

No. 725,868.

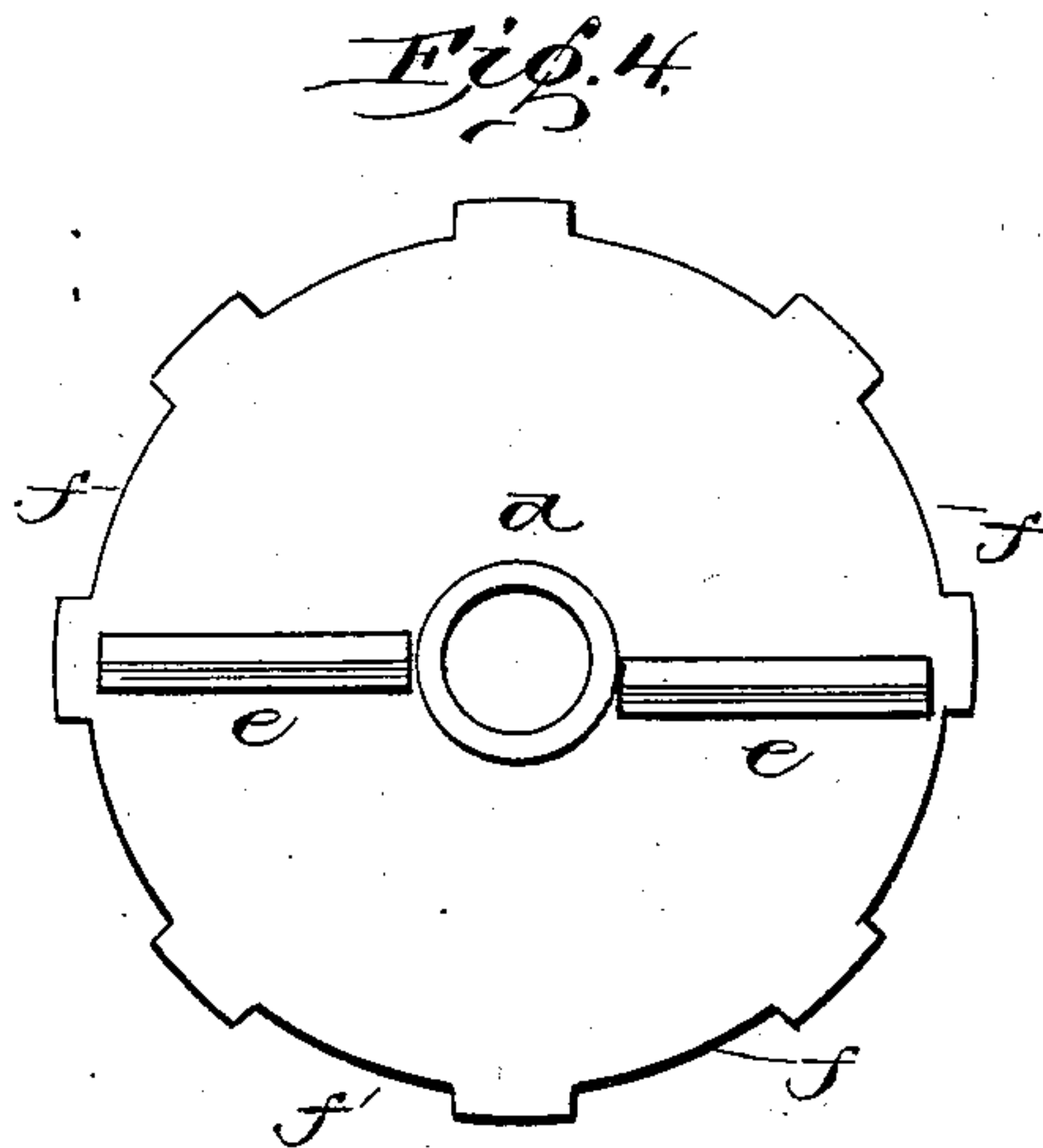
