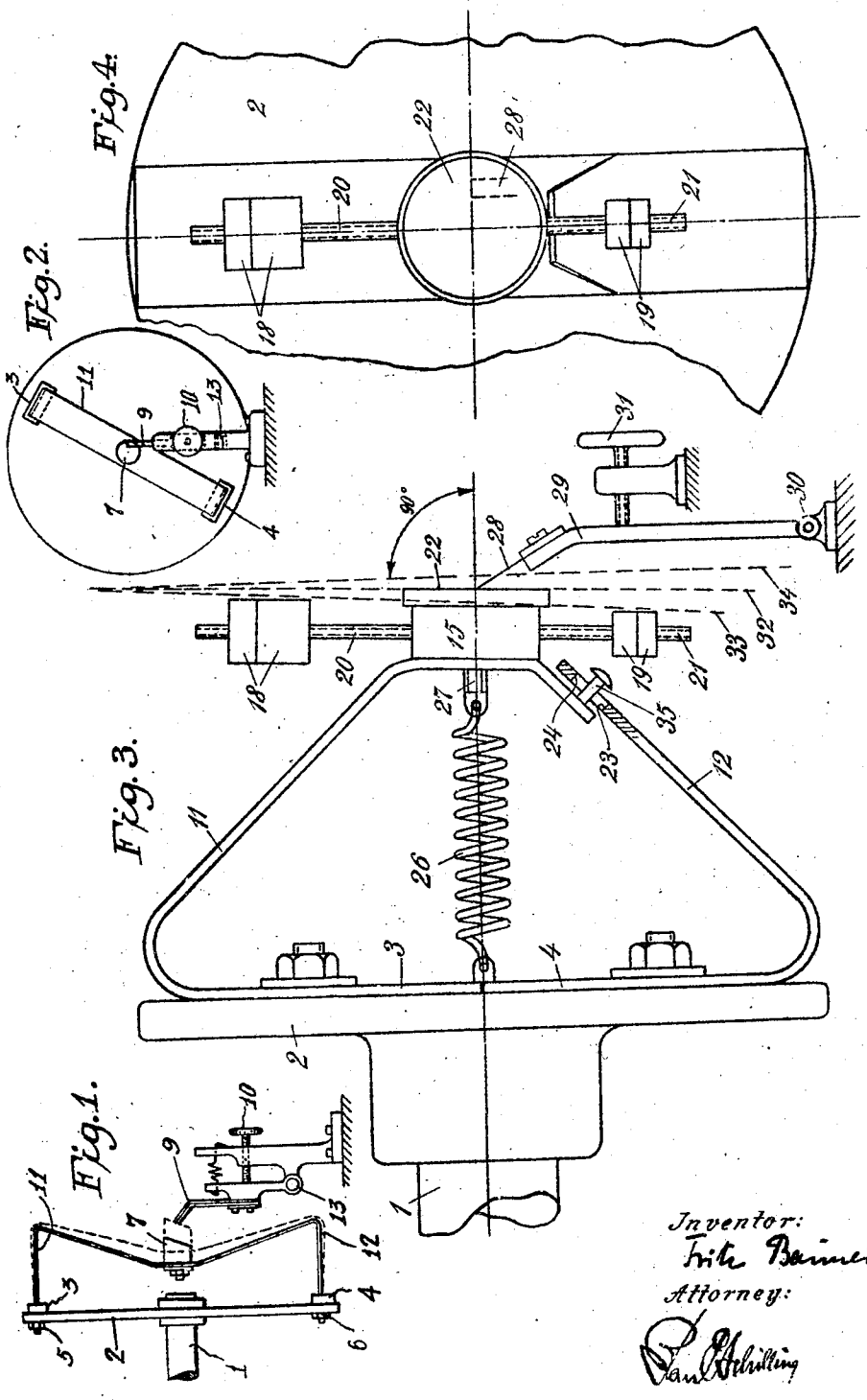
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F. BANNEITZ

SPEED REGULATING DEVICE

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SPEED-REGULATING DEVICE.

Application filed May 22, 1924. Serial No. 715,257.

To all whom it may concern:

Be it known that I, Dr. FRITZ BANNEITZ, a citizen of the German Republic, residing at Berlin-Charlottenburg, Soorstr. 89, Germany, have invented certain new and useful Improvements in Speed-Regulating Devices, of which the following is a specification.

This invention relates to speed regulating devices. Existing speed regulating devices usually fail when they are used for regulating the speed of high frequency machines, it being absolutely essential for the high frequency machines used in connection with wireless telegraphy that the speed of rotation should be as constant as possible and that the regulation should act quickly. The known speed regulating devices do not possess these properties, but with the device hereinafter described it is possible to fulfil the necessary conditions for the proper regulation of high frequency machines.

