PATENT SPECIFICATION

Application Date: Apr. 14, 1919. No. 9486/19.

Complete Left: July 30, 1919.

Complete Accepted: July 14, 1920.

146,642

PROVISIONAL SPECIFICATION.

Improved Means for Actuating Speed Indicating Devices and Governors from Rotating Shafts.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva," Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, Engineer, do hereby declare the nature of this invention to be as follows:—

The present invention relates to devices of the type which are described in my Patent Specification serial No. 130,367 as applied to speed indicating devices.

In the said patent specification the speed of rotation of a shaft is measured by the use of an open tube bent at one end immersed in a ring of liquid kept in position by centrifugal force in a vessel rotating from the shaft.

The present invention consists in means by which the depth of the liquid ring can be maintained constant independently of the quantity of liquid in the system.

The invention further consists in providing a secondary open bent tube the pressure branch of which is immersed in the liquid and arranged at a point nearer to the axis of the rotating shaft than the inlet of the principal open bent tube which transmits the pressure of the liquid.

The invention further consists in connecting the secondary tube to a small reservoir of liquid situated at a higher level than the rotor.

In carrying the invention into effect according to one example, the capacity of the rotor of the instrument should be such that when the instrument is at rest, the small reservoir should just be empty of liquid, the rotor being nearly half full. Any excess of liquid which may be put in the small reservoir when the rotor is at rest, would simply pour out of the bearings of the rotor. The capacity of the rotor should be on the other hand of such size that when the rotor is rotated and all the liquid is thrown into the form of a ring by the centrifugal force, the depth of the ring thus formed is sufficient to cover the inlets of both the principal and secondary tubes.

The action of the secondary tube is as follows:—As soon as the rotor is speeded up, the pressure created on the inlet of the secondary tube, forces the liquid to flow back into the small reservoir with which it is connected. This flow of liquid continues until all the liquid between the centre of rotation of the rotor and a circle passing through the inlet of the secondary tube is exhausted. The only liquid remaining in the instrument is therefore the liquid ring whose depth is limited by the inlet of the secondary tube.

It can be seen that in this way the quantity of liquid in the rotor is constant during the whole time it is rotating. At the same time there will be a reserve of liquid in the small reservoir which will compensate automatically any losses due to evaporation or otherwise in the instrument. It is obvious that if the depth of the liquid ring is not sufficient to cover the inlet of the secondary tube, the pressure at its inlet falls and liquid from the small reservoir flows by gravity into the rotor until the ring of liquid has reached a depth sufficient to cover the secondary tube inlet. A pressure is then created against the gravity of the liquid in the small reservoir and the flow due to gravity is stopped.

When the rotor is brought to rest, gravity asserts itself again on the liquid from the reservoir and the liquid flows back into the instrument, the reservoir remaining empty.

By this arrangement as long as there is any liquid left in the small reservoir when the rotor revolves the depth of the liquid ring in the rotor remains constant.

Price 4s 6d

The invariability of the depth of the liquid ring in the rotor is important when the instrument is used in conjunction with an ordinary pressure gauge, from the principal tube only the pressure branch being used. When the main tube is used with both its branches connected to a differential gauge as I have shown in my Specification serial No. 130,367, a variable depth of the liquid ring in the rotor does not cause a great variation of pressure on the gauge because the effect of the static centrifugal pressure in the rotor depends on the depth of the liquid ring, and is the same on both branches of the principal tube and therefore disappears in the differential gauge. But if only the pressure branch of the principal tube is used and is connected to an ordinary pressure gauge, the depth of the liquid ring has an important bearing on the readings on the pressure gauge because the pressure measured would be of two parts; the first part is the dynamic pressure due to the relative speed between the liquid and the tube at the inlet of the tube and is independent of the thickness of the liquid ring; the second part is the static pressure all over the liquid ring due to the centrifugal action and depends on the depth of the liquid ring.

