April 3, 1928.

1,664,874

G. CONSTANTINESCO

UNIDIRECTIONAL DRIVING DEVICE

Filed March 17, 1927

Fig. 1.

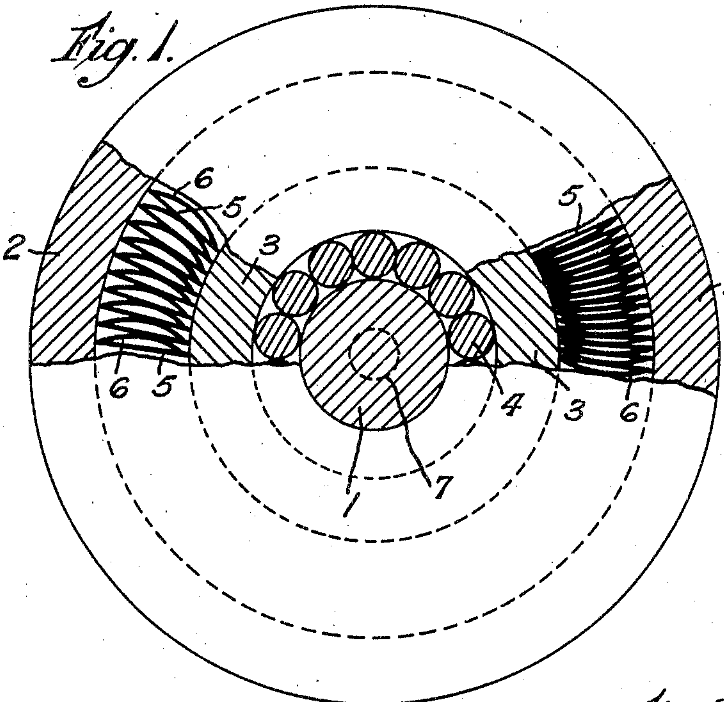


Fig. 2.

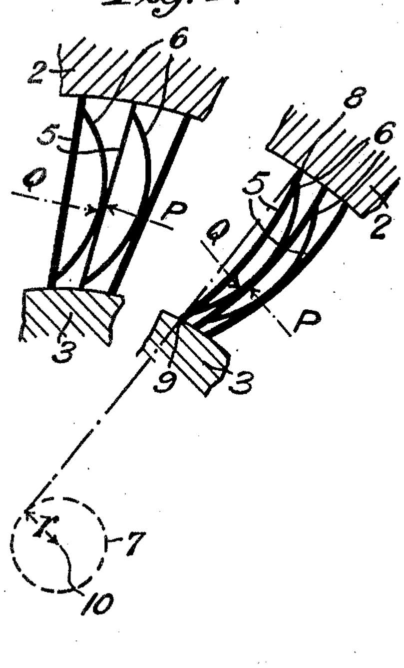
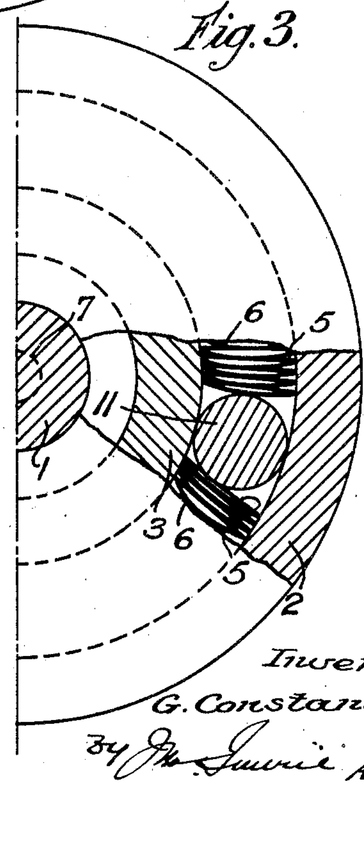


Fig. 3.



Inventor.
G. Constantinesco
By [signature] Atty.

Patented Apr. 3, 1928. 1,664,874

UNITED STATES PATENT OFFICE.

GEORGE CONSTANTINESCO, OF WEYBRIDGE, ENGLAND.

UNIDIRECTIONAL DRIVING DEVICE.

Application filed March 17, 1927, Serial No. 176,163, and in Great Britain September 1, 1926.

This invention relates to unidirectional driving devices which permit relative motion in one direction of rotation between a rotor and an oscillator and drive in the opposite direction.

The invention consists in the interposition between a rotor and an oscillator of a pack of approximately radially disposed couples of slightly curved hard metal blades, one of the blades in a couple being wider than the distance between rotor and oscillator gripping surfaces, and the other blade in the couple being narrower than this distance.

