

July 8, 1924.

R. GOLDSCHMIDT

1,500,988

MECHANISM FOR CONVERTING ROTARY INTO RECIPROCATORY MOTION

Filed June 22, 1921

4 Sheets-Sheet 1

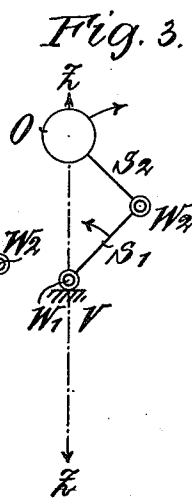
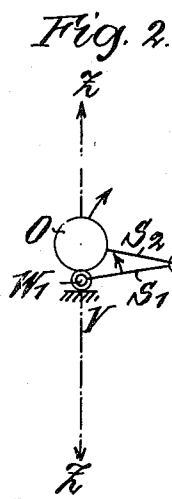
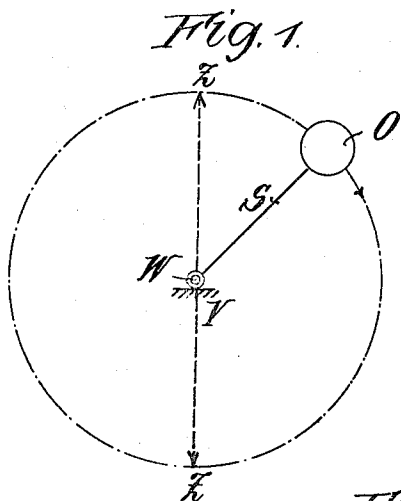


Fig. 5.

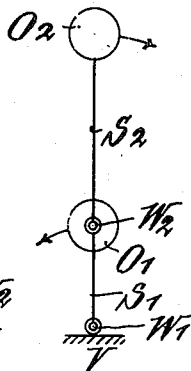


Fig. 4.

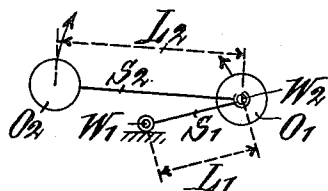


Fig. 6.

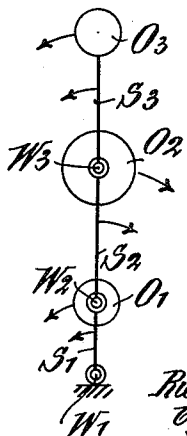
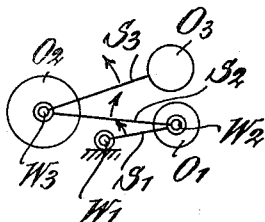


Fig. 7.

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July 8, 1924.

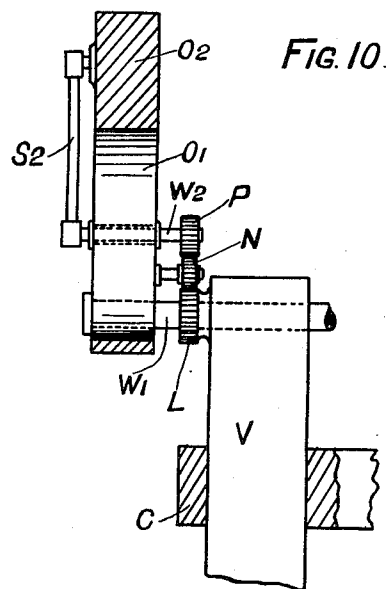
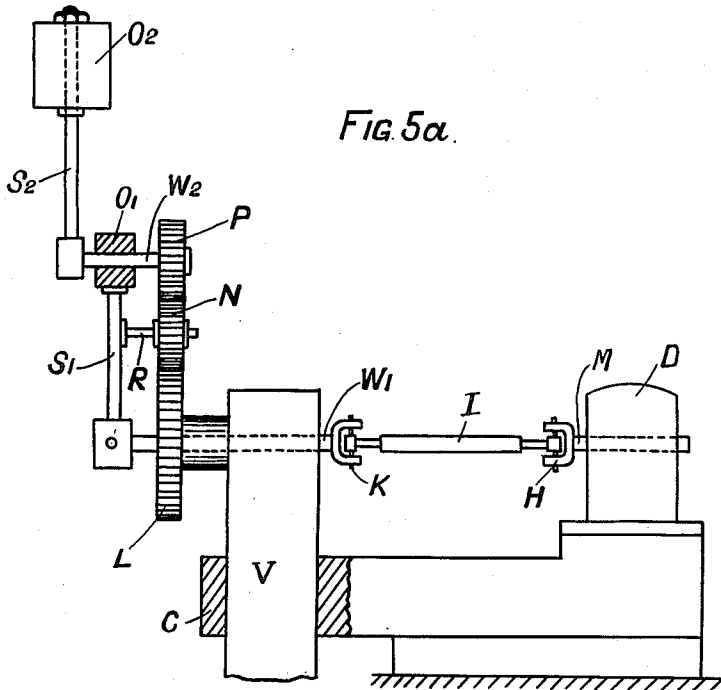
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MECHANISM FOR CONVERTING ROTARY INTO RECIPROCATORY MOTION

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Fig. 8.

