A. J. ERICSSON.

CENTRIFUGAL MACHINE.

APPLICATION FILED MAR. 23, 1906.

911,652.

Patented Feb. 9, 1909.

5 SHEETS—SHEET 1.

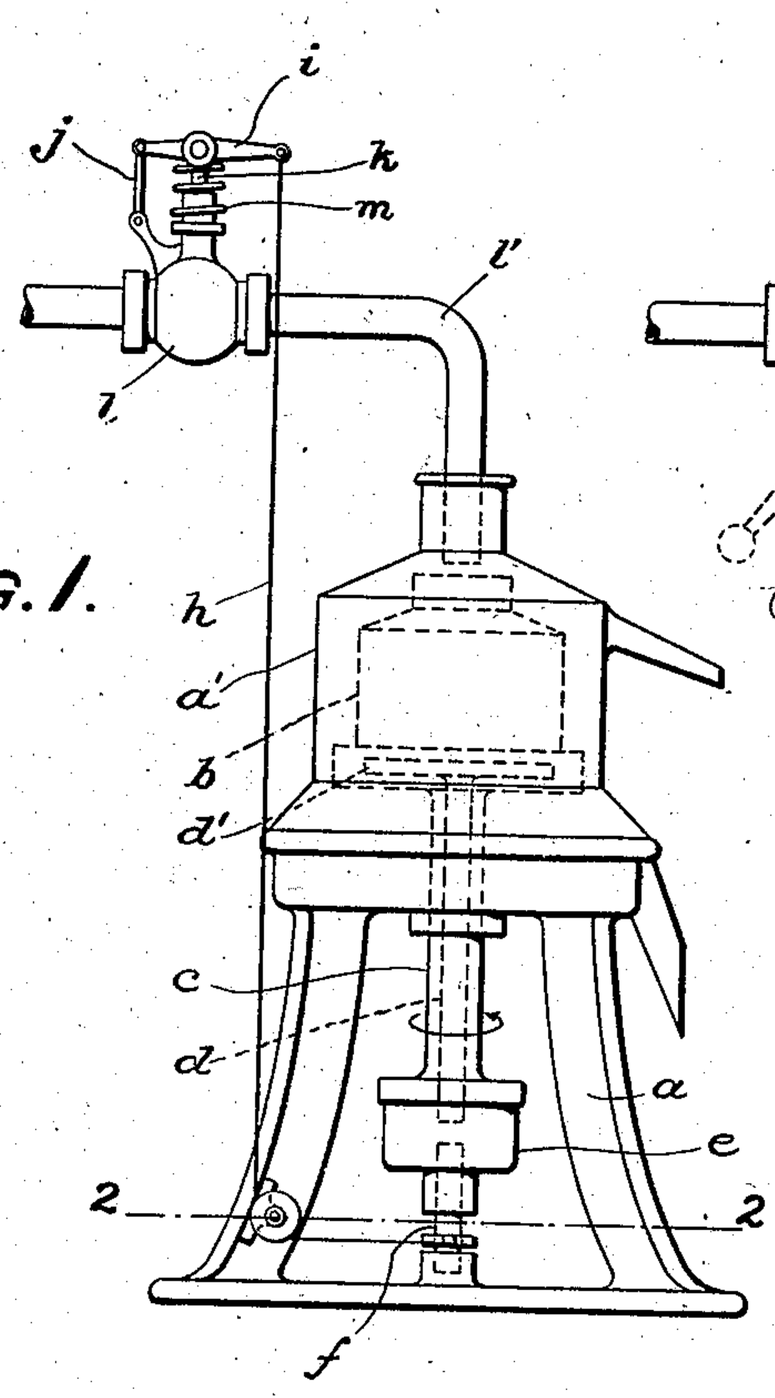


FIG. 1.

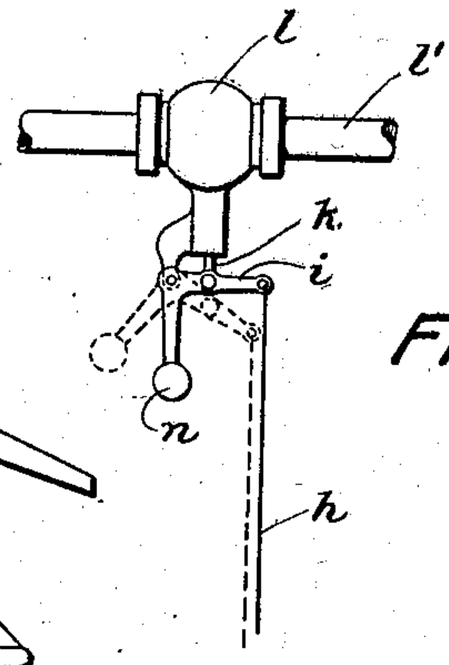
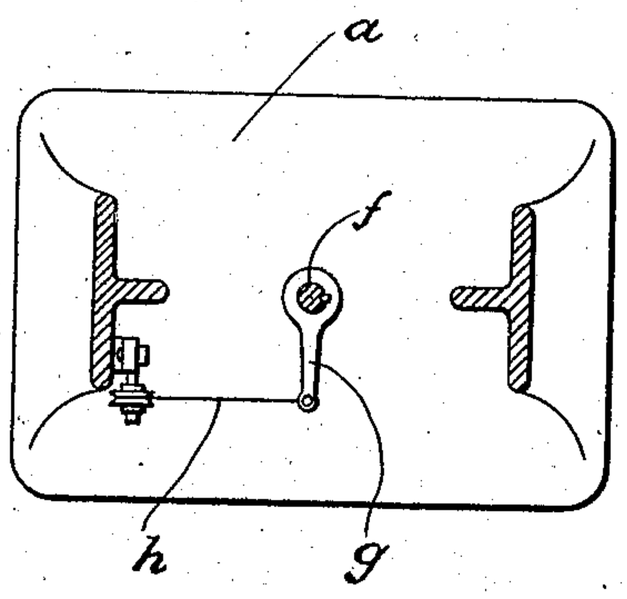


