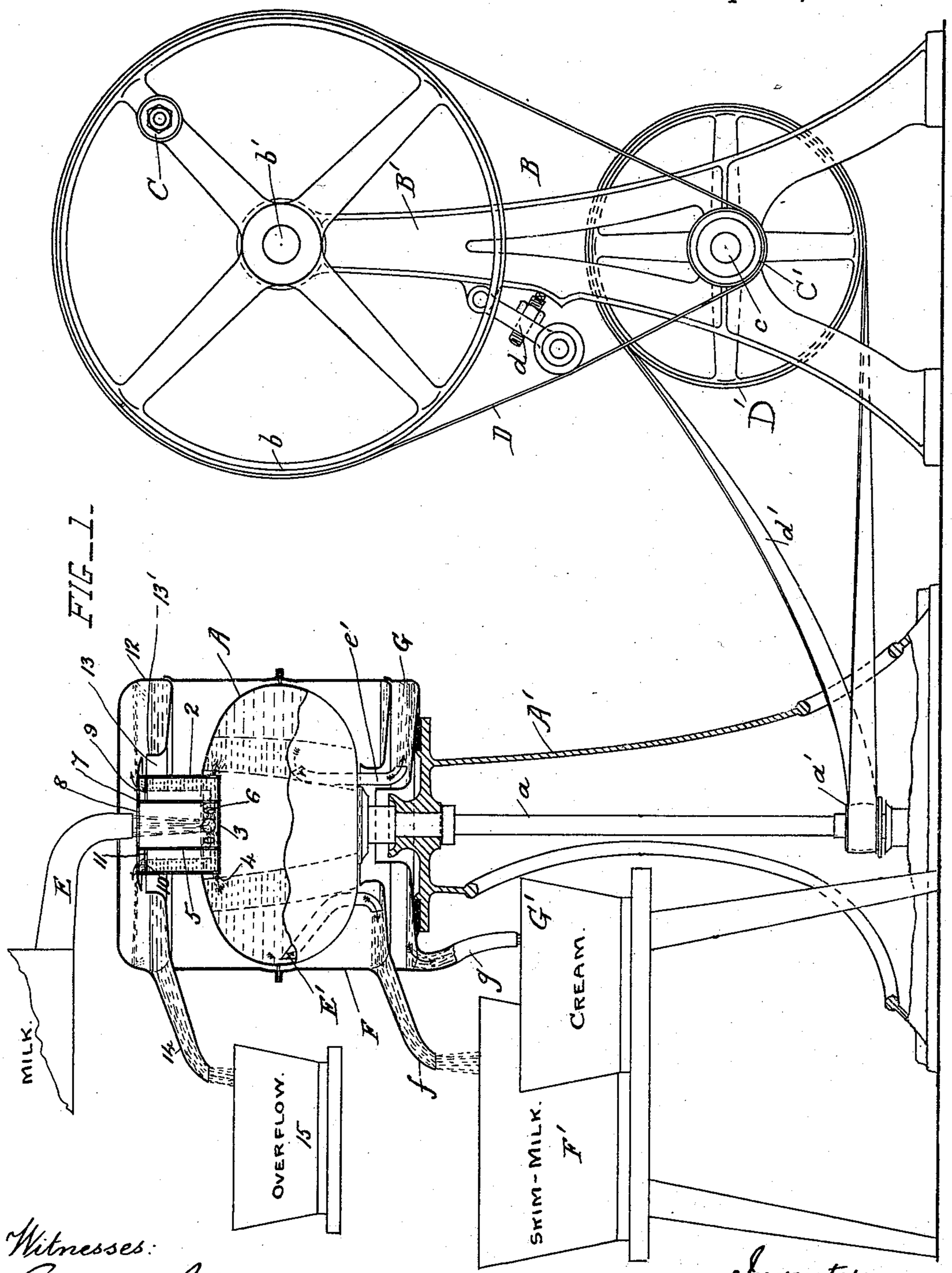
(No Model.) 3 Sheets—Sheet 1.

F. LUDLOFF.

CENTRIFUGAL SEPARATOR AND METHOD OF REGULATING THE SUPPLY THERETO.