The speed regulating device according to the present invention comprises a resilient member which is arranged on a shaft driven by the machine whose speed is to be regulated, and is constructed in such a manner that the radial movement of a part of the member, produced by centrifugal force, produces in a positive manner an axial movement of another part of the said member. The said axial movement, which is therefore dependent on centrifugal force, can be utilized in a very simple manner for operating a contact device. By suitably dimensioning the resilient member it is possible to produce axial movements even under very slight changes of speed of the machine, the said axial movements being sufficient to give a very accurate speed regulation. Another important advantage of this invention consists in the fact that even very small axial movements of the resilient member (fractions of a millimeter for example) adequately influence the energy supplied to the driving machine. This result is obtained by giving a contact disc secured to the resilient member a slight inclination relatively to a plane at right angles to the axis of rotation. The stationary contact arranged opposite the said disc is set in such a manner that the disc comes into contact with the stationary contact once during each revolution, and at the correct speed of revolution remains in contact during half a revolution for example. Consequently the time during which contact is made is equal in this case to the time during which it is broken. If, owing to a slight increase in the speed of rotation, an axial movement of the contact disc is produced in the direction towards the stationary contact, contact will be made somewhat earlier and opened somewhat later and the duration of contact during one revolution will thus be increased. If for instance the time during which contact is made amounts to three quarters of a revolution and the time during which it is broken amounts to one quarter of a revolution, the energy supplied to the driving machine will be weakened in the same ratio. The opposite effects take place when the speed of the machine drops, the rotating contact disc then moving away from the stationary contact. If this contact device controls a current of 100 m. a., an axial movement of the resilient member to the extent of a fraction of a millimeter will be sufficient to influence this control current between zero and its full value. With the said pulsating control current it is then possible by means of well known devices, to regulate in a simple and perfect manner, for instance by means of intermediate relays, thermionic tubes or exciting machines, the energy supplied to the driving machine within very wide limits, even between idle running and full load.

According to another mode of construction the invention relates to speed regulating devices particularly for high frequency machines which, if they are to be successfully used for wireless telegraphy, must have their frequency maintained sufficiently constant. It is well known that the higher the frequencies to be produced by such machines the more perfect must be the constancy of the frequency or of the speed of rotation of the rotor of the machine. The speed regulating devices already known give moderately satisfactory accuracy in the case of low frequencies but for higher frequencies it has not been heretofore found possible to devise speed regulators that would answer all the requirements. The present invention provides a device which becomes operative even in the case of exceedingly slight deviations from the normal number of revolutions and brings about immediate regulating.

The aforesaid mode of construction represents a development and improvement of

the well known regulating devices and results in the possibility of securing a highly sensitive setting for the desired speed of revolution by means of sliding weights and of an adjustable spring. It is possible to vary the setting between the stable state and the unstable state. This facility of varying the sensitiveness is due to the fact that the centre of gravity of the mass exposed to the action of centrifugal force can, according to the present invention, be brought to a given distance from the axis of rotation by adjusting weights.

Another feature of the invention is that the mass is supported by a resilient and rotating bracket and that, owing more particularly to such an arrangement, all rubbing parts such as links and sleeves, are eliminated, so that the adjustment or setting takes place entirely without friction. A helical spring assisting the spring force of the bracket and utilized at the same time for fine adjustment or setting of the device, is mounted on the axis of rotation so that it is not affected by centrifugal force.

Another feature of this device is that a concentrically arranged contact plate is secured to the resilient bracket with a slight inclination relatively to a plane at right angles to the axis of rotation, so that when the bracket swings out under the action of centrifugal force, the said contact plate comes nearer to, or farther away from, a stationary contact arranged opposite it, and moreover its inclination relatively to the said plane is reduced. If the end or limit position of the contact plate corresponding to the lowest number of revolutions is assumed to be such that contact is maintained only for a very short portion of each revolution (for example one tenth of a revolution) and the other end position corresponding to the highest number of revolutions to be such that contact is maintained for practically the whole revolution, it will be obvious that within the said limits the control will be available during the greatest fluctuations of the load and of the current, more particularly if it is considered that between the end or limit values, a lift or movement of $\frac{1}{10}$ mm. is sufficient, and such a movement can be set without difficulty for a change of 0.01% in the number of revolutions. As contact is made once per revolution and as there is consequently one rush of current of a given duration (corresponding to the speed of revolution at the time), the regulation of the machine will be rapid.