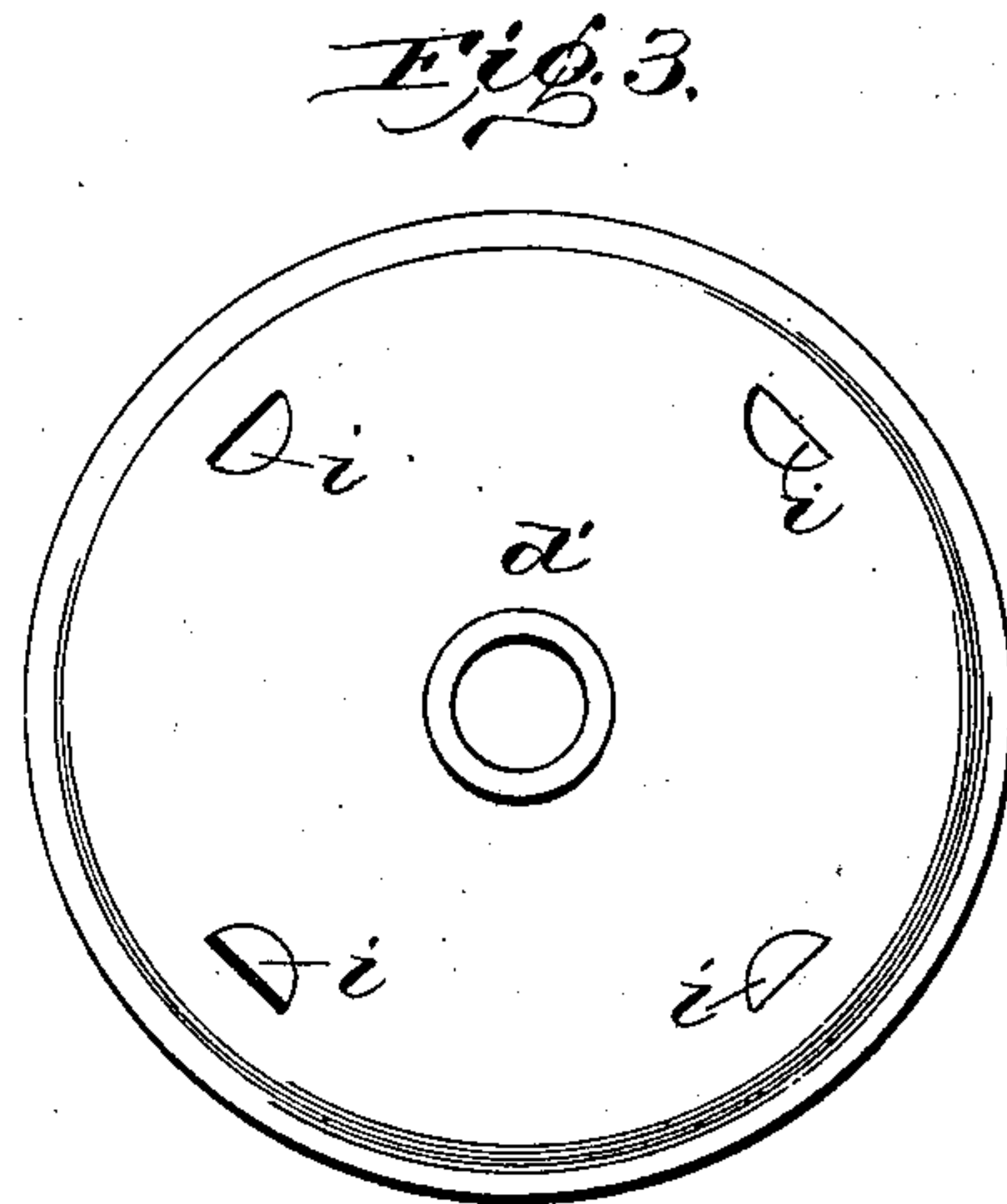