No. 504,422. Patented Sept. 5, 1893.

FIG. 1.



Witnesses:
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(No Model.) 3 Sheets—Sheet 2.

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FIG. 2.

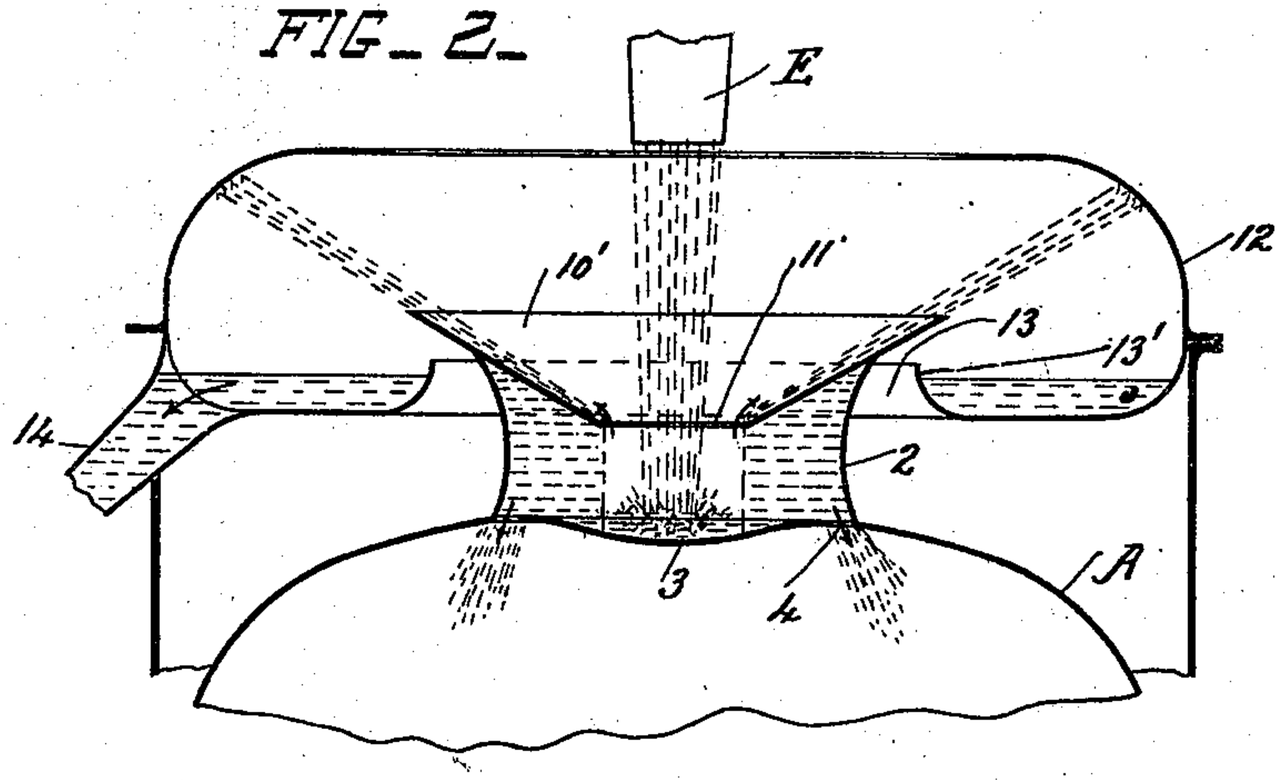

FIG. 3.