In order that the said invention may be clearly understood and readily carried into effect, the same will be more fully described, with reference to the accompanying drawings, in which:—

Figures 1 and 2 are respectively a side elevation and a face view showing diagrammatically a device in accordance with this invention.

Fig. 3 is a side elevation showing diagrammatically another form of regulating device according to this invention and

Fig. 4 is a part face view of Figure 3.

To the shaft 1 driven by the machine whose speed is to be regulated is secured a disc 2. The resilient member 11, 12, in this case an M-shaped bracket of suitable elastic material, is rigidly secured to the disc 2 by means of bosses 3 and 4 and studs 5 and 6. In the centre of this bracket is mounted the contact disc 7 the outer and flat surface 8 of which is slightly inclined with respect to a plane at right angles to the axis of rotation of the said bracket. In Figure 1 this inclination is drawn in an exaggerated manner. A spring contact 9 is secured in such a manner that its end can be moved towards and away from the contact disc 7 by means of the set screw 10. The spring 9 is offset relatively to the centre of the contact disc 7 as shown in Figure 2. The position of the resilient bracket shown in full lines in Figure 1 corresponds to the position of rest of the shaft 1.

If the shaft 1 is rotated, centrifugal force will act chiefly on the parts 11 and 12 of the resilient bracket and force them outwards. The portion of the bracket carrying the contact disc 7, situated between the parts 11 and 12, will be forced towards the stationary contact 9 by the outward radial movement of the bracket parts 11 and 12. When the normal speed of revolution is reached, the shape of the bracket will be somewhat as shown dotted in Figure 1, that is to say contact will occur between the contact surface 8 of the disc 7 and the stationary contact 9. By giving the resilient bracket a suitable shape, it is possible to obtain a favorable ratio between the radial movement of the parts 11 and 12 and the axial movement of the contact disc 7. In a construction similar to the example illustrated, the radial movement of the parts 11 and 12 amounted to 2 mm., whilst the axial movement of the contact disc 7 amounted to 6 mm.

In the position shown dotted in Figure 1, that is to say when the speed of revolution is normal, contact between 8 and 9 will be made during half of each revolution owing to the inclination of the contact disc 7. If at a somewhat higher speed the contact disc 7 is moved a little further towards the stationary contact 9, the time during which contact is made during each revolution will be increased. By changing the inclination of the contact disc 7 the sensitiveness of this regulation can be brought to the desired degree. By moving the spring contact 9, it is possible in a simple manner to set the speed to a given value or to alter it to a given extent, without its being necessary to

stop the machine. This is particularly important in the case of high frequency machines where during the working it is necessary to provide an exact setting to give the desired frequency, or where the frequency has to be altered to a given extent. Another advantage of this arrangement consists in the possibility of examining and cleaning the contacts during working.

Instead of the resilient member being in the form of an M-shaped bracket as above described, other shapes could be adopted. In some cases it will be preferable to make the resilient member as a figure of revolution having a sectional shape corresponding substantially with the shape of the aforesaid bracket. The pulsating current produced by the device according to this invention can be used in various ways for influencing the driving machine. As a rule, the field of the driving motor will be influenced—if it is a direct current motor—by means of intermediate relays, thermionic tubes or special devices. In the case of an alternating current motor, both the motor current and the stator current could be influenced in a well known manner.

Sometimes instead of employing the above described rubbing contact arrangement it will be found more advantageous to operate a pressure contact by means of a lever, sliding spring or roller actuated by the inclined face 8. Also instead of mounting the resilient member on the free end of the shaft 1, it may be advantageous to mount the regulating device separately either at one or at both sides. In this way the contact surface would have a sufficient eccentricity in view of unavoidable inaccuracies in the construction of the resilient member, so that it is then unnecessary to bevel or incline the contact surface 8 in order to obtain the pulsating regulating current. Instead of the contact 9 being made adjustable about the pivot 13, an axial adjusting movement of this contact could be provided for by mounting it in a guide.

In the mode of construction shown in Figs. 3 and 4 to the shaft 1 to be regulated is secured a disc 2 to which is attached the resilient bracket 3, 4. To the end of the said bracket is secured a concentric mass 15 which is provided with additional weights 18 and 19 sliding on radial rods 20 and 21. The contact plate 22 is mounted on the mass 15. The extension 11 of one arm 3 of the bracket serves in conjunction with the extension 12 of the other arm 4 of the bracket, to provide the two outermost limits of movement, for example by a pin 35 and stops 23, 24. There is no contact or friction between the two extensions of the arms of the bracket, and the stop 24 is used merely to protect the apparatus against overload. The helical spring 26 which, together with the spring action of the bracket, acts in opposition to centrifugal force, can be set to a given tension by means of the screw 27. The spring contact 28 is mounted on a lever 29 which can be moved about the fixed pivotal point 30 by means of the set-screw 31 and thus brought to a given position relatively to the contact plate 22. It will be seen from Figure 4 that the contact 28 is offset with respect to the axis of rotation.

