[Second Edition.]

PATENT SPECIFICATION

Application Date: April 14, 1923. No. 10,189/23. 218,406

Complete Left: Feb. 14, 1924.

Complete Accepted: July 10, 1924.

PROVISIONAL SPECIFICATION.

Improvements in Power Transmission.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great Britain and Ireland, do hereby declare the nature of this invention to be as follows:—

The present invention relates to unidirectional driving devices or ratchets intended to convert an oscillating or reciprocating motion to an intermittent rotary motion in one direction.

The invention consists in a unidirectional driving device comprising a stabilizing link pivoted at a fixed point and having at its free end a pivot oscillated about a mean position and connected to a ratchet device alternately engaging and disengaging a rotor mounted on a fixed axis, the various pivots being so disposed that the ratchet device moves at double the frequency of the driving oscillation.

The invention further consists in the application of the mechanism above specified to the splitting of motion of an oscillating member between an intermittently driven rotating member and a mass oscillating about a mean position.

The invention also consists in the application of the mechanism above described for obtaining rotary motion from alternating movements derived from impulses produced by pneumatic, hydraulic, electric or other means in cases in which no definite mean position about which the motion takes place would otherwise be obtained.

In carrying the invention into effect according to one example two fixed pivots are provided. A stabilising link oscillates about one of these fixed pivots and a driven rotor rotates about the other. The stabilising link carries at its free end a driving pivot to which oscillating motion is imparted, the motion being symmetrical about a mean position with a given frequency. This pivot is connected by a driving link substantially in line with the first when in the mean position with an oscillating member carrying a pawl, slider or ratchet device whose pivot oscillates at double the frequency of the driving pivot about an axis concentric with the axis of the rotor, the ratchet device being adapted to engage the rotor in one direction. It will be seen that with this arrangement each complete oscillation of the driving pivot will produce two driving strokes of the oscillating member carrying the pawl or ratchet so that the longitudinal frequency of the driving strokes of the pawl is double the transverse frequency of the driving pivot. This will result in intermittent impulses on the rotor, with idle periods of equal interval between them. If desired two sets of apparatus may be employed differing in phase by 90 degrees and driven by the same prime mover, and in this case there will be no intervals between successive impulses on the rotor.

Dated the 14th day of April, 1923.

W. GRYLLS ADAMS,
87, Victoria Street, London, S.W. 1,
Chartered Patent Agent.

COMPLETE SPECIFICATION.

Improvements in Power Transmission.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great Britain and Ireland, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and

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ascertained in and by the following statement:—

In my Patent Specifications No. 185,022 and No. 206,204 I have shown methods of transmitting power from a prime mover to a shaft which is to be rotated against a variable resisting torque by splitting alternating or sinusoidal motion derived from a steadily rotating shaft into component alternating motion of the same frequency; one component motion being caused to give alternating motion to a mass without absorbing energy, while another is caused to give alternating motion to a pair of unidirectional driving devices working in opposite phase and rotating a shaft.

I have shown that such systems are indeterminate and unstable except under the play of the internal forces developed during motion. Also I have shown how the object of the invention can be attained by a method using a combination of the following fundamental principles namely:—

(*a*) The frequency of oscillations must be the same for every part of the system and always proportional only to the speed of the prime mover.

(*b*) The steady motion of the prime mover is split into component motions optionally between a vibrating mass which does not absorb energy and unidirectionals conveying energy to a rotating shaft in such a way that when the stroke of the unidirectionals increases, the oscillations of the mass decrease.

(*c*) Each unidirectional should give an impulse to the rotor for each half revolution of the shaft of the prime mover.

(*d*) The possible movement of the parts of the system should be indeterminate and not determined by the change of position of any single part so that stability of the system during motion depends on the internal forces created by internal forces which are to act and compensate in such a way as to maintain a definite and stable mean position for the various vibrating parts, enabling them therefore to have the same frequency and to maintain such frequency.

The object of this application is to show alternative means to those illustrated in my said specifications by which the same result can be obtained. Such alternative arrangements are obtained as particular cases from the arrangements described and illustrated.