FIG. 3.

FIG. 2.



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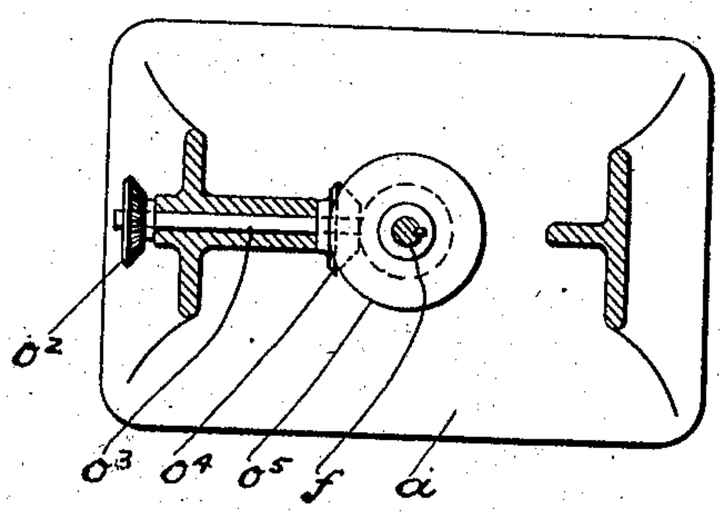
5 SHEETS—SHEET 2.

FIG. 4.

FIG. 5.



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5 SHEETS—SHEET 3.

FIG. 6.

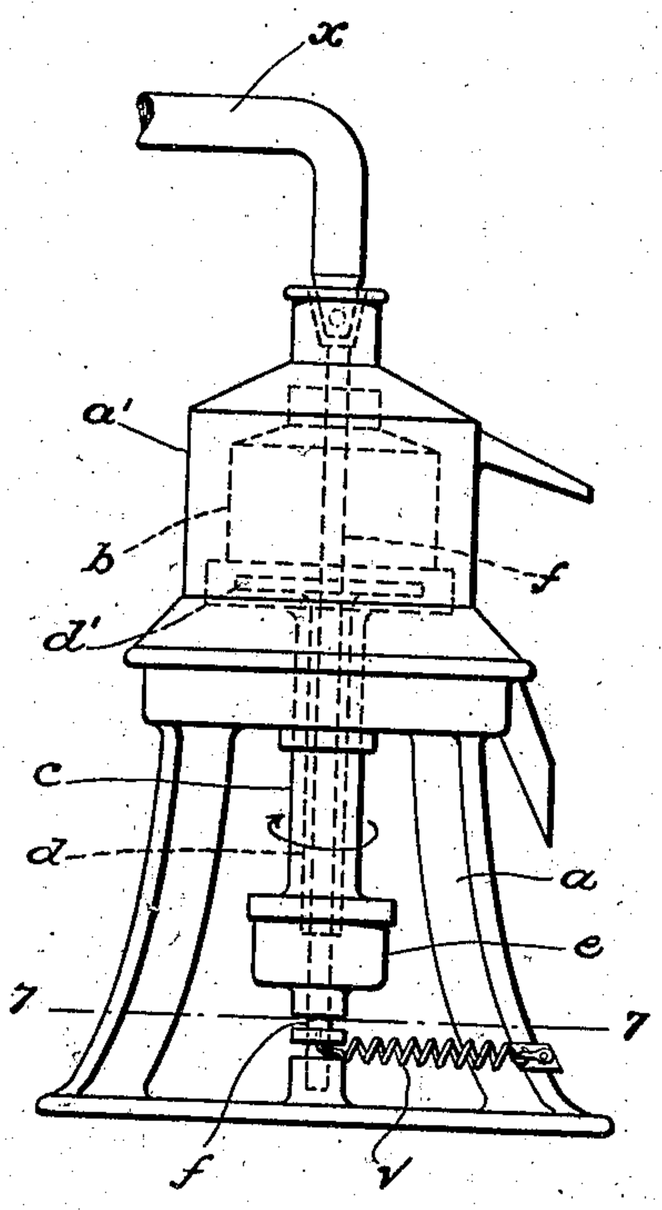
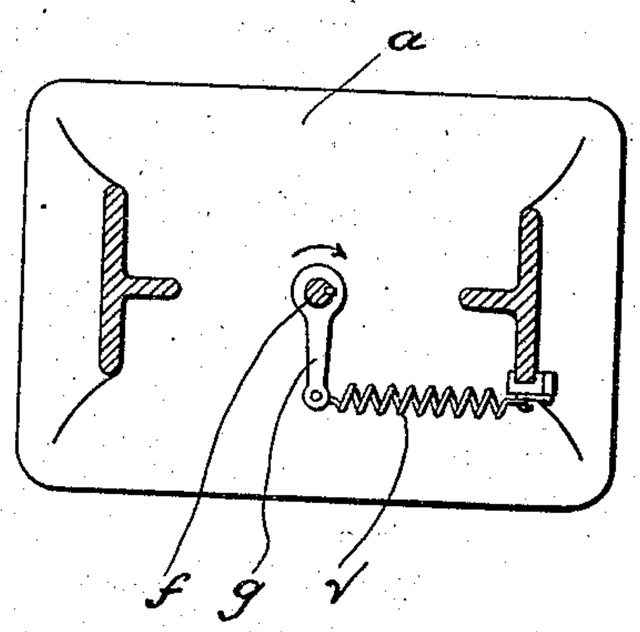