The invention further consists in making the wider blade almost plane or very slightly curved when free while the narrower blade has a substantial curvature when free, in such a way that when a large series of adjacent couples are fairly closely crowded together in the annular space between the oscillator and rotor, the wider elements are themselves curved while the curvature of the narrower elements is reduced, with the final result that all blades are slightly curved in the same direction, the chords of each curved blade making with the radius of the oscillator a certain angle less than the angle of friction, for example, for hard steel surfaces an inclination of about ten to twenty per cent. The width of the wider blade will in this case be about one per cent greater than the width of the gap between the oscillator and rotor gripping surfaces.

The oscillator and rotor must be concentrically maintained by suitable means, for example, by mounting the oscillator on a plain or roller bearing concentrically supported on the same shaft on which the rotor is keyed. Another alternative is to interpose a few large rollers in the pack of blades, between the oscillator and the rotor, this latter method being the less satisfactory in case of very high frequency of oscillations.

In the accompanying drawings, Figure 1 shows one embodiment, Figure 2 is a diagram illustrating the principle of the invention, and Figure 3 shows a second embodiment.

In Figure 1, which is a cross section, 1 is the driven shaft on which is keyed a hollow rotor 2 by means which it is not necessary to show. 3 is a cylindrical body supported by means of rollers 4 upon the shaft 1 and oscillated by any suitable means not shown, such, for example, as the mechanism described in my patent specification No. 1,542,-668. The function of the rollers 4 is partly to reduce friction and partly to keep the rotor and oscillator concentric. A space is left between the oscillator and the rotor and in this space are placed closely crowded together a number of pairs of elastic plates or blades, each pair consisting of a normally flat member 5 and a normally curved member 6. For clearness some of these blades only are shown. The width of the members 5 is slightly greater than the distance between the rotor and oscillator measured radially, and the chord of the curve of the members 6 is slightly less than this distance. The pairs of plates or blades are placed so that the curved member of each pair is in contact with the normally flat member of the next pair. On the left hand side of Figure 1 the blades are shown before they are closely crowded; they are shown after close crowding on the right hand side. This latter is their operative state, in which condition the normally flat blades 5 are slightly bent, their chordal width, however, being still somewhat greater than the distance between the stator and the rotor. Their chords are all slightly inclined to radial planes through the apparatus, and all touch a small imaginary circle shown at 7 in dotted lines. In the example shown the oscillator may have a diameter of 100 m/m. the inner diameter of the rotor being 150 m/m. The metal used is hard steel carefully ground so as to produce two concentric gripping surfaces.

The thickness of the blades is, say, 0.7 m/m. to 1.5 m/m. if made of very good quality spring steel possessing a high elastic limit. The width of the driving blades 5 should be 25.25 m/m. to 25.50 m/m., and the spring blades 6 about 24.8 m/m. It is essential that the spring blades shall be a little narrower than the gap between the oscillator and the rotor, otherwise the distribution of forces inside the pack is upset. For a width of the blades of about 20 millimetres, the mechanism illustrated will be capable of transmitting safely in the driving direction a tangential force acting on the oscillator of one thousand kilograms, while in the free direction the tangential force will be only about 10 kilograms.

The working of the apparatus is as follows:—

The packing of the couples of blades 5

and 6 so that they are all slightly curved produces a peculiar distribution of internal forces inside the pack, the result of which is that each wide blade is maintained automatically in contact with the surfaces of the rotor 2 and oscillator 3 respectively. It can be proved that each wide blade is subjected to a tilting torque in the correct direction for maintaining it in contact with the two cylindrical gripping surfaces. The wide blades being inclined to the cylindrical surfaces, any relative rotation between the oscillator 3 and the rotor 1 in the direction of inclination will be quite free to take pla ·, the only tangential force on the oscillator being produced by the aforesaid frictional contact between the long b' des and the cylindrical surfaces.

Any attempt to rotate the oscillator relatively to the rotor in the opposite direction will be resisted by the long blades which will grip immediately. A force will be produced along the chord of each long blade, this force being eccentric to the common axis of rotation. This force, which produces the drive between the oscillator and the rotor through the slightly curved wide blades will increase still further the curvature of these blades, thereby storing elastic potential energy which is released afterwards on the next reverse movement of the oscillator. This property of the wide blades, hereinafter called the driving blades, to bend under load is very important, as the consequence of this bending is an automatic adjustment for the distribution of the load between the various driving blades if their widths are not identical due to inaccuracy in manufacture which is almost inevitable.

The next very important consequence of this property of bending under load of the driving blades is that if the driving torque between oscillator and rotor be excessive, the chords of the driving blades will shorten elastically until a certain point is reached when suddenly all of them reverse their inclination to the oscillator and rotor, the whole system being now ready to work, but in the reverse direction. This provides a very simple means for reversing the direction of rotation of such a device by merely holding the rotor stationary while the oscillator is forced to rotate relatively to the rotor in the driving direction until all the driving blades have been bent sufficiently to change their inclination from one direction to the reverse direction.