In the above mentioned Patent Specification No. 185,022 means are shown for imparting motion of variable amplitude to the mass.

As shown, a simple crank and connecting rod connected to one point of a floating lever is obviously one of the simplest and most efficient way to produce variable movement from a revolving invariable crank. I have found that other means may also be used for the purpose of splitting motion optionally between masses and unidirectionals while still maintaining the fundamental features of the invention.

For instance the floating lever which carries or is attached to a mass and to the unidirectionals, may be vibrated by attaching at any suitable point of it an additional mass which is capable of oscillating in one or two directions, and therefore describing illiptical orbits. In Figures 1 and 2 of my Specification No. 185,022 the masses which are attached to the floating lever move in elliptical orbits. This can be shown by the fact that as every part of the mechanism has a harmonic motion of the same frequency, the motion of any point of any link projected along any set of two rectangular axes of reference can be expressed by a sinusoidal expression of the same period but different phase. It can be shown mathematically that the trajectory of such a point is generally an ellipse which may be in some particular cases a circle or a straight line, representing in this last case one of the principal axes of a very flat ellipse.

I have found it possible to obtain the same results by means of a very great variety of combinations of links, masses and unidirectionals provided the essential condition is maintained, namely, that an oscillating motion derived from a steadily rotating crank is split into two component oscillating motions of the same fundamental frequency, one imparted to a mass and the other to unidirectional mechanisms which give at least two impulses on a rotor at each oscillation produced by the rotating crank and in such a way that when the amplitude of movement of the mass increases, the speed of the rotor diminishes and *vice versa*.

The fundamental frequency of all moving points must be always exactly the same for every part of the mechanism. Another condition essential to such mechanism is that such systems must not be restrained so that the movement of one part determines the movement of all; the parts must have freedom to set themselves into a state of stability round certain well defined and practically fixed mean positions, such positions being determined by the internal forces developed in the mechanism.

To obtain this effect it is essential that the unidirectionals shall be arranged in

such a way or such a number shall be provided that at least two equal impulses for each complete period of the frequency of the system are obtained. But this is not sufficient, it is further necessary that the direction and magnitude of the average forces and the average positions of such forces acting on the system, shall form figures in stable equilibrium with the various links in the mechanism and that such positions shall be independent of the speed of the rotor or of the prime mover.

It is to be observed that the various orbits of moving points in any such mechanisms need not be absolutely true geometrical ellipses, circles or straight lines. A slight deviation in shape is not important. But is important that such orbits shall be closed circuits, or at least must not vary in position except to a small extent alternately on one side and the other of fixed mean positions.

To obtain all other possible forms of the mechanism performing like the above mentioned (185,022) it is sufficient to arrange a system of connection between a steadily rotating shaft, acting masses, and unidirectionals driving a rotor such that the acting masses can describe during one period a closed elliptical orbit of which at least one of the principal axes is maximum when the rotor is held stationary and that the masses are stationary or describe closed orbits of which at least one of the principal axes is zero or a minimum when the rotor attains its maximum speed. For all intermediary stages the conditions of the system must be such that if we represent by X and Y the amplitude of the movements or velocities of the effective mass and unidirectionals respectively, and by A B two constants depending only on the design of the mechanism, we shall have the fundamental relation

$$\left(\frac{X}{A}\right)^2 + \left(\frac{Y}{B}\right)^2 = 1$$

In such case it can be shown by mathematical analysis that if we represent by

$\mathbb{Z}$ = the torque on the secondary
ω = the angular speed of the primary
v = the angular speed of the secondary
W = the torque of the primary

C, D, the constants depending on the mass system and linkage system, we have always

$$(C\mathbb{Z})^2 + (D\omega v)^2 = \omega^4$$
$$W\omega = \mathbb{Z}v.$$

The first relation is the characteristic fundamental relation of all such mechanisms satisfying the above enumerated conditions. The second relation merely expresses the principle of conservation of energy; namely, that the energy of the prime mover is equal to the energy collected at the rotor neglecting the mechanical losses which are generally small with such mechanism. For example, if the torque W of the prime mover is maintained constant, the above fundamental relations are expressed geometrically by the curves in Figure 7 (Specification 185,022).