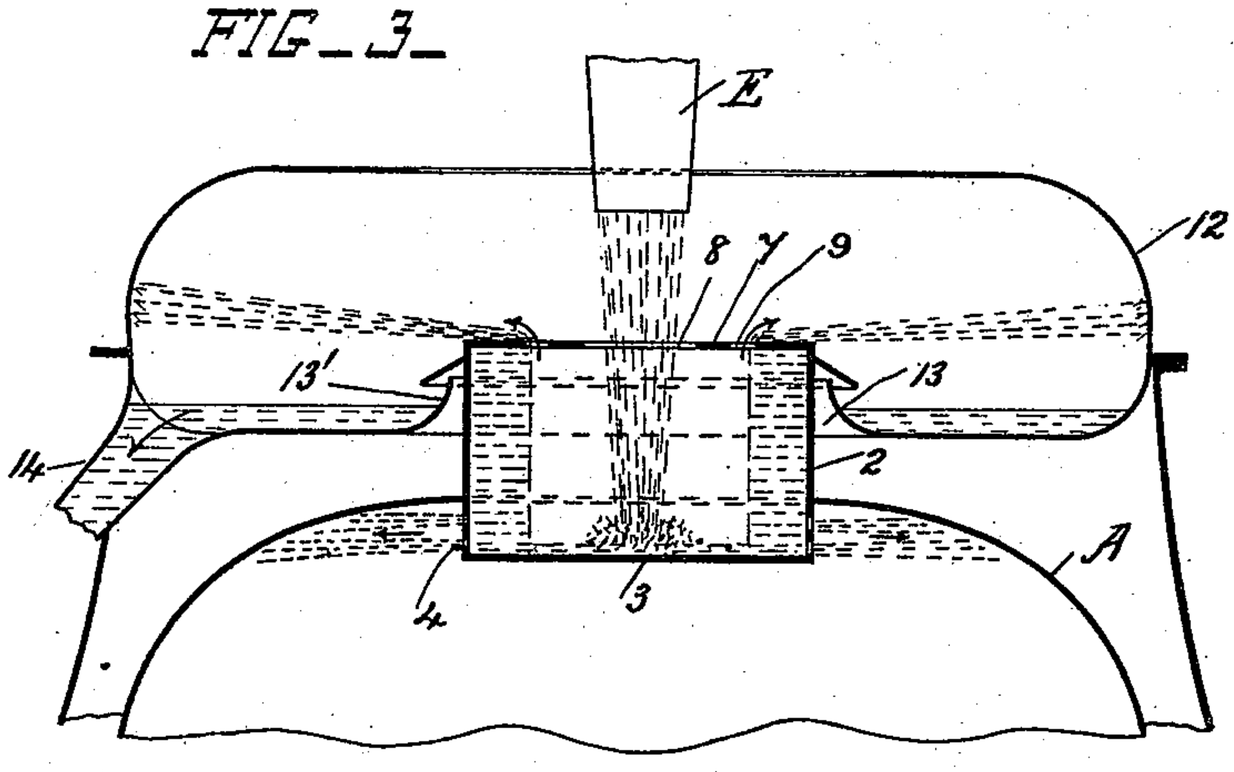

FIG. 4.

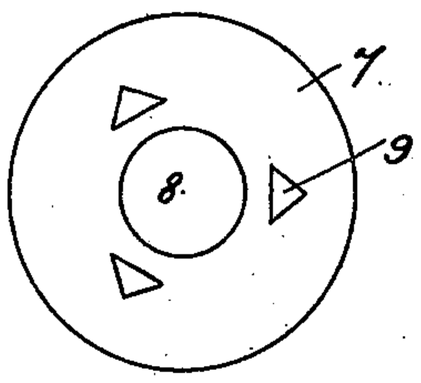

FIG. 5.

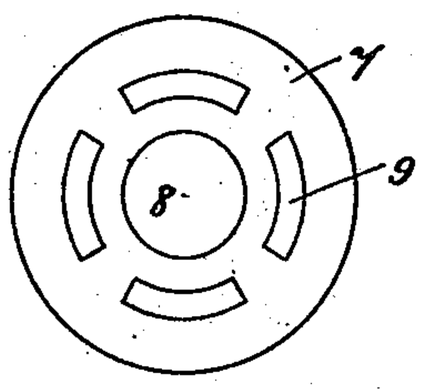

FIG. 6.