FIG. 7.



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5 SHEETS—SHEET 4.

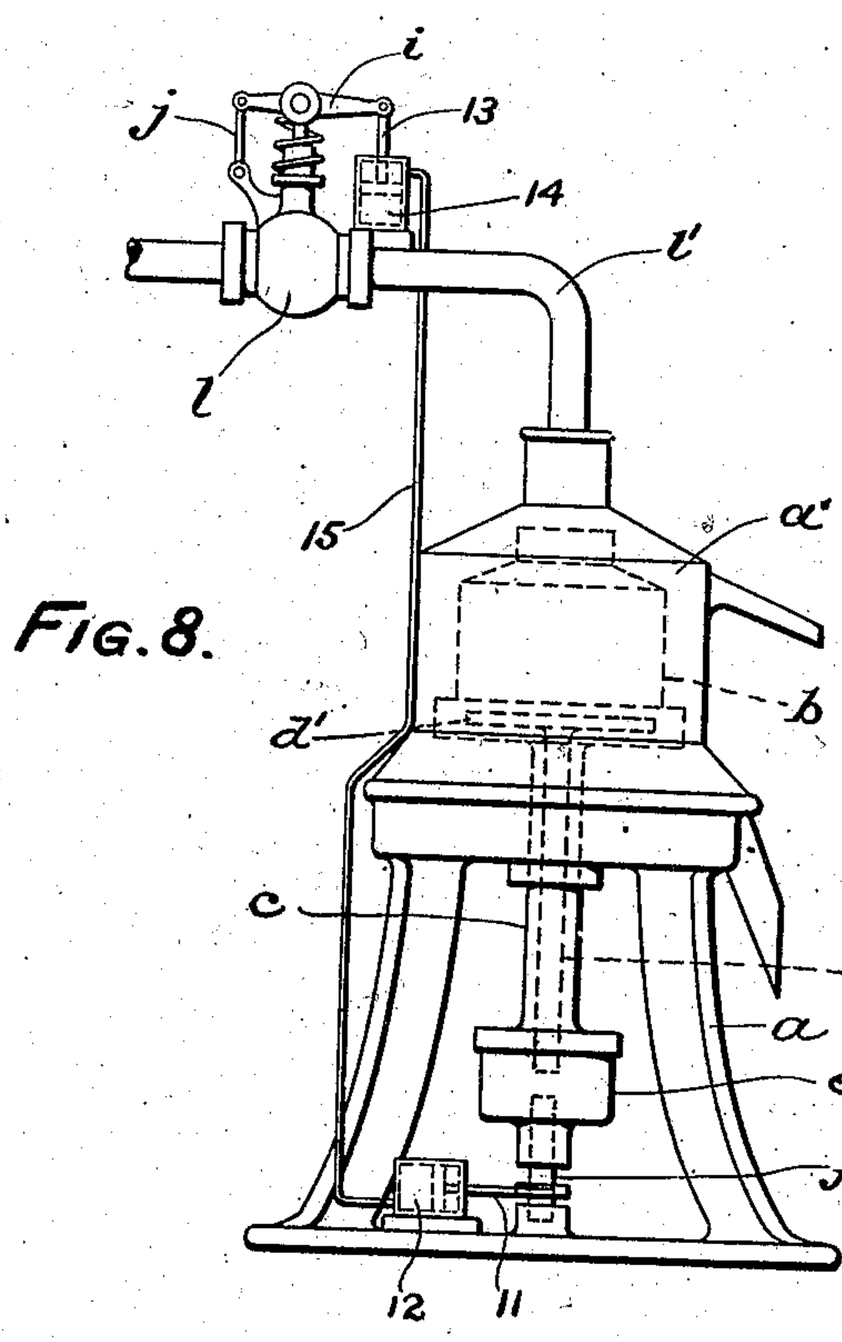

FIG. 8.