The present invention has a very important application not only to the measurement of speed as described in my Specification serial No. 130,367, but owing to the fact that any loss or excess of liquid in the rotor is automatically compensated from a small reservoir, enables one to use the pressure of liquid created on the principal tube to actuate other apparatus than a pressure gauge. The pressure can be used to actuate a piston which works any other piece of apparatus, for example, a piston working as a governor for controlling the prime mover which drives the rotor.

I may use this invention, therefore, to govern the speed of steam turbines, hydraulic turbines, or any form of steam, hydraulic or internal combustion engine by simply using the pressure and flow of liquid from the main tube to actuate a piston or device governing the valves vanes, throttles, or any other part of a machine. This pressure can be used in high speed internal combustion engines to automatically actuate the sparking advance on the ignition like the magnetos of motor cars. At the same time the throttle can be controlled by the same pressure in order to prevent the engine exceeding a certain dangerous speed.

The invention can be applied also to measuring the difference of speed between two shafts. For this purpose one rotor instrument is fixed to one shaft and one to the other shaft. The pressure sides only of the principal tubes are retained in both instruments and are connected to a differential gauge. In this case the two secondary tubes from both instruments may be connected to a single compensating reservoir.

The two instruments may be used to act on a double acting piston supported by springs. The movements of this piston can be used to control one way or the other the relative speeds of the two shafts, and therefore this arrangement would be useful for keeping two prime movers at the same speed automatically.

In twin-engined aeroplanes, twin turbine steamers, or in electric stations to keep several alternators going at the same speed, the above simple arrangement can be employed to measure the speed, to govern the prime movers and to act as a synchronising device, all these functions being separate or even simultaneous. For example, if two turbines are driving independently say two electric alternators, each turbine would be provided with centrifugal apparatus above described. Each instrument may have for example complete a tube showing at a distance the speed of each machine on differential gauges as described in my Specification serial No. 130,367. Two secondary tubes as described in the present specification may be connected to the compensating reservoirs independent of each other or to a common reservoir. The pressure branches of the principal tubes from each instrument may be connected to a piston controlling the steam inlet to each turbine and therefore provide for the governing of each turbine to keep it at its proper speed. A branch from each of these pressure pipes from the principal tubes may go to a double acting piston supported by springs in a mean position. If the speeds of both turbines are equal, this double-acting piston being acted on by equal pressures on both sides would remain stationary. If the speeds of the turbines are a little different, the pressures being not equal, the double-acting piston will move one way or the other from its mean position and will therefore be suitable to act directly or as a relay to correct the speeds of the turbines in the opposite direction by a suitable connection to the steam valves of the turbines.

The above was given only as an example, but many other combinations are possible where it is necessary to synchronise a large number of machines. It is possible by coupling each machine with a "pilot" machine whose speed is taken as a standard to bring any number of machines in to synchronisation between themselves as would be the case in an electric generating station where a large number of turbines are driving independent electric machines.

Dated this 14th day of April, 1919.

MARKS & CLERK.

COMPLETE SPECIFICATION.

Improved Means for Actuating Speed Indicating Devices and Governors from Rotating Shafts.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva," Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to devices of the type which are described in my Patent Specification serial No. 130,367 as applied to speed indicating devices.

In the said patent specification the speed of rotation of a shaft is measured by the use of an open tube bent at one end which is immersed in a ring of liquid kept in position by centrifugal force in a vessel rotating with the shaft.

The present invention consists in means by which the depth of the liquid ring in apparatus of this type can be maintained constant independently of the quantity of liquid in the system.

The invention further consists in providing a secondary open bent tube which is immersed in the liquid and in a direction to receive pressure therefrom in operation and arranged at a point nearer to the axis of the rotating shaft than the inlet of the principal tube which transmits the pressure of the liquid.

The invention further consists in connecting the secondary tube to a small reservoir of liquid situated at a higher level than the rotor.