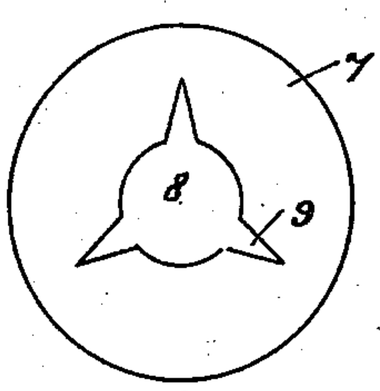

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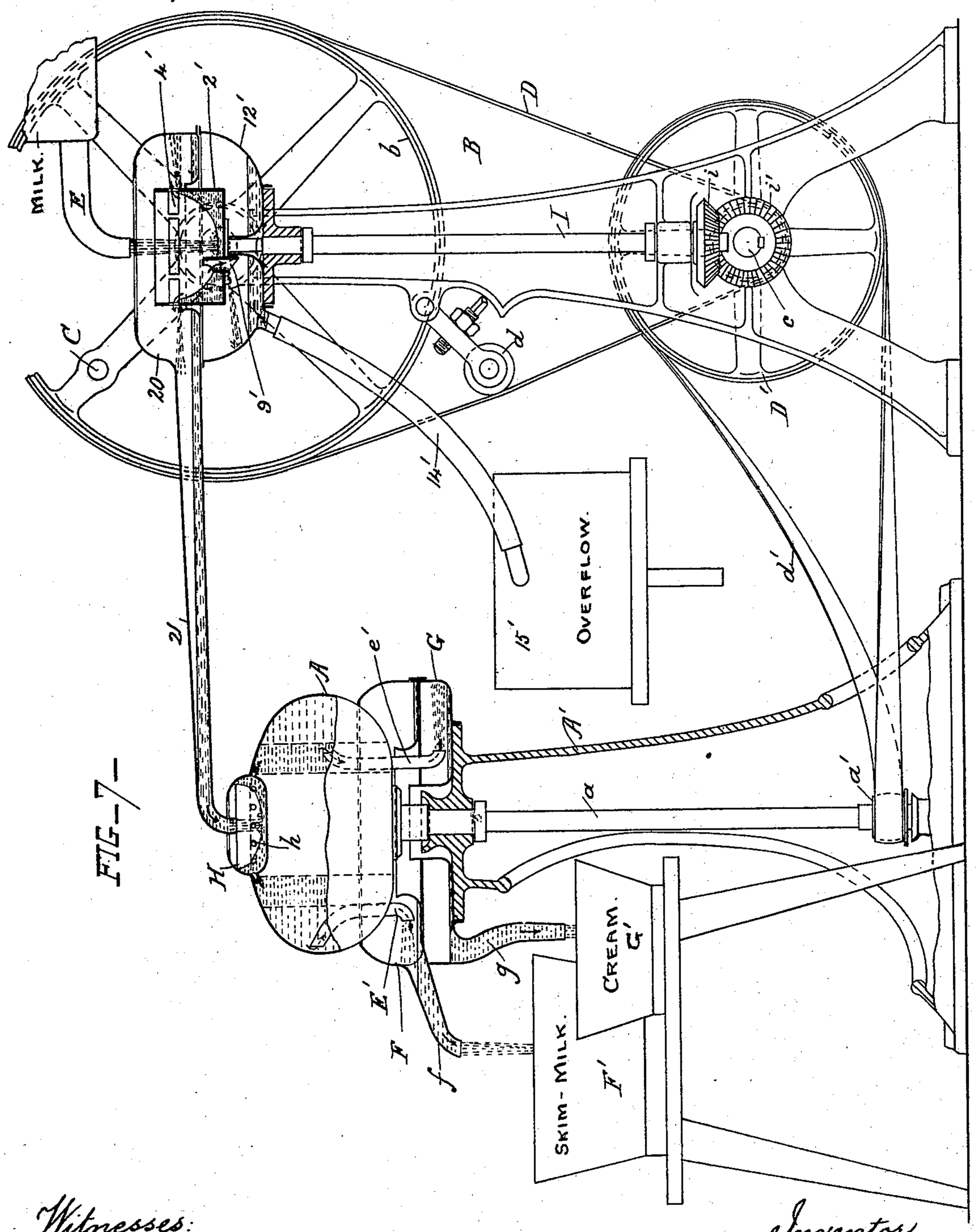
FIG. 7.



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UNITED STATES PATENT OFFICE.

FRIEDRICH LUDLOFF, OF BERLIN, GERMANY.

CENTRIFUGAL SEPARATOR AND METHOD OF REGULATING THE SUPPLY THERETO.