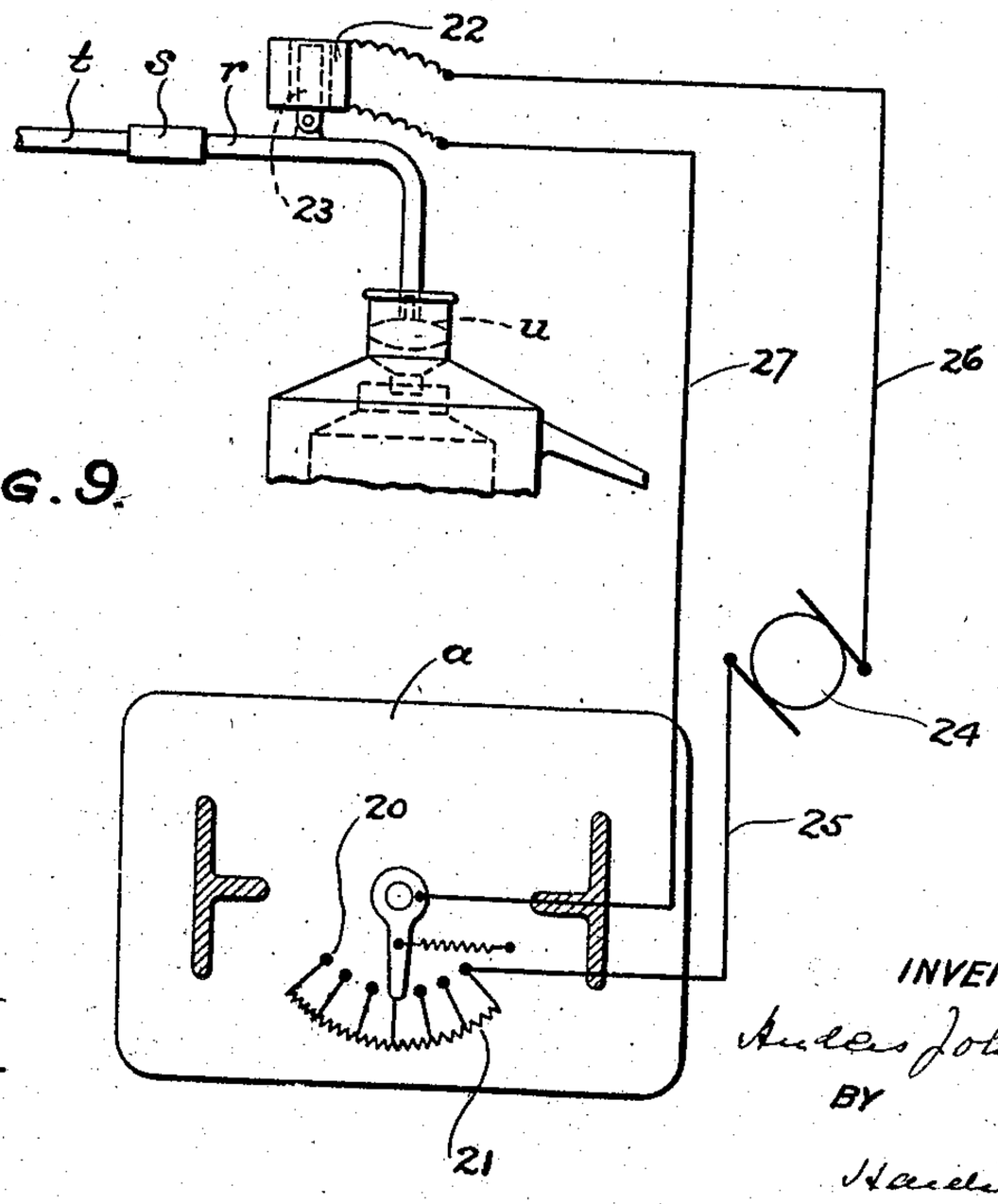

FIG. 9.

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5 SHEETS—SHEET 5.

FIG. 10.