Referring to the accompanying drawings:—

Figure 1 is an axial section and

Figure 2 a section on the line 2—2, Figure 1, of a device constructed according to the invention.

Figure 3 is a diagrammatic view showing the operation of the apparatus.

Figure 4 is a part axial section, and

Figure 5 is a section on the line 9—9, Figure 4, of the apparatus constructed for direct attachment to a revolving shaft.

Figure 6 shows the apparatus employed for indicating the speed of two shafts and for governing the speed so that the shafts are kept rotating synchronously.

In the form of the invention shown in Figures 1, 2, and 3, the rotor *a*, formed of two cup-shaped pieces in which the liquid is contained, rotates on bearings *b*, being connected to a driven shaft in any suitable manner. The bearings are mounted on a shaft *c* having passages *d*, *e*, formed therein leading to the two bent tubes *f* *g*. The tube *f* is longer than the tube *g* as indicated in Figure 2. Ribs *h* may be provided in the circumference of the chamber containing liquid to decrease the relative slip between the liquid and the rotor. The longer tube *f* is connected by a tube *k* with a pressure gauge *l* while the shorter tube *g* is connected by a pipe *m* with a liquid reservoir *n*.

When the apparatus is at rest the liquid will remain in the lower part of the rotor *a* filling this rotor up to the level of the bearings and any excess will flow out through the bearings. On rotating the rotor the liquid will be carried round also and will take the form of a ring around the circumference of the rotor, and this ring will diminish in depth, the excess liquid being gradually forced through the pipe *m* into the reservoir *n*. Liquid will be continually forced into the reservoir *n* until the shorter end of the tube is just immersed in the liquid so that when the rotor is rotating, the liquid it contains will be in the form of a ring of constant depth. The pressure transmitted from the longer leg of the tube to the pressure gauge *l* through the pipe *k* will accordingly be registered, and the indication of the instrument will depend only on the velocity of the liquid.

The capacity of the rotor of the instrument should be such that when the instrument is at rest, the small reservoir should just be empty of liquid, the rotor being nearly half full. Any excess of liquid which may be put in the small reservoir when the rotor is at rest, would simply pour out of the bearings of the rotor. The capacity of the rotor should be on the other hand of such size that when the rotor is rotated and all the liquid is thrown into the form of a ring by the centrifugal force, the depth of the ring thus formed is sufficient to cover the inlet of both the principal and secondary tube.

It can be seen that in this way the quantity of liquid in the rotor *a* is constant during the whole time it is rotating. At the same time there will be a reserve of liquid in the small reservoir *n* which will compensate automatically any losses due to evaporation or otherwise in the instrument. It is obvious that if the depth of the liquid ring is not sufficient to cover the inlet of the secondary tube *g*, the pressure at its inlet falls and liquid from the small reservoir *n* flows by gravity into the rotor *a* until the ring of liquid has reached a depth sufficient to cover the secondary tube inlet. A pressure is then created against the gravity of the liquid in the small reservoir and the flow due to gravity is stopped.

When the rotor is brought to rest, gravity asserts itself again on the liquid from the reservoir and the liquid flows back into the instrument, the reservoir remaining empty.

By this arrangement as long as there is any liquid left in the small reservoir when the rotor revolves the depth of the liquid ring in the rotor remains constant.

The invariability of the depth of the liquid ring in the rotor is important when the instrument is used in conjunction with an ordinary pressure gauge, from the principal tube only the pressure branch being used. When the main tube is used with both its branches connected to a differential gauge, a variable depth of the liquid ring in the rotor does not cause a great variation of pressure on a differential gauge because the effect of the static centrifugal pressure in the rotor depends on the depth of the liquid ring and is the same on both branches of the principal Pitot tube and therefore disappears in the differential gauge. But if only the pressure branch of the principal tube is used and is connected to an ordinary pressure gauge, as shown in the figures, the depth of the liquid ring has an important bearing on the readings on the pressure gauge because the pressure measured would be of two parts; the first part is the dynamic pressure due to the relative speed between the liquid and the tube at the inlet of the tube and is independent of the thickness of the liquid ring; the second part is the static pressure all over the liquid ring due to the centrifugal action and depends on the depth of the liquid ring.