I have found that the fundamental relation above expressed holds good only for transmission mechanism in which the orbit of every moving point is a closed elliptical circuit which is described in exactly the same period of time as a revolution of the prime mover or such multiple or submultiple of such time when the prime mover acts through some form of gearing or linkage which may multiply or reduce such time in a fixed ration.

Furthermore the relation holds good only for such combinations of masses, links and unidirectionals as have at least two distinctly different fixed axes supporting the mechanism which must never coincide. It can be seen that Figures 1, 2 of my Patent Specification No. 185,022 show for each case two distinct axes of support 20. The rest of the figures have three distinct fixed axes of support. In other words this means that the positions of the various orbits described by every moving point of the mechanism must remain invariable relative to at least two independent and distinct fixed axes.

In the figures in my Specification No. 185,022 the fixed axes shown by the reference numeral 20 are used to carry respectively the prime mover shaft, the unidirectionals, and the inertia. I have found that at least two distinct and non-revolvable axes of support are essential for obtaining the object of the invention as otherwise it will be impossible to maintain fixed the mean position of the elliptical orbits of the various points, and also impossible to maintain the stability of the system.

Another essential condition for obtaining the stability of the mechanism is that the number of impulses given by the unidirectional ratchet devices shall be at least twice the fundamental frequency.

In the examples shown in Figures 1 and 2 of my Specification No. 185,022 one point of a floating lever is compelled to describe a circle by a crank 2. Therefore each point of the floating lever is free to describe an elliptical circuit, one axis of which is constant and the other variable from a maximum to a minimum.

The mass inertia in such mechanism is represented by the whole of the floating lever plus the weight 12 at the end of it.

The final object of the mechanism is to enable a certain mass as represented by the weight 12 and a unidirectional mechanism giving two impulses at each revolution of the driving shaft, to obtain variable amplitude motions from a steadily rotating shaft in such a way that these respective motions are components obtained from a single motion of constant magnitude; when one component diminishes, the other increases, the exact relation being that given above, namely that such motions can be represented on a convenient scale by the two sides of a right angled triangle whose hypothenuse is constant.

The object of this specification is to show alternative means for obtaining a similar result and I do not claim in the present specification any invention described or claimed in my prior Specifications No. 185,022, Nos. 206,204 or 206,700.

The invention consists in an automatic variable power transmission gear for transmitting motion from a steadily rotating shaft to a shaft which has to be rotated against a variable resisting torque by splitting the motion of the driving crank between an oscillating mass and oscillating members carrying unidirectional driving mechanism; arranged so that each complete oscillation of the driving pivot will produce at least two driving strokes of the oscillating member carrying each pawl or its equivalent so that the frequency of the driving stroke of each pawl or its equivalent is double the frequency of the driving pivot.

The invention also consists in the improved automatic variable transmission mechanism hereinafter described.

Referring to the accompanying drawings:—

Figure 1 shows a form of the invention in which unidirectional mechanism is used moving with double the frequency of the primary crank;

Figure 2 shows a quadruple frequency arrangement;

Figure 3 shows another form of the invention utilising a rotating mass and giving quadruple frequency impulses in the rotor.

Figure 4 shows a form in which a rotating mass is employed in combination with a ratchet moving at double the frequency of the prime mover;

In the form of the invention shown in Figure 1, the driving crank *a* on the shaft *b* which carries a heavy flywheel *c* is connected by a rod *d* to a pivot at an intermediate point of a floating lever *e* which serves to split the motion of the crank *a* between a driving pivot *y* which transmits energy to a driven member and a rod *f* connected to a crank *g* on a shaft *h*, which carries an oscillating flywheel or other mass *i*, as described in my Patent Specification No. 185,022. The driving pivot *y* is pivoted at the free end of a link *s* pivoted at a fixed point *t* and is connected by a rod *x* to a pivot *z* at one end of a link *k* pivoted at a fixed point *l* and shown in its mean position in the figure. The pivot *z* is connected by a link *m* to an oscillating member *o* oscillating about a fixed point *p* and carrying a ratchet device *r* acting on a rotor *q*. The oscillating member *o* is shown in its lowest position at the end of its stroke in full lines and the dotted lines indicate its position at the other end of its stroke; and it will be readily seen that with this arrangement the oscillating member *o* moves with double the frequency of the driving pivot *z* and consequently of the primary driving crank *a*.