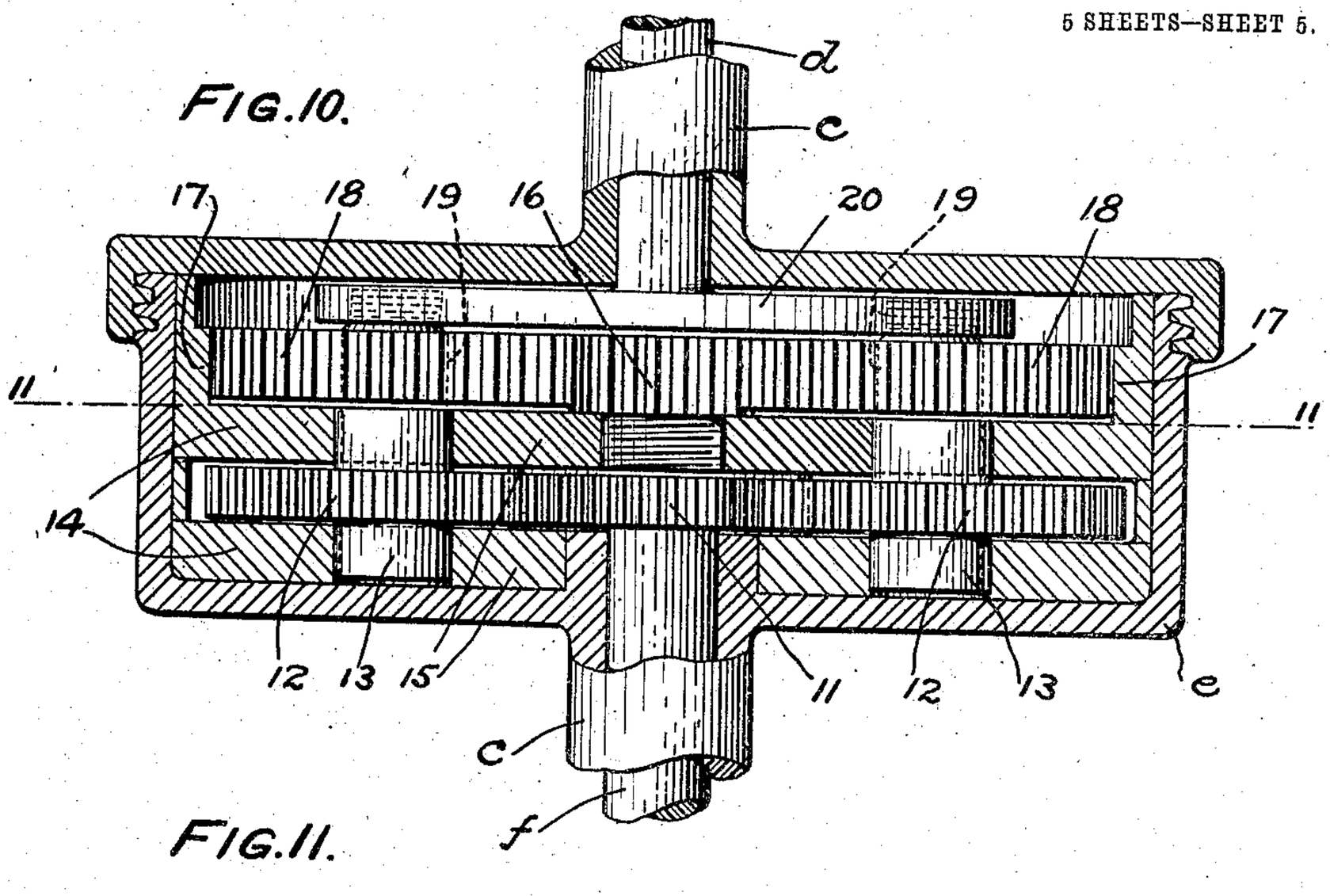
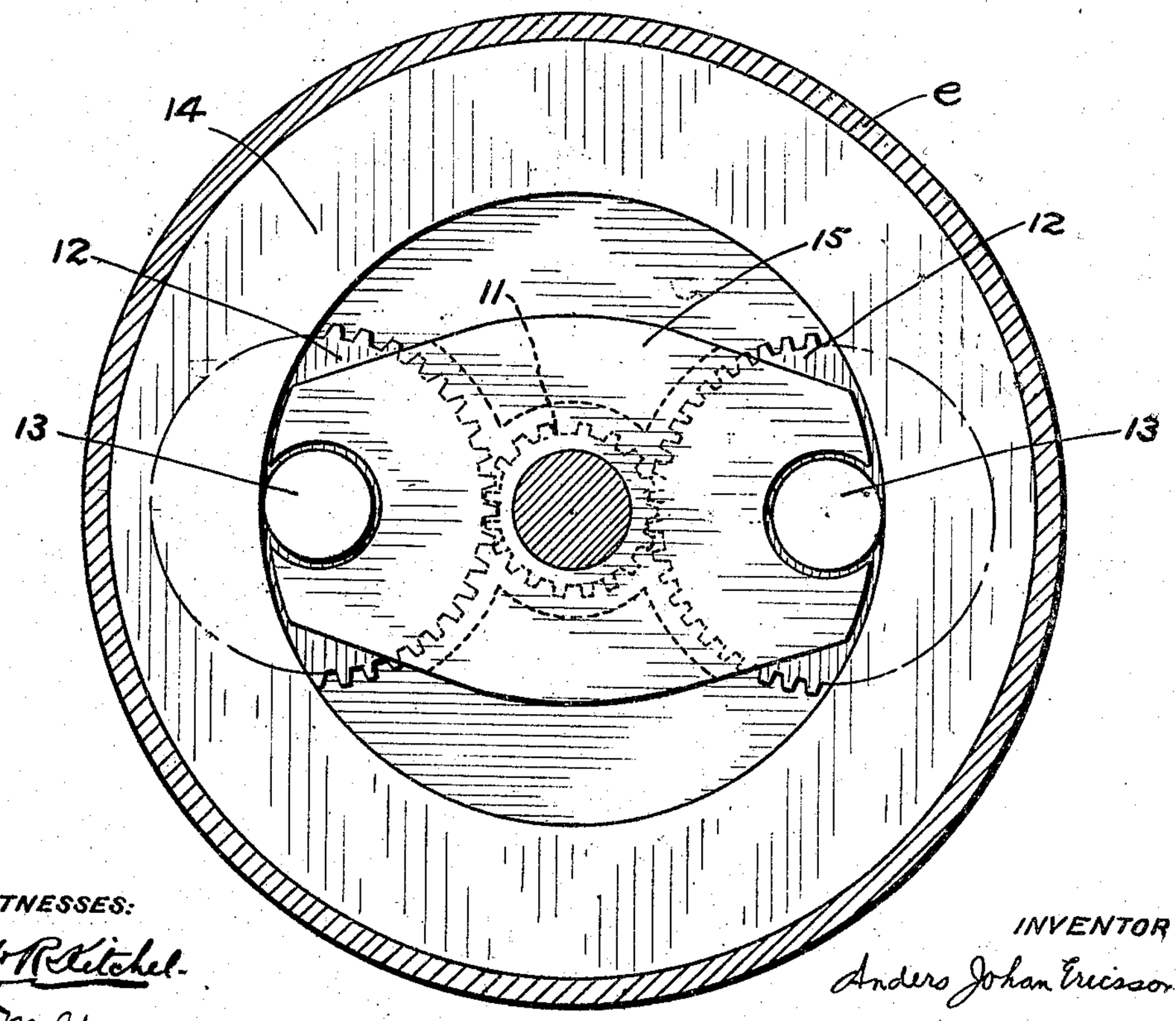


