim of the latter to an annular gutter formed at the ends of the secondary basket. An eduction-pipe, h^2, extends into the gutters of the secondary basket and carries off the liquid by its momentum, so that it can be discharged into a tank. The liquid passing through the openings in the cylinder of the primary basket passes through the coarse wire screen or netting in the outer ends of the secondary basket and unites with the liquid passing through the filtering-layers of the secondary basket placed on the coarse screen or netting, and is then passed through the openings in the rim of said basket into the gutter of the same, where it is scooped up by the eduction pipe and conveyed off. The filtering-surface is formed by a coarse wire screen, then by a finer wire screen, on which is placed a filtering-cloth of felt or other material.

The buckets of the secondary basket may also be arranged as shown in Fig. 4^a, in which the secondary basket E is located sidewise of the primary basket D on the spindle A and the buckets b arranged at that end of the secondary basket adjacent to the primary basket. In this case the buckets are narrow and act in the nature of a turbine wheel. In place of the buckets other equivalent means for driving the secondary baskets may be used, such as fibrous or granular substances which are capable of receiving the impact of the liquid discharged from the primary basket. These substances are attached to the shell of the basket E by means of internal bands, o^3, and binding-wires o^4, as shown in Figs. 15 and 16, or retained by equivalent means.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with a rotary primary basket, of one or more secondary baskets placed loosely on the spindle of the primary baskets, said secondary baskets being provided with buckets, so as to be driven by the power stored in the liquid discharged from the primary basket, substantially as set forth.

2. The combination of a spindle, and elastic bearings for said spindle with a primary basket secured rigidly to said spindle and one or more secondary baskets placed loosely on the spindle of the primary basket and provided with buckets exterior to said primary basket, substantially as set forth.

3. In a centrifugal machine, a secondary basket composed of a section having interior buckets or other driving means and an independent draining-section sidewise of the same, substantially as set forth.

4. The combination of a rotary primary basket with a secondary basket placed loosely on the spindle of the primary basket and provided with buckets or other equivalent means for utilizing the power of the liquid discharged

from the primary basket, and with an independent draining-surface, substantially as set forth.

5. The combination of a primary basket having a perforated surface with a secondary basket having driving-buckets and means for discharging the drained liquid from the secondary basket, substantially as set forth.

6. The combination of a rotary primary basket and a secondary basket placed loosely on the spindle of the primary basket and provided with buckets with an exterior casing having annular overflow-gutters, substantially as set forth.

7. The combination of a rotary primary basket with a secondary basket placed loosely on the spindle of the primary basket and concentric therewith, said secondary basket being wider than the primary basket, and provided with buckets at that portion encircling the primary basket, substantially as set forth.

8. The combination of a rotary primary basket with a secondary basket of larger diameter supported loosely on the spindle of the primary basket, said secondary basket being provided with buckets at that part encircling the primary basket, and an exterior casing having annular overflow-gutters, substantially as set forth.

9. The combination, with a rotary primary basket, of a secondary basket placed loosely on the spindle of the primary basket, provided with buckets and driven by the liquid discharge from the primary basket, supply-pipes, and an exterior casing having overflow-gutters and discharge-pipes, substantially as set forth.

10. The combination of a horizontal spindle with a primary basket secured rigidly to said spindle, a secondary basket surrounding the primary basket and extending beyond the same, the secondary basket being provided with buckets at that part concentric with the primary baskets, supply-pipes, and an exterior casing having overflow gutters and pipes and a bottom discharge-pipe, substantially as set forth.

11. The combination of a horizontal spindle, two primary baskets secured rigidly to said spindle, a secondary basket surrounding the primary baskets and supported loosely on the spindle between the primary baskets, buckets at that part of the secondary basket surrounding the primary baskets, rims at the open ends of the primary and secondary baskets, with supply-pipes for said baskets, and a casing surrounding the secondary basket and provided with overflow-gutters and discharge-pipes, substantially as set forth.

12. The combination of a horizontal spindle, two primary baskets secured to said spindle, a secondary basket surrounding the primary basket and supported loosely on the spindle between the primary baskets, buckets on the secondary basket at that part surrounding the primary baskets, an exterior casing having overflow gutters and pipes, with supply-pipes having enlarged nozzles, a discharge-pipe at the bottom of the exterior casing, and V-shaped current-deflectors at both sides of said discharge-pipe, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

TEILE H. MÜLLER.

Witnesses:
PAUL GOEPEL,
CARL KARP.