The present invention has a very important application owing to the fact that any loss or excess of liquid in the rotor is automatically compensated from a small reservoir, enables one to use the pressure of liquid created on the principal tube to actuate other apparatus than a pressure gauge.

In the form of the invention shown in Figures 4 and 5, the rotor *a* is mounted on a shaft 1 and the bent tubes are fixed to a stationary part 2 from which pipes 3, 4 are carried outwards, and in this instance the effect of rotation will be to create a circulation through any apparatus connected to the pipes 3 and 4. The bent tubes may be of large inside diameter and may be supported independently of the rotor on a fixed support and the rotor may be fixed on a driving shaft. In such an arrangement no internal bearings are required. The stator formed by the principal tube and secondary tube would have no moving parts. The rotor would simply revolve round the stator. The principal tube, whose pressure side only is retained, would act as the delivery and the secondary tube would act as the inlet. In the arrangement shown the inlet of the liquid would be under gravity.

The invention can be applied also to measuring the difference of speed between two shafts. For this purpose one rotor instrument is fixed to one shaft and one to the other shaft. The pressure sides only of the principal tubes are retained in both instruments and are connected to a differential gauge. In this case the two secondary tubes from both instruments may be connected to a single compensating reservoir.

The two instruments may be used to act on a double acting piston supported by springs. The movements of this piston can be used to control one way or the other the relative speeds of the two shafts, and therefore this arrangement would be useful for keeping two prime movers at the same speed automatically.

In twin-engined aeroplanes, twin turbine steamers or in electric stations to keep several alternators going at the same speed, the above simple arrangement can be employed to measure the speed, to govern the prime movers and to act as a synchronising device, all these functions being separate or even simultaneous. For example, if two turbines are driving independently say, two electric alternators, each turbine would be provided with centrifugal apparatus above described. Each instrument may show at a distance the speed of each machine on pressure gauges. Two secondary tubes as described in the present specification may be connected to the compensating reservoirs independent of each other or to a common reservoir. The principal tubes from each instrument may be connected to a piston controlling the steam inlet to each turbine and therefore provide for the governing of each turbine to keep it at its proper speed when running alone. A branch from each of these pressure pipes from the principal tubes may go to a double acting piston supported by springs in a mean position. If the speeds of both turbines are equal, this double-acting piston being acted on by equal pressures on both sides would remain stationary. If the speeds of the turbines are a little different, the pressures being not equal, the double-acting piston will move one way or the other from its mean position and will therefore be suitable to act directly or as a relay to correct the speeds of the turbines in the opposite direction by a suitable connection to the steam valves of the turbines.

Figure 6 shows the apparatus applied to twin engined aeroplanes for the purpose of actuating a differential gauge 11 indicating the difference between the speed of rotation of two shafts connected to separate rotors 12, 13. The shorter tubes inside the two rotors are connected to a common reservoir 14. The longer ends of the tubes in addition to being connected to the differential gauge 11 are connected to cylinders 15, 16 in which two connected pistons 17, 18 can reciprocate. These pistons form differential governors controlling the valve 19 by which the flow of air through two pipes 20, 21, leading to different carburettors is controlled. The longer tube from one instrument is also connected to a governing piston 22 controlling a throttle valve 24, while the longer tube of the other instrument is connected to the piston 25 controlling the throttle valve 26. The two instruments in this case, therefore, control a common differential governor and also maximum speed governors, one for each engine cylinder, and a differential gauge indicating the relative speeds of the two shafts.