FIG. 11.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL MACHINE.

No. 911,652 Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed March 23, 1906. Serial No. 307,572.

To all whom it may concern:

Be it known that I, ANDERS JOHAN ERICSSON, a subject of the King of Sweden, residing at Stockholm, Sweden, have invented a new and useful Improvement in Centrifugal Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My present invention relates to improvements in centrifugal machines for separating solid matters from liquids and especially to separators of the class described in my United States Patent No. 773,489, and it more particularly relates to arrangements for the automatic regulation of the flow of the liquid compound into the centrifugal machine. In centrifugal machines of this kind there are two different shafts, one driving the centrifugal bowl at a certain speed and the other driving a mechanism inside the bowl at a different speed from that of the bowl. These two shafts receive their different speed by means of a gearing device such as that described in the patent of Birger Ljungstrom No. 845,103, dated February 26, 1907. In that patent a device is shown, in which one shaft has the shape of a box, in which cog-wheels roll with their naves on rolling surfaces, said cog-wheels gearing with a central, fixed cog-wheel. The naves of the cog-wheels are embraced by a cross-piece or the like, to the center of which a cog-wheel is secured, gearing with other cog-wheels, rolling upon a cog-ring, the naves of said cog-wheels being secured to a disk or the like. To the center of said disk the other shaft is secured. Briefly, between one shaft and a fixed gearing-wheel a series of wheels is placed, which, by the rotation of the shaft, gets a rotary motion, which, by means of other wheels, is imparted to the other shaft. In this way said shaft is connected with a fixed wheel by means of a gearing transmission, and on that account the reaction pressure which acts upon said fixed wheel to rotate it is (apart from the frictional losses) directly proportionate to the work which is performed inside the bowl by the mechanism for transporting the solids out of the bowl. Said pressure depends, in its turn, upon the quantity of solids which has stratified along the inner periphery of the bowl and which is to be transported outside the bowl. It is evident, that in this way there is a relation between the quantity of solids stratifying along the inner periphery of the bowl, and the reaction pressure acting upon the fixed wheel. On this fact the present invention is founded.

On carrying out my invention I arrange the shaft or spindle of the said fixed cog-wheel in such a manner that it can turn in a journal box. The turning motion of said part is, however, counteracted by a spring, weight, or in any other suitable way. The motion of the turning part is transmitted to a valve in the feed pipe or to some other suitable regulating device, said motion being transmitted in a mechanical way such as by means of a cord or cog-wheel-gearing, or in a pneumatic, hydraulic or electrical way.

The invention is illustrtaed on the annexed drawings, in which—

Figure 1 shows a centrifugal machine in elevation, in which the motion of the turning part is transmitted to a lever by means of a cord or a chain, said lever acting upon a valve or cock arranged in the feed pipe. Fig. 2 is a section on line 2—2 of Fig. 1. Fig. 3 is a detail elevation of a modified valve-operating device. Fig. 4 shows a centrifugal machine in elevation in which the motion of the turning part is transmitted to the regulating device by means of a cog-wheel gearing. Fig. 5 is a section on line 5—5 of Fig. 4. Fig. 6 shows a centrifugal machine in elevation, in which the turning part whose motion is transmitted to the regulating device extends through the centrifugal machine, said extension being at its upper end connected with a cock, arranged in the opening of the feed pipe. Fig. 7 is a section on line 7—7 of Fig. 6. Fig. 8 shows a centrifugal machine in elevation, in which the motion of the turning part is transmitted through the medium of an hydraulic arrangement. Fig. 9 shows a centrifugal machine in elevation, in which the motion of the turning part is transmitted through the medium of an electrical arrangement shown in diagram. Figs. 10 and 11 are respectively a vertical section and a horizontal section, of the gearing.