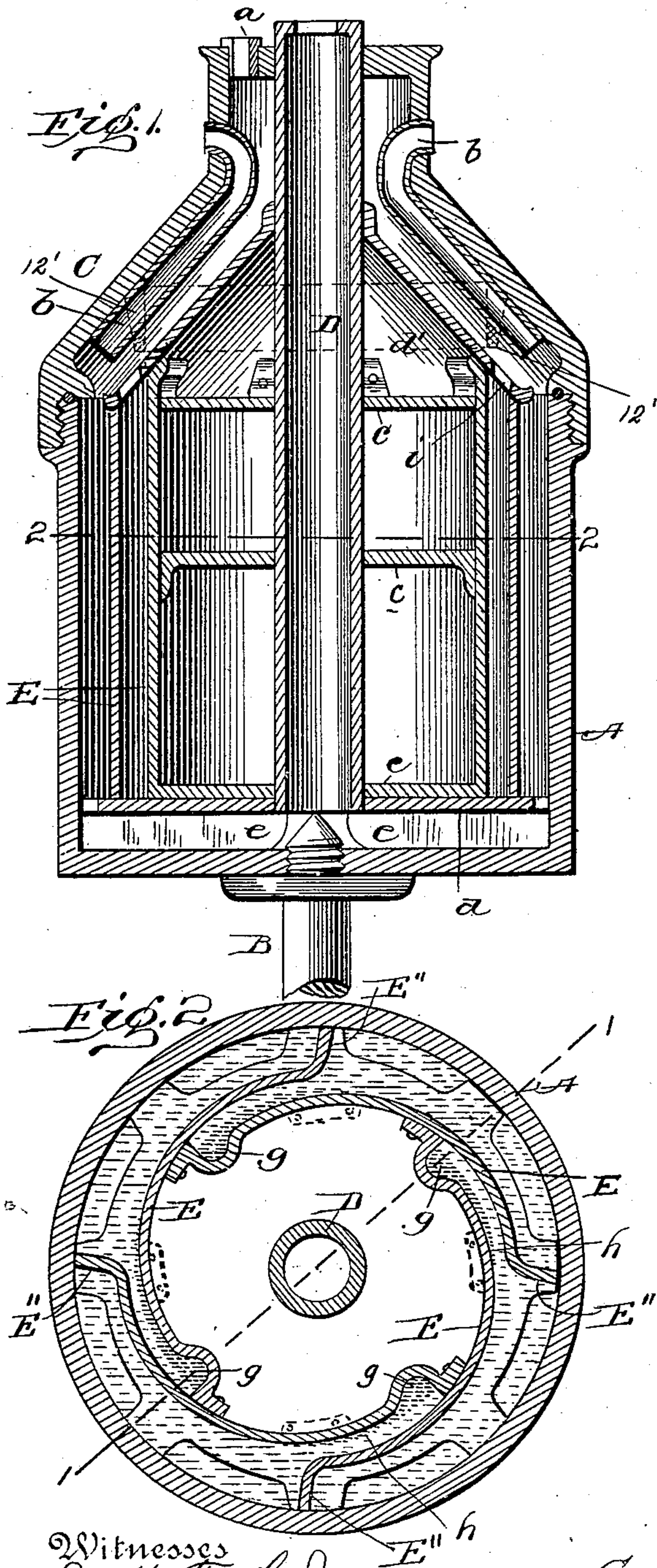
PATENTED APR. 21, 1903.