In Figure 2 a quadruple frequency arrangement is illustrated, the motion of the prime mover being slit between an oscillating inertia and a driving pivot through which energy is transmitted to the driven shaft, according to the common point method described in my Specification No. 206,204. In this form of the invention the driving crank 1 is connected by a link 2 to a common point 3, which is connected by a link 4 to the crank 6 driving the oscillating flywheel 7 and by a link 5 to a driving pivot 8 on a stabilising link 9 pivoted at a fixed point. The pivot 8 is connected by a link 10 to an intermediate point on an arm 11, pivoted at a fixed point 12 and having at its free end a pivot 13 connected by a link 14 with a member 15 oscillating about a fixed pivot 17 and carrying a ratchet device 15 which drives the rotor 18 in one direction.

It will be seen that in this case the relative positions of the pivots are such that the frequency of movement of the driving pivot 8 in the horizontal direction is double that of the driving crank 1 while the frequency of movement of the driving pivot 13 in the vertical direction is double that of the driving pivot 8 in the horizontal direction, so that four impulses are given to the rotor 18 at each revolution of the driving crank 1.

In the form of the invention shown in Figure 3, the rotating mass 51 is rotated about the axis 52 at which is also situated the mass 61 carried by an arm 62 pivoted

at a fixed point 63, so that the mean position of the mass 61 is situated in the line between the pivot 63 and the driving pivot 64. The driving pivot is connected by a link 65 with the pivot 52 and drives the oscillating members 36, 37 through connecting rods 56, 57 giving four impulses to the rotor for each revolution of the driving shaft.

The dotted lines in this case show the extreme lower position of the pivot 52.

The form of the invention shown in Figure 4 is similar to that shown in Figure 3 with the exception that the arm 70 carries a single ratchet device 71 so placed that two impulses are given to the rotor at each complete oscillation of the mass 61, the pivot 52 being directly connected to the oscillating member by the connecting rod 72.

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. An automatic variable power transmission gear for transmitting motion from a steadily rotating shaft to a shaft which has to be rotated against a variable resisting torque by splitting the motion of the driving crank between an oscillating mass and an oscillating member carrying unidirectional driving mechanism arranged so that each complete oscillation of the driving pivot will produce at least two driving strokes of the oscillating member carrying each pawl or its equivalent so that the frequency of the driving stroke of each pawl or its equivalent is double the frequency of the driving pivot.

2. Improved means for transmitting motion hereinbefore described and illustrated at Figure 1 of the accompanying drawings.

3. Improved means for transmitting motion hereinbefore described and illustrated at Figure 2 of the accompanying drawings.

4. Improved means for transmitting motion hereinbefore described and illustrated at Figure 3 of the accompanying drawings.

5. Improved means for transmitting motion hereinbefore described and illustrated at Figure 4 of the accompanying drawings.

Dated the 14th day of February, 1924.

W. GRYLLS ADAMS,
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Chartered Patent Agent.

Hereford: Printed for His Majesty's Stationery Office, by The Hereford Times Ltd.
[Wt. 21A—125/5/1925.]