In Figs. 1 and 2 *a* is the frame of the centrifugal machine, *b* the centrifugal bowl, *a'* the bowl casing, and *c* the driving shaft. Inside the bowl there is a device *d'* for transporting the solids outside the bowl. A device of this character is shown in Letters Patent issued to me October 25th, 1904, No.

773,489, it not being herein shown in detail, as its particular construction forms no part of the present invention. Said device *d'* is driven from a shaft *d*, which is driven from the shaft *c*, at a speed different from that of the shaft *c*, by means of a gearing device, inclosed in the box *e*, and a shaft or spindle *f*.

The gearing device is shown in detail in Figs. 10 and 11. The shaft or spindle *f* is provided with a cog wheel 11 gearing into the cog wheels 12, which are provided with shafts 13 pressing against the rolling surfaces of the inner walls of the rings 14 secured to the box *e*. The shafts 13 are embraced by the cross-piece 15 rotatable around the axes of the shafts *c*, *d*, *f*. 16 is a pinion secured to the cross-piece 15. 17 is a circular cog-ring secured to the inner wall of the box *e*. Two cog-wheels 18 are placed between, and mesh with, the pinion 16 and cog-ring 17. The cog-wheels 18 rotate on shafts 19 that project from the disk 20 secured to the shaft *d*. This gearing device is constructed in accordance with the application of Ljungstrom hereinbefore referred to, but no particular construction of gearing device is essential to the present invention. From the spindle *f*, which is turnably arranged on the frame, an arm *g* projects, said arm being connected by means of a cord *h* with a lever *i*, which is secured to the spindle *k* of the valve or feed regulating device *l* on the feed pipe *l'* and pivotally supported on the valve by means of a link *j*. The spiral spring *m* acts to press the spindle *k* to its highest position. The device acts in the following manner.

Power is applied to the machine by means of a belt engaging the shaft *c* or box.

If a considerable quantity of solid matters should stratify along the inner periphery of the bowl, on account of too great a quantity of liquid compound being fed into the bowl, or on account of the liquid compound being too rich in solid matters, the shaft *d* will be loaded more than before. As said shaft is connected with the shaft *f*, this will be acted upon by the increased reaction pressure so as to turn a little. This turning motion is then transmitted by means of the cord *h* to the lever *i*, the front end of which will be pressed downwards, so that the cock *l* is more or less throttled. Thereby the flow of the liquid compound to the centrifugal machine will be restrained, and then the quantity of solids on the inner periphery of the bowl will also soon be reduced. As soon as the work of the transporting device inside the bowl is reduced, the load on the shaft *d* will also be reduced, whereby the reaction pressure on the spindle *f* decreases, so that the arm *g* on account of the tension of the spring *m* is turned to its normal position, whereby the cock *l* is fully opened again.

In Fig. 3 a modification is shown, in which the lever *i* is loaded by a weight *n* instead of a spring, said weight acting upon the lever to hold it in the position shown in the figure, whereby the valve is fully opened. When the spindle *f* is loaded more than normally, the weight *n* and the lever *i* will take the positions shown in dotted lines, whereby the cock is throttled.

In Figs. 4 and 5 another embodiment of my invention is illustrated. The box *e* is omitted and the spindle *f* is integral with the shaft *d*. By means of bevel gears o^5 and o^4, shaft o^3, and bevel gears o^2 and o', the shaft *f* is connected with the spindle *o*, which, by means of the spiral spring *p*, is normally held in a certain position. The spindle *o* is screw-threaded at its upper end, and this end of the spindle fits into a threaded shell *q* secured to the tube *r*. By means of a flexible tube *s* or in any other suitable way the said tube *r* is joined with the feed tube *t* for the liquid compound. The tube *r* opens on the float *u*. The arrangement acts in the following way: If the loading on the shaft *d* be increased on account of the increased resistance inside the bowl, the torsion of the spring *p* will be overcome and by means of the cog-wheel gearing the spindle *o* is turned more or less in the direction indicated by the arrow. The shell *q* will be lowered and then also the tube *r*, whereby the opening thereof is lowered against the float *u* and become more or less constricted. The flow of the liquid compound into the centrifugal machine will in this way be restrained and then the quantity of the separated solid matters reduced. When the work of the inner mechanism is reduced, the load of the shaft *d* is also reduced and then the spiral spring *p* turns the spindle *o* with the spindle *f* to their normal positions. The opening of the tube *r* is then again raised from the float and the flow of the liquid compound to the machine is increased. It is evident that the spiral *p* need not be arranged so as to act by means of its torsion, nor need it be arranged to act upon the spindle *o*, but can be otherwise arranged or connected to produce the same result.