With hard steel blades the thickness of the blades must not exceed about one twentieth to one tenth of their length. The spring blades 6 should also be about half the thickness of the driving blades 5, as more particularly illustrated in Figure 2.

This device is capable of converting oscillatory motions of the oscillator of several hundreds of periods per second into practically continuous rotation in one or the other direction of the rotor.

The chief advantage over other known forms of unidirectional driving mechanisms is that it is impossible to overload. Overloading simply throws the mechanism in the reverse without any damage to any parts.

A slight inaccuracy in the width of the driving blades will be automatically compensated by their capacity to bend more or less relatively to one another. The pack of blades could be crowded almost to the point when the tips on the oscillator are nearly touching—a small working clearance, however, being necessary.

Figure 2 shows in a diagrammatic form on the left hand the blades in two couples before crowding. On the right side of the figure the same couples are shown after crowding, showing how the driving blades are automatically bent to their proper form for working. The forces Q P at the point of contact between each spring blade and the driving blade produce by their reactions on the driving blade a small tilting torque maintaining the blade in contact at each end with the rotor, and with the oscillator. These pressures of contact are sufficient to enable the blade to grip on the driving stroke.

If we consider, for example, any one of the driving blades in its working condition, the driving force passes through the points 8 9 along the chord and passes at a distance r (which we may call the eccentricity) from the axis of rotation 10.

While the load increases, the further bending of the driving blade 5 reduces the distance r and a relative elastic rotation between oscillator and rotor follows. This state of conditions is stable only up to a certain maximum critical load when the eccentricity r has reached a certain value. Any slight increase of the load beyond this stage results in a state of instability, the elastic relative rotation between oscillator and rotor proceeds further by itself and the eccentricity r becomes negative, the mechanism passing therefore into reverse. The same will happen again if the load is reversed. The mechanism will take the same load in reverse until the critical eccentricity is reached, and suddenly jump into the former position. This could be repeated many times without producing undue stresses anywhere in the mechanism.

This capacity for instant reversal of direction of drive can be made use of in driving any machine having to perform reciprocating motion, for example, a planing machine, a drop forging hammer or a tapping machine. It will be sufficient merely to increase suddenly the load on the machine—for example by putting a stop in the way of the performing tool—and the action will be reversed at once.

For example, if we want to lift a drop forging hammer to a certain height, the drum of the rope lifting the hammer may be driven by the rotor. The oscillator may be oscillated by an elastic connecting rod obtaining an alternating motion from a crank revolving uniformly or better still by a mechanism as described in my patent specification No. 1,542,668. When the hammer has reached its highest point against a fixed stop the sudden overload on the driving blades in the mechanism will reverse the action and the forging hammer will drop down quite easily. The drum will continue to rotate in its new direction until the rope is coiled in the other direction and the hammer will go up again until it reaches the stop when it will fall again. This action will continue indefinitely as long as the oscillator is working. The same arrangement can be applied to a planing machine. It will be sufficient to put two stops on both ends of the planing table. The sudden overload at the ends of the planing stroke will reverse the motion automatically.

Figure 3 shows a half section of a modification in which the rollers 4 are omitted, the oscillator and the rotor are kept concentric by rollers, one of which is shown at 11, inserted at suitable intervals between the elastic plates in the space between the rotor and oscillator. The diameters of these rollers should be equal to the radial width of this space with a slight working clearance only.

The above examples are only illustrations of the application of this invention, but obviously a very large variety of combinations can be made in which this invention can be applied.

What I claim is:—

1. A unidirectional driving device comprising in combination a driven member consisting of a shaft and a rotor fixed thereon, and an oscillating member concentrically mounted on the driven shaft, a space being left between the rotor and the oscillating member, and pairs of elastic plates or blades in the said space, each pair consisting of a normally flat member and a normally curved member, the width of each normally flat member being greater than the radial width of the space between the rotor and the oscillator, and the chordal width of the curved members being slightly less than this width, such pairs being packed so closely together that the opposite edges of the normally flat plates abut against the rotor and the oscillator member respectively, and the said plates are themselves slightly bent when in their operative positions.

2. In a unidirectional driving device as claimed in claim 1, rollers interposed between the said driven member and the said oscillating member.

3. A unidirectional driving device as claimed in claim 1, adapted to reverse its direction of driving when overloaded.

In testimony that I claim the foregoing as my invention, I have signed my name this seventh day of February, 1927.

GEORGE CONSTANTINESCO.