SPECIFICATION forming part of Letters Patent No. 504,422, dated September 5, 1893.

Application filed June 16, 1893. Serial No. 477,808. (No model.)

To all whom it may concern:

Be it known that I, FRIEDRICH LUDLOFF, a subject of the German Emperor, residing at Berlin, in the Kingdom of Prussia, German Empire, have invented certain new and useful Improvements in Devices for Regulating the Feed of Centrifugal Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to means for automatically regulating the supply of liquid to a centrifugal separating machine; and it consists in the novel construction and combination of the parts hereinafter fully described and claimed.

In the drawings: Figure 1 is a vertical section through a centrifugal separating machine and its automatic supply regulator, and shows also means for revolving the said parts. Fig. 2 is a vertical section of a modified form of regulator secured to the top of a separator drum, and drawn to a larger scale. Fig. 3 is a vertical section similar to Fig. 2, but showing another modification in the construction of the regulator. Figs. 4, 5 and 6 are plan views showing three modifications in the arrangement of the apertures in the top plates of the regulators. Fig. 7 is a vertical section of a separator and a regulator, similar to Fig. 1, but the construction of the regulator is modified and it is detached from the separator.

The centrifugal separator may be of any approved construction adapted to separate substances of different specific gravity.

In illustrating the application of the automatic regulator a simple form of separator has been shown which is adapted to separate milk into cream and skim-milk, but the use of the regulator is not confined to this form of separator, nor to the separation of milk, nor to the devices shown for revolving it.

A is the separator drum secured on the vertical shaft *a*, which is journaled in the frame A′ and is provided with a driving pulley *a′*.

B is an operating device for revolving the shaft *a*. This device consists of a belt pulley *b* mounted on a shaft *b′* which is journaled in the frame B′. A handle C projects from one of the arms of the pulley *b* so that it may be turned by hand.

C′ is a belt pulley secured on a shaft *c*, journaled in the lower part of the frame B′.

D is a belt which passes around the belt pulleys *b* and C′, and *d* is a device for keeping the belt taut. Another belt pulley D′ is secured on the shaft *c*, and *d′* is a belt which passes around the pulleys D′ and *a′*, so that the drum A may be revolved rapidly by turning the handle C.

The milk is led into the separator drum A from the supply pipe E. When the drum is revolved very rapidly its contents form a hollow paraboloid inside it, the skim-milk being driven to the periphery of the drum and the cream remaining nearer its center.

E′ is a collecting pipe for removing the skim-milk, and *e′* is a collecting pipe for removing the cream. The lower end of the pipe E′ communicates with a cylinder F which is secured to the frame A, and *f* is an outlet pipe projecting from the bottom of the cylinder F and adapted to discharge the skim-milk into the receptacle F′. The lower end of the cream collecting pipe *e′* communicates with an annular chamber G in the said cylinder F, and *g* is an outlet pipe projecting from the bottom of the chamber G and adapted to discharge the cream into the receptacle G′.

In a centrifugal separator of this description the supply of milk from the supply pipe E is constant, and it is found that the separation is best effected when the drum is driven at a certain speed, say of four thousand revolutions a minute. If this speed is decreased all the available cream will not be separated from the skim-milk, and if the speed is increased unnecessary work will be done. It is difficult to revolve the drum at one uniform high velocity, more especially when its driving is effected by a hand-operated device.

In carrying out the present invention the supply of milk from the supply pipe to the drum is automatically varied and controlled by the speed of the drum itself, so that no irregularity in the work of the machine is caused by fluctuations in its speed.