The above was given only as an example, but many other combinations are possible where it is necessary to synchronise a large number of machines. It is possible by coupling each machine with a "pilot" machine whose speed is taken as a standard to bring any number of machines into synchronisation between themselves as would be the case in an electric generating station where a large number of turbines are driving independent electric machines.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. In apparatus comprising a hollow rotor and an open bent tube within the rotor adapted to produce a pressure difference corresponding to the circumferential velocity of the fluid within the rotor, means by which the radial depth of the liquid ring can be maintained constant independently of the quantity of liquid in the system, substantially as described.

2. In apparatus as claimed in Claim 1, a secondary tube which is immersed in the liquid and directed so as to receive pressure therefrom in operation, arranged at a point nearer to the axis of the rotating shaft than the inlet of the principal tube, substantially as described.

3. In apparatus as claimed in Claim 1, a small reservoir of liquid situated at a higher level than the rotor and connected to the secondary tube, substantially as described.

4. The improved apparatus for indicating and governing the speed of rotating shafts hereinbefore described and illustrated in the accompanying drawings.

Dated this 30th day of July, 1919.

MARKS & CLERK.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1920.

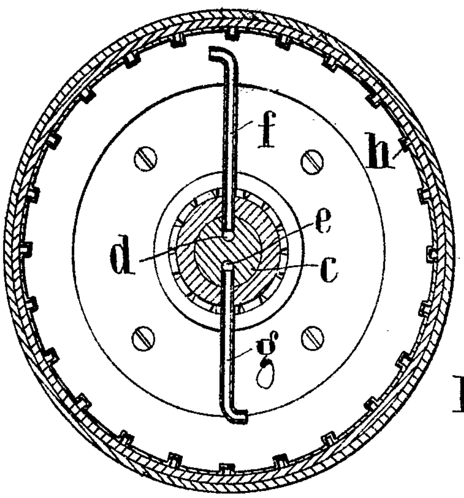


Fig. 2.

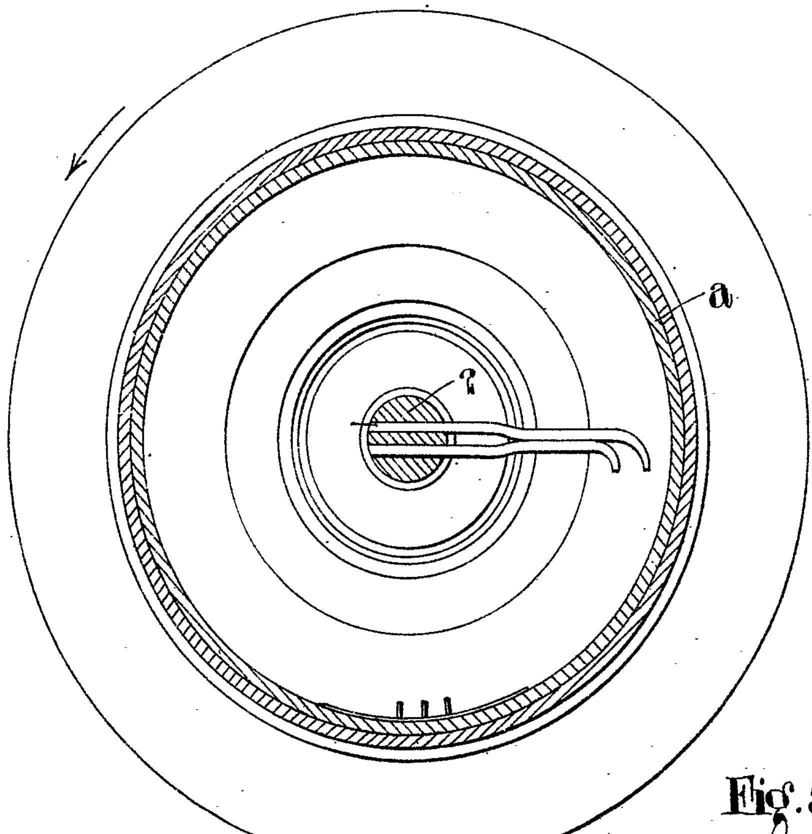


Fig. 5.