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Fig.1

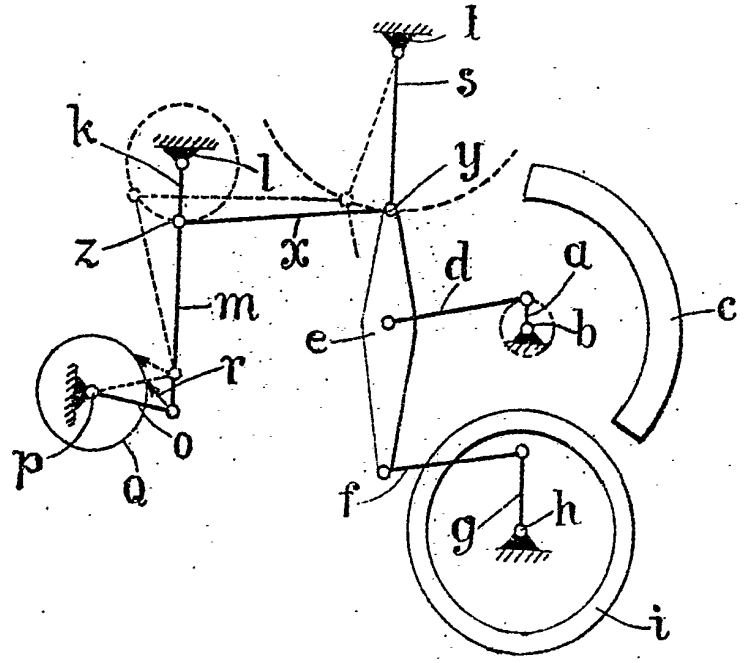

Fig.2.

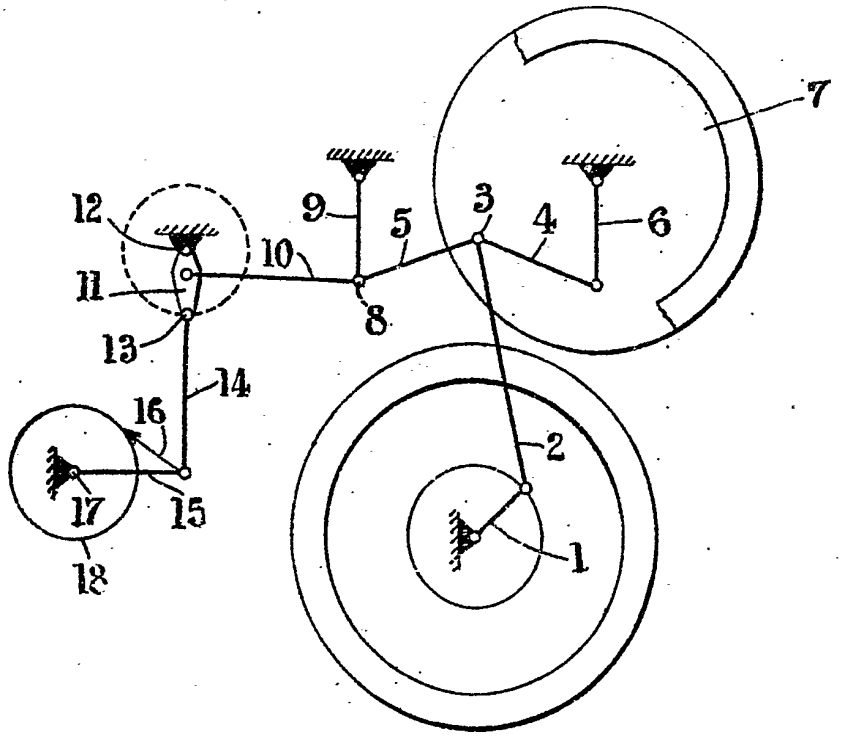

Fig. 3.

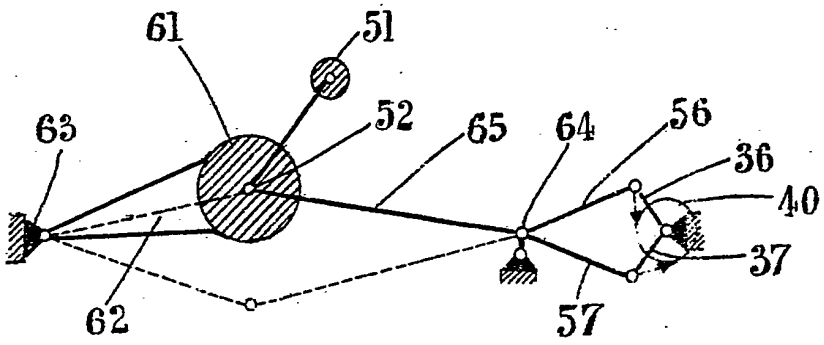

Fig. 4.