In the form of automatic regulator shown in Fig. 1, 2 is a vessel secured to the top of the drum A under the supply pipe. This

vessel is provided with a bottom 3 and has one or more outlets 4 through which the milk may pass into the drum. The outlet or outlets 4 are proportioned in area so that a certain prearranged quantity of milk will pass through them per unit of time with a prearranged normal speed of revolution of the vessel. Inside the vessel 2 is preferably a cylinder 5 provided with holes 6 at its lower part. The holes 6 are of large area so that they do not obstruct the flow of milk under any circumstances. The cylinder 5 may be dispensed with if desired, but it is useful as it prevents the milk from splashing in the vessel 2. A cover plate 7 is secured to the top of the vessel 2. This cover plate has a central hole 8 under the supply pipe, and holes or openings 9 between the hole 8 and its periphery. The holes 8 and 9 may be variously arranged and proportioned. In Fig. 4 the holes 9 are small and triangular; in Fig. 5 the holes 9 are circumferentially-curved slots; and in Fig. 6 the openings 9 join into the center hole 8. In Fig. 1 a plate 10 is shown a little below the top plate, and is provided with a large central hole 11, but this plate may be dispensed with if desired. A stationary catch pan 12 is secured to the top of the cylinder F, or is supported in any other approved manner. The top of the regulator vessel 2 projects through a central hole 13 in the bottom of the catch pan, which is provided with a flange 13′. The catch pan is also provided with an outlet pipe 14 adapted to discharge into the overflow vessel 15.

The operation of the automatic regulator is as follows: As the vessel 2 is revolved rapidly with the drum A, the milk is thrown to its periphery by centrifugal force, and passes through the outlets 4 into the drum, rising to some extent around the periphery of the said vessel. When the speed of the drum and the regulator vessel is temporarily diminished, the milk will be forced through the outlets 4 with less pressure, and will accumulate around the periphery of the vessel 2. As soon as the accumulating milk overflows the edge of the hole 11 of the plate 10 it is driven off through the holes or openings 9 and falls into the catch pan 12, whence it passes into the overflow vessel 15. The action is the same when the plate 10 is not used but the position of the outer edges of the holes or openings 9 then determines when the overflow shall commence, and the point at which overflow commences can be more nicely regulated by using the plate 10 having a single large hole 11 in it. The milk can be seen as it runs into the overflow vessel, and the operator then knows that the machine must be turned with increased speed. The milk is subsequently removed from the overflow vessel and is poured into the supply vessel. It is not expected that the speed of the drum and regulator vessel will ever be much increased above the normal, but if such should be the case the operator will notice that no milk whatever is being driven into the overflow vessel, and will not drive the machine so fast. Increase of speed is of no detriment to the product like diminution of speed, but only tires the operator. The automatic regulator however guards against the evil effects of both increase and diminution of speed.

In the modification shown in Fig. 2, the bottom of the vessel 2 is concave and consists of a portion of the top of the drum A, the outlets 4 being in the bottom 3 instead of in the sides. The inner cylinder 5 is dispensed with, and the cover plate 7 and the plate 10 are replaced by a single funnel-shaped plate 10′ having a central hole 11′. The operation of this form of the regulator is identical with the form shown in Fig. 1.

The modification of the regulator shown in Fig. 3 is exactly the same as that shown in Fig. 1 except that the cylinder 5 is left out.

In the modification shown in Fig. 7, the regulator is driven separate from the separator drum. The separator and the mechanism for driving it are exactly the same as shown in Fig. 1, but the separator drum shown in Fig. 7 has a small receiver H at its top provided with holes *h* at its lower part inside the drum A, so that the milk can be driven into the drum without carrying in air with it. In this form of the apparatus the regulator vessel 2′ is arranged at the upper part of the frame B′ of the operating device, and is secured on a vertical shaft I journaled in the said frame and operatively connected with the shaft *c* by the intergearing beveled toothed wheels *i i′*. The milk supply pipe E is arranged over the regulator vessel, and regulator vessels such as hereinbefore described may be used.

In the modified form of regulator shown in Fig. 7, the action is substantially the same as in the regulators hereinbefore described, but the positions of the corresponding parts are reversed. The vessel 2′ has outlets 4′ in the upper part of its periphery, and an outlet pipe 9′ in its bottom near its center. When the vessel 2′ is revolved at its prearranged normal speed, the milk rises against its periphery and passes through the outlets 4′ into the receptacle 20, and thence down the spout 21 into the receiver H of the drum A. When the vessel 2′ is revolved at its prearranged normal speed no milk passes down the pipe 9′, but when its speed and that of the separator drum A is diminished a portion of the milk passes down the pipe 9′ into the catch pan 12′, whence it passes into the overflow vessel 15′ by way of the pipe 14′.