Malby & Sons, Photo-Litho

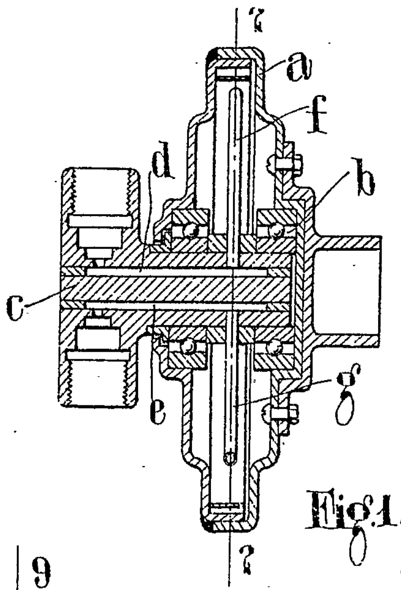


Fig. 1.

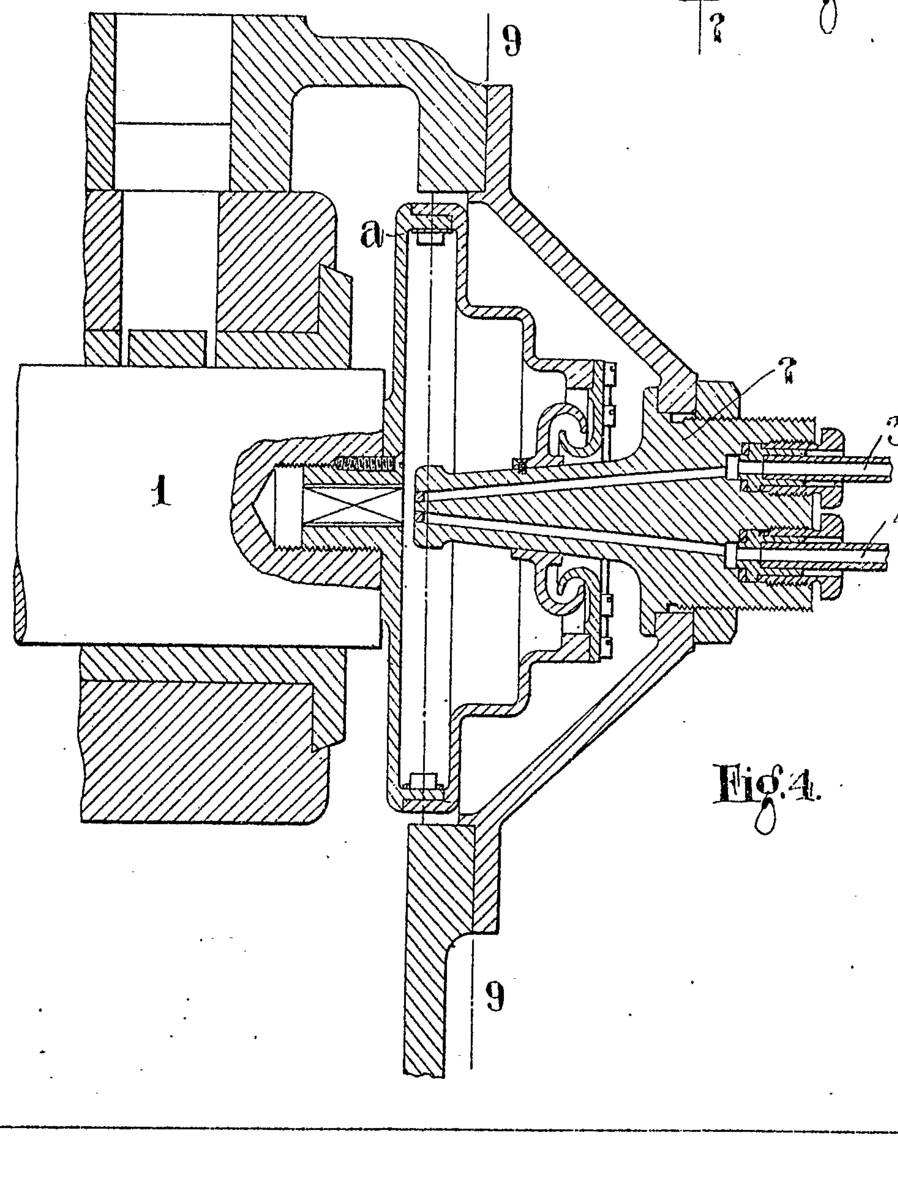


Fig. 4.