C. J. PIHL.
CENTRIFUGAL SEPARATOR.

APPLICATION FILED AUG. 28, 1901. RENEWED OCT. 16, 1902.

NO MODEL.

2 SHEETS—SHEET 1.



Witnesses
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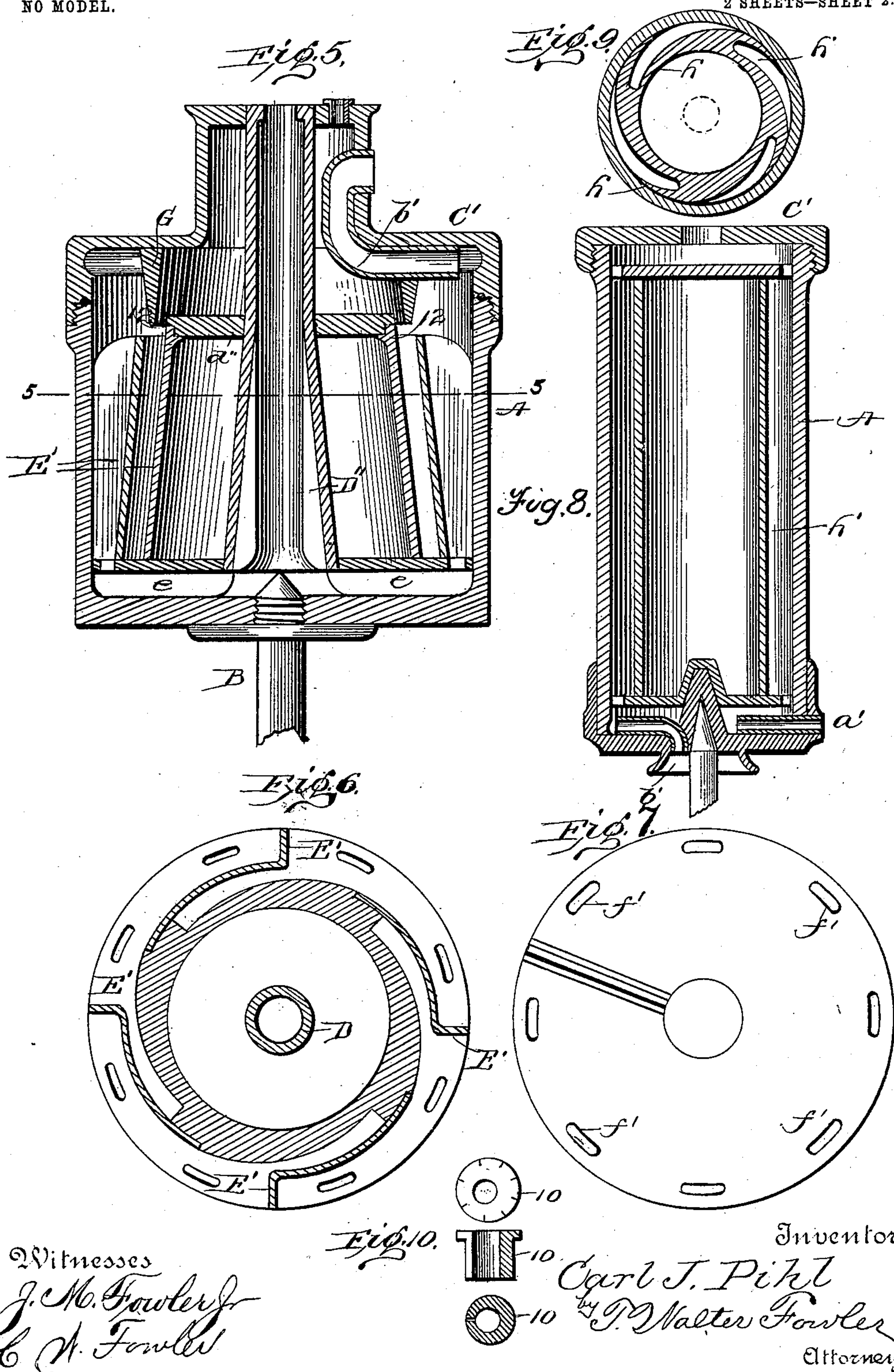
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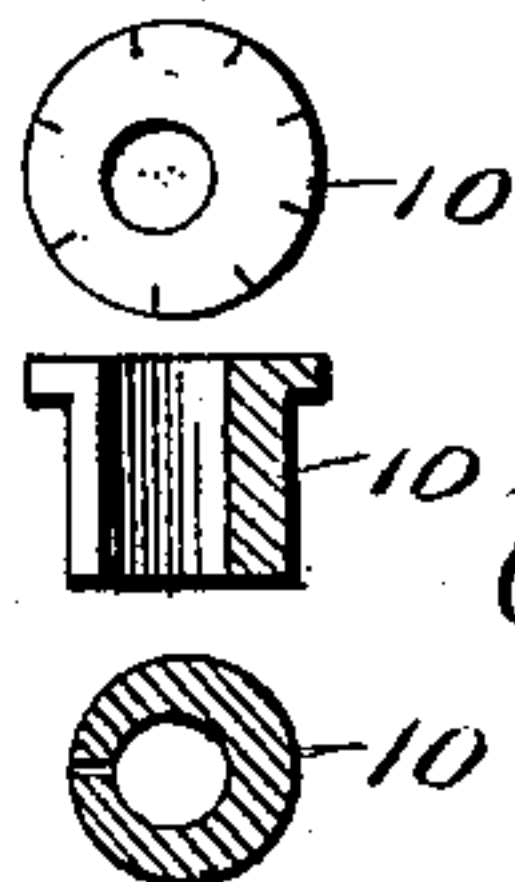
NO MODEL.

2 SHEETS—SHEET 2.



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Fig. 10.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 725,868, dated April 21, 1903.

Application filed August 28, 1901. Renewed October 15, 1902. Serial No. 127,390. (No model.)

To all whom it may concern:

Be it known that I, CARL J. PIHL, a citizen of the United States, residing at Cambridgeport, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Centrifugal Separators, of which the following is a specification.

My invention relates to that class of centrifugal machines known as "liquid-separators," and which machines are designed for the reception of a compound liquid, such as whole or fresh milk, and which liquid is to be separated into constituent parts, as cream and skim-milk, of different specific gravities; and my invention consists of the parts and the constructions and combinations of parts which I shall hereinafter fully describe and claim.