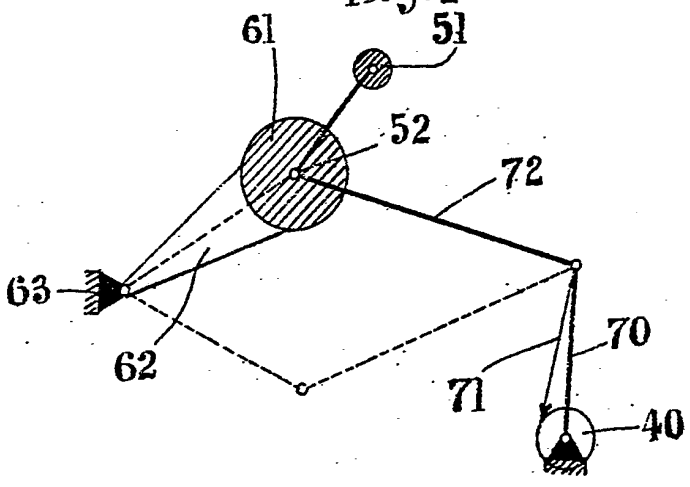

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Fig.1

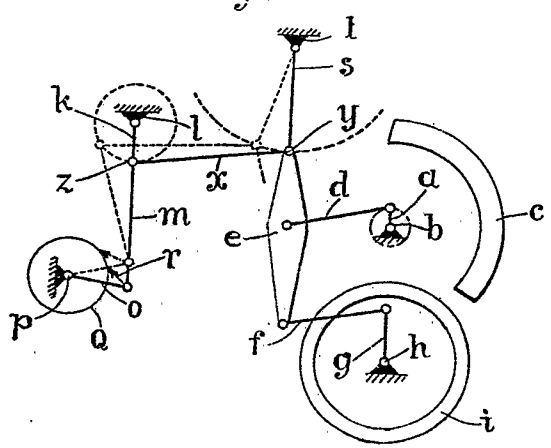
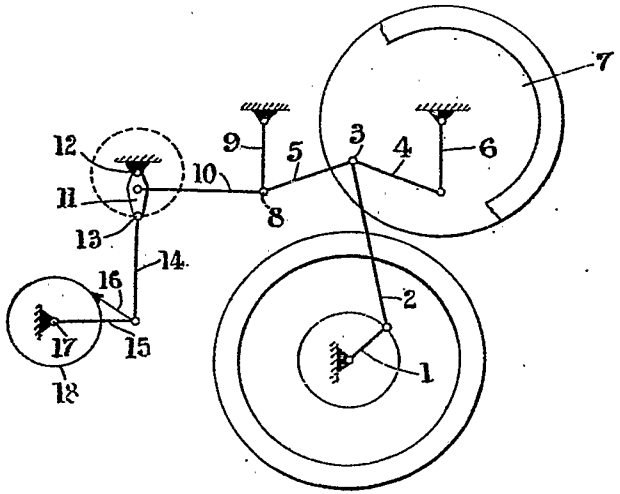


Fig.2.



SHEET 2

Fig.3.

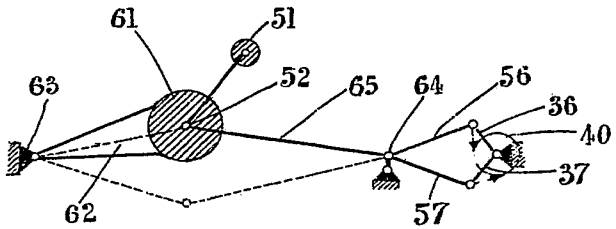
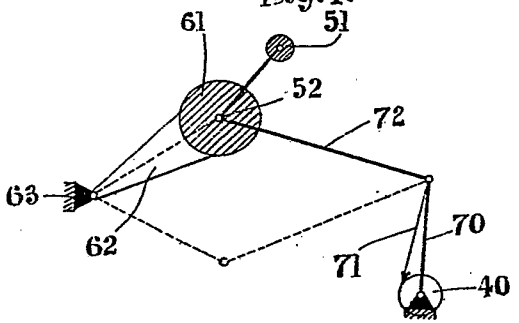


Fig.4.



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