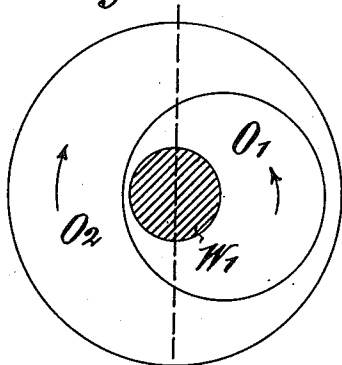


Fig. 11.

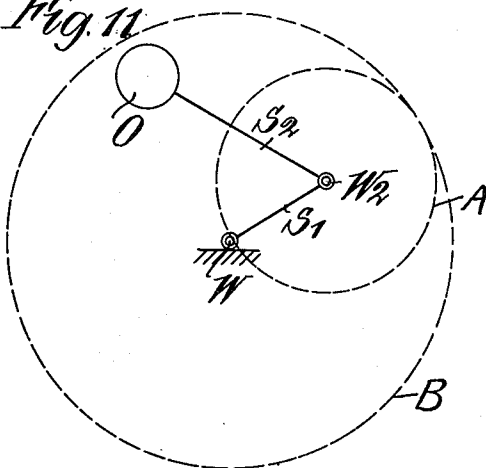


Fig. 9.

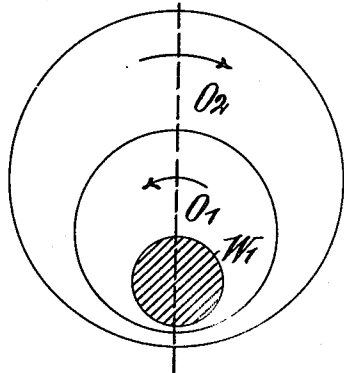


Fig. 12.

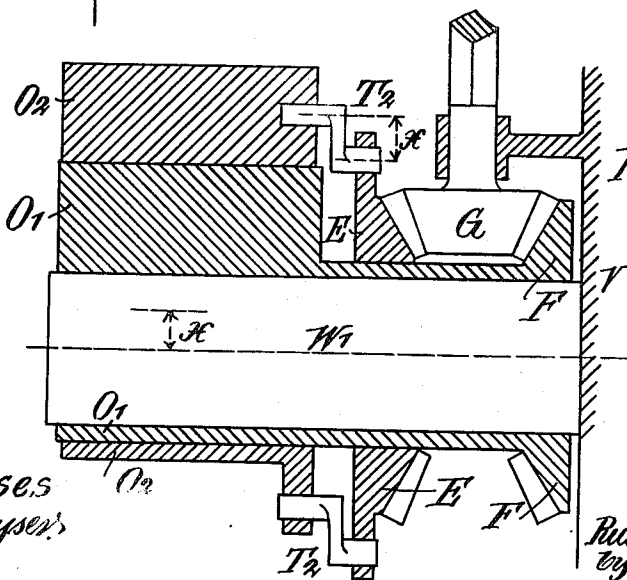
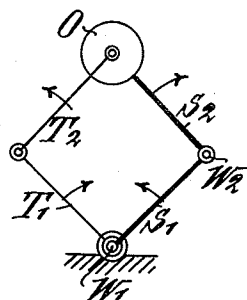


Fig. 13.

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Fig. 14.

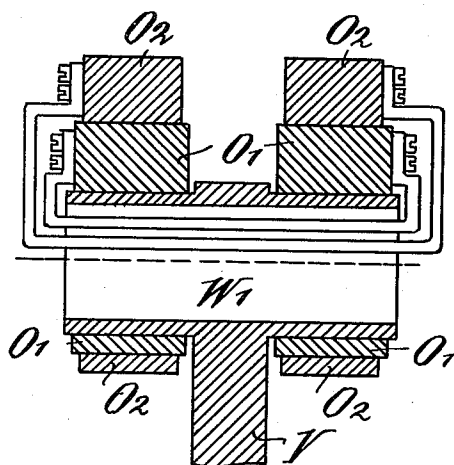


Fig. 15.