In the accompanying drawings, forming part of this specification, and in which similar characters of reference indicate corresponding parts, Figure 1 is a longitudinal vertical sectional view of a centrifugal separator embodying my invention, the line of section being indicated as on the line 1 1 of Fig. 2. Fig. 2 is a horizontal sectional view on the line 2 2 of Fig. 1. Fig. 3 is a plan view of the cap-plate *d'*, showing the cream-outlets which communicate with the vertical passages or raceways *g* in Fig. 2. Fig. 4 is a plan view of the bottom plate *d*. Fig. 5 is a longitudinal section of another form of separator to be hereinafter described. Fig. 6 is a cross-section of Fig. 5 on the line 5 5. Fig. 7 is a view of the bottom plate of the separator shown in Fig. 6. Fig. 8 is a vertical section, and Fig. 9 is a cross-section, of another modified form of separator. Fig. 10 is a detail to be referred to.

In the said drawings, Figs. 1 to 4, the bowl A is of any well-known or appropriate form and is suitably fixed to a shaft B, so as to be rotated at a high speed in the manner usual with this class of machine. The bowl has fixed to it the usual cover C, which has the cream-outlet *a* in the contracted neck and has also secured to it the skim-milk tubes, of which there may be any desired number and two of which are shown at *b* as lying along the inner inclined side of the cover and with

the lower end near the junction of the peripheral vertical wall of the bowl with the inner wall of the cover, said tubes having their opposite or outlet ends piercing the neck of the cover and adapted to discharge the blue or skim milk outside of the cover in the well-known manner. The interior of the bowl is provided with suitable annular vertical walls which lie substantially close to the inner wall of the bowl, the first-named walls being connected at the top and bottom by suitable disks or plates, so as to form substantially an inner drum, which may be hollow and air-tight and may be internally braced by horizontal diaphragms or partitions *c*, or, if desired, the drum may be in the form of a solid with channels or raceways formed in its periphery to accommodate the progressive movements of the cream and skim-milk toward their respective outlets. The parts of the drum may also be braced by flanges, as shown by dotted lines in Fig. 2, to give stability. In the top of the neck is a feed-inlet, into which the full or whole milk is received, said inlet communicating with a vertical milk-passage D, which extends through the vertical center of the machine and has its lower end terminating just above the bottom of the bowl A. The bottom plate *d* of the inner structure lies about in the horizontal plane of the lower end of the tube or passage D, and the under side of the plate is formed or provided with the usual radial wings *e*. It also has liquid-passages formed in it either by notching the edge, as shown at *f* in Fig. 4, or by apertures made through the plate near the edge, as shown at *f'* in Fig. 7, or otherwise made to communicate with the raceways.

The separating-walls or partitions E in Figs. 1 and 2 are vertically disposed and in cross-section are curved transversely, and they overlap each other to form the raceways or passages for the separated constituents. Referring to Fig. 2, it will appear that each of the plates or partitions E has one edge secured, and proximate to this edge the plate is curved inwardly to form a pocket or recess *g* and thence curves outwardly in a line substantially eccentric to the axis of the ma-

chine, whereby its free edge or opposite portion is separated from the rear portion of a contiguous plate or partition to form a separating passage or raceway *h*. Thus in cross-section the partitions or separating-walls are substantially double-walled at intervals, and the space between the walls forms a channel narrow in horizontal section, and the whole or full milk being led into the machine, as before indicated, will be received into a passage formed by the inner wall of the bowl and an imperforate wall close to said inner wall and revoluble therewith, and during the revolution of the machine the cream constituents tend to crowd themselves against this inner wall of the transversely-curved partitions *E*. As these partitions decline transversely toward the pockets or recesses *g* in the partitions, the cream is gradually worked back into the space of least agitation until it finally occupies the pockets or recesses and so much of the outer surface of the curved wall adjacent thereto as may be required, while the skim-milk or other separated constituent is thrown outward by the centrifugal action to occupy the remaining space of the raceways between overlapping partitions and the space between the outer surface of said partitions and the inner wall of the bowl, and in this relation the separated constituents flow upward, the cream escaping from the raceways through outlets *i*, formed in the arched top plate *d'*, and the skim-milk escaping around the edge of this plate and into the outlet tube or tubes, the cream continuing its flow upward and finally escaping through its own outlet.