The dotted line 32 indicates the inclination of the contact plate in the central position of the parts, whilst the line 33 indicates the inclination when the pin 35 on the extension 11 is in engagement with the stop 23. When at the highest speed of revolution the pin bears against the stop 24, the plane of the contact surface will lie in a plane at right angles to the axis of rotation as represented by the dotted line 34.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a speed regulating device of the character set forth, a rotatable resilient member provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member, and an element co-operating with said surface to coact therewith in accordance with the position of said surface, the axial movement of which is effected by the deformation of said resilient member by the action of centrifugal force.

2. In a speed regulating device, a rotatable resilient member, a contact plate carried by said member and provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member to close a circuit therethrough in accordance with the position of said surface, the axial movement of which is effected by the deformation of said resilient member by the action of centrifugal force.

3. In a speed regulating device, a rotatable resilient member, a contact plate carried by said member and provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member, and a stationary contact element, off-set with respect to the axis of rotation, co-operating with said surface to close a circuit therethrough in accordance with the position of said surface, the axial movement of which is effected by the deformation of said resilient member by the action of centrifugal force.

4. In a speed regulating device, a rotatable resilient member provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member, a member co-operating with said surface, and means for adjusting the latter member.

5. In a speed regulating device, a rotatable support, a resilient bracket of M-shape

thereon provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said bracket, and an element co-operating with said surface to close a circuit therethrough in accordance with the position of said surface, the axial movement of which is effected by the deformation of said resilient bracket by the action of centrifugal force.

6. In a speed regulating device, a rotatable resilient member provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member, and an element co-operating with said surface to close a circuit therethrough in accordance with the position of said inclined surface, the axial movement of which is effected by the deformation of said resilient member by the action of centrifugal force, and means for adjusting said element toward or from said inclined surface of the resilient member.

7. In a speed regulating device, a rotatable resilient member, a mass exposed to the action of centrifugal force mounted on said member, means whereby the center of gravity of this mass can be set at variable distances from the axis of rotation of said member, and means whereby the speed regulation is controlled by the deformation of said resilient member during rotation.

8. In a speed regulating device, a rotatable resilient member provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member, a mass exposed to the action of centrifugal force mounted on said member, means whereby the center of gravity of this mass can be set at varying distances from the axis of rotation of said member, and an element co-operating with said surface to effect the speed regulation of said member in accordance with the angular position of said surface which varies with the degree of deformation of said resilient member under the action of centrifugal force on said mass.

9. In a speed regulating device, a rotatable resilient member, a contact plate carried by said member and provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member, a mass exposed to the action of centrifugal force mounted on said member, means whereby the center of gravity of this mass can be set at any desired distance from the axis of rotation of said member, and a stationary contact element co-operating with said surface to effect the speed regulation of said member in accordance with the angular position of said surface, which varies with the deformation of said resilient member under the action of centrifugal force on said mass.

10. In a speed regulating device, a rotatable resilient member, a contact plate carried by said member and provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said member, radial rods carried by said member, adjustable weights mounted on said rods, and a stationary contact element co-operating with said surface to effect the speed regulation of said member in accordance with the deformation of said resilient member under the action of centrifugal force on said mass.

11. In a speed regulating device, a rotatable member, an element of resilient nature attached to said member at a point spaced a distance from the axis of rotation of said member and bent with its free end in coincidence with this axis of rotation spaced a distance from said member, a mass mounted on the free end of said resilient element, a contact member on said mass and provided with a surface inclined with respect to a plane at right angles to the axis of rotation of said rotatable member, supports on said mass, weights adjustably mounted on said supports, and a stationary contact member co-operating with said inclined surface.

12. In a speed regulating device, in combination with a driven member, a resilient member fixed on said driven member and presenting a surface inclined relative to a plane extending at right angles to the axis of rotation of said resilient member, and an element cooperating with said inclined surface to close a circuit therethrough for controlling the rotary speed of the driven member in accordance with changes in the position of said inclined surface relative to said co-operating element, the axial displacement of said inclined surface being effected by the deformation of said resilient member under centrifugal stress.

In testimony whereof I have affixed my signature.

DR. FRITZ BANNEITZ.