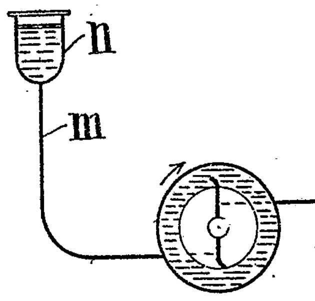
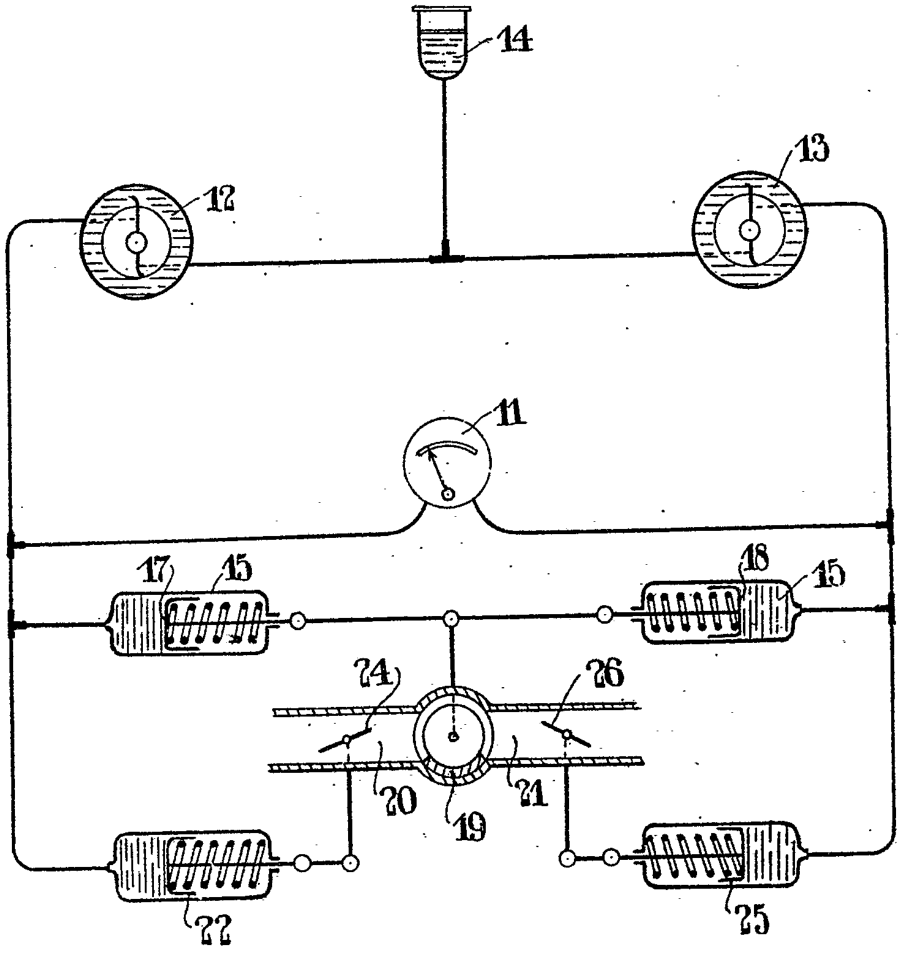


Fig.3.



Fig

Malby&Sons, Photo-Litho.