While the recess or pocket portion of the partition is nearer the axis of revolution than the remaining portions of the partition, still it is sufficiently removed from said axis to effectually operate on the liquid to produce centrifugal separation during the period the liquid is flowing through the separating zone to the outlets. If the raceways or channels were too close to the axis of revolution, some of the skim-milk constituents might remain in the cream constituents, and separation would not be perfectly accomplished. Therefore while I locate the recesses or pockets nearer the point of least agitation I also locate them sufficiently far from this point to effect complete separation, and the cream is afforded ample time to assemble in the pockets or recesses for nearly the whole or greater portion of the length of the height of the bowl and to be finally discharged entirely separated from the milk constituents. I also provide the neck of the machine with a cream-outlet that is made adjustable—that is, I employ a plug 10, in which a hole is made eccentrically, as shown in the detail Fig. 10, this plug being divided or split through one of its walls, whereby it may be compressed into position, and expansion will hold the plug with sufficient friction to maintain it in any of its adjusted positions. The plug has

a flanged top portion, and a tool may engage this flange to partially rotate the plug to bring the thin side of the plug nearer or farther from the axis of revolution of the machine, and thereby regulate the overflow of cream.

The form of machine illustrated in Figs. 5 and 6 is like that shown in Figs. 1 and 2 in its essential parts, except that the partitions *E'* are declined upwardly to give a general taper to the separating-wall, and the tube or milk-passage *D'* may be provided with wings *D''*. In using the longitudinally-declining partitions of Fig. 5 the raceways increase in size from the bottom to the top or from the zero-point, where separation commences, to the point where it substantially ends. I also show in Figs. 5 and 7 a flat top plate *d''* and a ring *G*, interposed between said plate and the under side of the cover *C'* with a cream-escape between the plate and ring, as shown at 12. The ring may also be used in Fig. 1, if desired, as shown by dotted lines at 12'. The position of the milk outlet or tube *b'* is slightly modified in Fig. 5, and its horizontal leg pierces the ring, as shown, and the pocket or recesses in the separating-partitions or curved plates are omitted, as the cream will seek the deepest portions of the raceways, and separation will be effected substantially as before described.

In passing the cream-escape 12 the cream takes an abrupt fall, and the ring will tend to prevent any intermingling of the skim-milk with the cream, said cream-escape 12 being suitably proportioned with respect to the capacity of the bowl.

In Figs. 8 and 9 I illustrate another modified form of device, where the whole milk is entered at one end and the separated constituents discharged from the opposite ends through the outlets *a'* and *b'*. In this case the raceways *h'* may be formed directly in a solid piece, Fig. 9, the walls of the raceways operating the same as the walls of the transversely-curved partitions of Figs. 1 and 2. To facilitate the cleansing of the raceways, the outer vertical edges of the partitions *E* may be turned outwardly, as shown at *E''*.

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

1. In a centrifugal separator, the combination with a bowl, of a wall proximate to the wall of the bowl and made double at intervals to form horizontally-curved raceways closed at the back and open at the front.

2. In a centrifugal separator, the combination with a bowl, of a transversely-curved wall opposing the wall of the bowl and made substantially double at intervals to form raceways of substantially narrow width horizontally and open at the front and closed at the rear.

3. In a centrifugal separator, the combination with a bowl, of an annular vertical wall opposing the same and made double at inter-

vals to form curved spaces said spaces being deeper at the rear than at the front.

4. In a centrifugal separator, the combination with the bowl, of a wall opposing the same and made double at intervals said wall including vertically-disposed transversely-curved plates with the front portion of one plate overlapping and separated from the rear portion of another plate to form a horizontally-curved raceway for separated constituents.

5. In a centrifugal separator, the combination with a bowl, of a wall opposing the wall of the bowl and including vertically-extending plates curved transversely and with the front portion of one plate or partition overlapping and separated from the rear portion of a contiguous plate to form a raceway, open at the front and closed at the rear, and separate outlets for the separated constituents.

6. In a centrifugal separator, the combination with a bowl, of a wall opposing the wall of the bowl and including vertically-extending surfaces curved transversely and overlapping and separated to form horizontally-curved raceways, said raceways terminating in enlarged recesses at the base or inner portions.

7. The combination with the bowl, of the vertical partitions curved transversely to form horizontally-curved raceways, a plate above and below the partitions, a ring above and separated from the upper plate, said plate having openings connecting with the raceways, and separate outlets for the separated constituents.

8. In a centrifugal separator having an opening for a separated constituent, means for regulating the flow from said outlet consisting of a split expansible plug axially mounted and provided with an eccentrically-formed opening.

9. In a centrifugal separator the combination of the bowl, the vertical partitions curved transversely as described, a plate above and below the partitions, and an annulus above the upper plate and separated at its lower edge therefrom.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CARL J. PIHL.

Witnesses:

CARL NORVELL SANBORN,
GRACE E. ROCKWELL.