In each form or modification of the regulator the revolving vessel 2 or 2′ is provided with two separate outlets or series of outlets, and one outlet is arranged nearer to its center or axis than the other outlet. The outlet or outlets more remote from the center of the regulator vessel deliver the milk to the revolving separator drum, and the outlets nearer to its center serve for the discharge of

the surplus milk when the speed of the separator drum and the regulator vessel falls below the prearranged normal speed at which they are designed to work.

The regulator is most conveniently arranged when attached to the top of the separator drum as shown in Fig. 1; but when arranged separate from the said drum it may be driven at a different speed from the drum. The regulator is connected with the drum so that the speeds of the regulator and drum are constantly in the same proportion, and so that a fluctuation of the speed of the drum is attended by a similar fluctuation in the speed of the regulator.

What I claim is—

1. The method of automatically regulating the supply of liquid to a centrifugal separator, which consists in subjecting the supply liquid to centrifugal force before it enters the separator and discharging into a separate vessel a portion of the supply liquid proportionate to any decrease in the normal speed of the separator, substantially as set forth.

2. The combination, with a centrifugal separator, of a centrifugal supply regulator consisting of a hollow vessel provided with two outlets arranged at different distances from its axis, and driving mechanism operating the separator and the regulator at the same proportionate speeds, whereby the supply of liquid is automatically rendered proportionate to the speed of the separator, substantially as set forth.

3. The combination, with a centrifugal separator, and driving mechanism for revolving it; of a centrifugal supply regulator consisting of a hollow vessel provided with two outlets arranged at different distances from its axis secured to the said separator and operating to automatically reduce the supply of liquid to the separator when the speed of the separator is diminished, substantially as set forth.

4. In an automatic supply regulator for a centrifugal separator, the combination, with a revoluble vessel provided with two outlets arranged at different distances from its axis, of a catch pan arranged around the outlet nearer the axis of the vessel and adapted to receive the surplus supply liquid when the speed of the said vessel is diminished, substantially as set forth.

5. In an automatic supply regulator for a centrifugal separator, the combination, with a revoluble vessel provided with an outlet at its lower part near its periphery for the passage of the liquid to the separator, and a second outlet at its upper part between the first said outlet and the axis of the vessel; of a catch pan arranged around the second said outlet and adapted to receive the surplus supply liquid when the speed of the said vessel is diminished, substantially as set forth.

6. In an automatic supply regulator for a centrifugal separator, the combination, with a revoluble vessel provided with an outlet at its lower part near its periphery, a second outlet at its upper part nearer the axis of the vessel than the first said outlet, and an internal vessel provided with openings at its lower part; of a catch pan for receiving the surplus liquid which passes through the second said outlet when the speed of the vessel is diminished, substantially as set forth.

7. In an automatic supply regulator for a centrifugal separator, the combination, with a revoluble vessel provided with an outlet at the lower part of its periphery, a cover plate provided with a central inlet hole for the liquid and outlets between the said central hole and its periphery; of a catch pan for receiving the surplus liquid when the speed of the vessel is diminished, substantially as set forth.

8. The combination, with the revoluble vessel 2 provided with an outlet 4 at its periphery, the internal cylinder provided with holes 6, the cover plate provided with a central hole 8 and outlets 9 between the hole 8 and its periphery, and the plate 10 secured in the vessel below the cover plate and provided with the outlet hole 11; of a catch pan encircling the said vessel and adapted to receive the surplus liquid driven through the outlets 11 and 9, substantially as and for the purpose set forth.

9. An automatic supply regulator for a centrifugal separator, comprising in its construction a revoluble vessel provided with a central opening for the entrance of the supply liquid and two separate outlets through which the said liquid is discharged by centrifugal force, one of the said outlets being arranged nearer the axis of the said vessel than the other said outlet, the outlet more remote from the axis operating to permit the passage of the liquid into the separator, and the outlet nearer the axis operating to permit the discharge of surplus liquid from the said vessel without entering the separator.

In testimony whereof I affix my signature in presence of two witnesses.

FRIEDRICH LUDLOFF.

Witnesses:
ADRE BOIS-REYMOND,
HERMANN DRÖSSE.