In Figs. 6 and 7 another modified form is shown. As in Figs. 1 and 2, the shaft *d* is driven from a gearing device in a gearing-box *e* and connected with the spindle *f*, which is provided with a projecting arm *g*. In this embodiment said arm is connected with a fixed part on the frame by means of a spiral spring *v*. The spindle *f* passes through the whole machine, requiring the shaft *d* to be hollow, and at its upper end has an enlarged month, which surrounds the opening of the feed pipe *x*. When the inner transporting mechanism is overloaded, the shaft *d* will also be so. The reaction pressure on the spindle *f* will then be increased and the ten-

sion of the spring *v* will be overcome, whereby the spindle *f* will turn in the direction indicated by the arrow, thereby closing more or less the opening of the feed pipe *x*. As soon as the quantity of the separated solid matters becomes normal, the reaction pressure will be reduced and the spindle *f* will then turn to its normal position on account of the action of the spring *v*, thereby more fully opening the feed pipe *x*.

In all the foregoing embodiments the tension of the springs used may be varied in any suitable way, whereby the capacity of the centrifugal machine may be varied.

In Fig. 8 the machine is the same as in Fig. 1 with the exception of the regulating device itself which is pneumatic or hydraulic in character. Connected to arm *g* is the piston 11 of a cylinder 12. Connected to lever *i* is the piston 13 of a cylinder 14. 15 is a pipe connecting the two pistons. When the shaft *f* is acted upon by the increased reaction pressure to turn a little as before described, the arm *g* turns clockwise, and the piston 11 is moved and acts upon the liquid or die in the cylinder 12, pipe 15 and cylinder 14 to force the piston 13 downwardly, thereby through lever *i*, throttling the valve *l*.

In Fig. 9, I have shown the feed tube *t* connected, by means of a flexible tube *s*, with the tube *r* opening on the float *u*, precisely as in Fig. 4. The lower part of the machine is not shown, but it may be assumed to correspond to Fig. 1, in which the arm *g* is turned when the reaction pressure increases beyond the normal. The arm *g* in this modification forms a contact arm adapted in its movement to move over the contacts 20 of an electrical resistance 21. 22 is a solenoid and 24 a source of current supply, such as a dynamo. The first contact of the resistance is connected by conductor 25 with one pole of the dynamo, the other pole of the dynamo being connected by conductor 26 with one end of the solenoid 22. The other end of the solenoid is connected by conductor 27 with the pivoted end of arm *g*. The core 23 of the solenoid is connected to the pipe *r*. When the lever *g* is turned clockwise as before described, the arm *g* moves to cut in resistance, thereby weakening the solenoid 22 and permitting the pipe *r* to drop, thus decreasing the supply of liquid to the separator, as will be more fully understood by reference to the machine of Fig. 4.

It is evident that the arrangements for the automatic regulation of the flow of the liquid compound may be used in centrifugal drying separators and will work in the same manner as in centrifugal machines.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. In a centrifugal machine for separating liquids from solid matters, the combination with the bowl and a device for transporting solids outside the bowl, of a gearing device interposed between the bowl and the transporting device by which the bowl and transporting device are driven at different speeds, a shaft engaging the gearing device and adapted to turn on account of the reaction pressure from the transporting device, a device for regulating the feed of the liquid compound to the bowl, and means connecting the shaft and the feed regulating device by which the latter is operated.

2. In a centrifugal machine for separating liquids from solid matters, the combination with the bowl and a device for transporting solids outside the bowl, of a gearing device interposed between the bowl and the transporting device by which the bowl and transporting device are driven at different speeds, a shaft engaging the gearing device and adapted to turn on account of the reaction pressure from the transporting device, and a tension device tending to restrain said shaft from turning but permitting it to turn to an extent proportionate to said reaction pressure.

3. In a machine for separating liquids from solid matters, the combination with the bowl and a device for transporting the solids outside the bowl, of a shaft connected with the solids transporting device and adapted to turn on account of the reaction pressure therefrom, a feed pipe for conducting the liquid compound to the bowl, a device for regulating the feed from the pipe, and means connecting the shaft and the feed regulating device to cause the one to be operated by the other, whereby the feed of the liquid compound to the bowl is caused to vary with the variation of solids in the bowl, substantially as described.

4. In a machine for separating liquids from solid matters, the combination with the bowl and its driving shaft, of a device for transporting the solids outside the bowl and a driving shaft therefor, a third shaft, a gearing device engaging the third shaft and interposed between the two driving shafts to proportion their speeds, a feed pipe, for conducting the liquid compound to the bowl a device for regulating the feed from the pipe, and means connecting the third shaft and the regulating device whereby one is operated by the other to cause the feed to vary with the turning of the shaft.

5. In a machine for separating liquids from solid matters, the combination with the bowl and its driving shaft, of a device for transporting the solids outside the bowl and a driving shaft therefor, a third shaft, a gearing device engaging the third shaft and interposed between the two driving shafts to proportion their speeds, a feed pipe for conducting the liquid compound to the bowl, a

regulating valve thereon, a tension device normally holding said valve open, an arm on the third shaft, and means connected with the arm and adapted to be actuated by the arm to more or less close said valve against the action of the tension device.

In testimony of which invention, I have hereunto set my hand, at Stockholm, on this 27 day of February, 1906.

ANDERS JOHAN ERICSSON.

Witnesses:
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