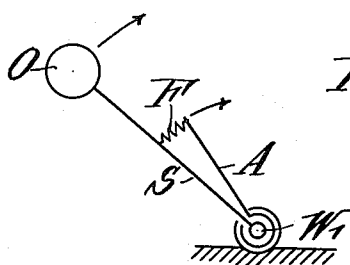
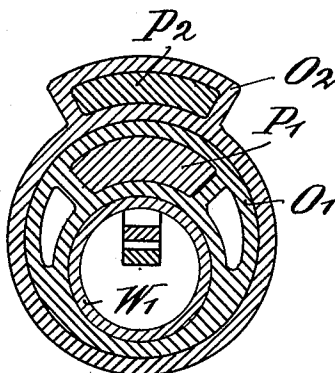


Fig. 16.

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Patented July 8, 1924.

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UNITED STATES PATENT OFFICE.

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MECHANISM FOR CONVERTING ROTARY INTO RECIPROCATORY MOTION.

Application filed June 22, 1921. Serial No. 479,573.

To all whom it may concern:

Be it known that I, RUDOLF GOLDSCHMIDT, a citizen of Germany, and a resident of Berlin, Germany, have invented certain new and useful Improvements in Mechanism for Converting Rotary into Reciprocatory Motion, of which the following is a specification.

This invention relates to certain improvements in or modifications of the mechanism described in the specification of my prior patent application No. 441097 of 29th January, 1921, wherein reciprocation is imparted to a reciprocatory member by a weight (or weights) carried on the outer part of a jointed arm pivoted on the reciprocatory member, the outer part of said arm being so jointed to the inner part as to be capable of complete rotation about the axis of the joint. The geometrical path of the centre of inertia of the weight is in such case of epicycloidal character, depending on the direction of rotation of the outer arm, the relative angular velocity and the relative lengths of the inner and outer parts of the arm.

The object of the present invention is to enable the weight to describe curved paths of different character.

In order that the invention may be more clearly understood, reference is hereinafter made to the accompanying drawings, whereon:—

Fig. 1 is a diagram of a common form of centrifugal mechanism.

Figs. 2 and 3 are views showing two positions of a form of mechanism described in my parent specification aforesaid.

Figs. 4 and 5 are views showing two positions of one form of mechanism according to the present invention.

Fig. 5^a is a side view at right angles to Fig. 5 showing a constructive form of the mechanism illustrated in Figs. 4 and 5.

Figs. 6 and 7 are views corresponding to Figs. 4 and 5 showing a modified form of mechanism.

Figs. 8 and 9 are views corresponding to Figs. 4 and 5 showing the same applied to eccentrics.

Fig. 10 is a side view at right angles to Figs. 8 and 9 showing a constructive form thereof.

Figs. 11 and 12 illustrate different forms of driving mechanism hereafter referred to.

Fig. 13 is a sectional view at right angles to Fig. 9.

Fig. 14 illustrates (in section) a modification of the mechanism shown in Fig. 13.

Fig. 15 is a cross-section showing a still further modification.

Fig. 16 is a side view of a form of mechanism hereafter described.

Throughout the drawings the direction of rotation of the parts are indicated by the arrows.

By reference to Fig. 1, it will be seen that a weight O carried on an arm S pivoted at W describes a circle. If the weight O is carried by an outer arm S² jointed at W² to an inner arm S¹ of equal length pivoted at W¹, the weight O may be geared to describe a straight line Z—Z (Figs. 2 and 3). In Fig. 1 the operation of setting a body V, on which the arm S rotates, in reciprocatory motion, is produced purely by centrifugal force. As the centrifugal action takes place in all directions, the reciprocatory movement of the body in a plane or on any desired surface can only be regulated if the body V to be moved is either positively guided or if a second oppositely rotating centrifugal weight is employed. In Figs. 2 and 3, the production of the alternating force on the body V depends entirely on the acceleration and retardation of the mass O, which produces corresponding reacting forces on the pivot W¹.

For convenience, the arrangement according to Fig. 1 will hereinafter be designated a "centrifugal gear" and that according to Figs. 2 and 3 a "reaction gear," that is to say a centrifugal action will be referred to if the centrifugal weight O or two oppositely rotating centrifugal weights carry out circular rotation relative to the body to be set in oscillation, whereas a reaction effect will be implied if the centrifugal weight (or weights) is subject to linear acceleration and retardation. In the general application of the present invention producing epicycloidal movement, elliptical movement, or the like, both actions are combined.

In the case of the mechanism shown in Fig. 2 no positive guide or oppositely rotating weights are required for the reason that forces are not set up at right angles to the line Z—Z, provided that the masses within the arms and bearings are practically

small compared to the mass of the weight O.

Sufficient space must be provided at right angles to the line Z, Z, for the free movement of the arms S^1 and S^2 which are of equal length. Nevertheless the arms S^1 and S^2 are only half the length of the corresponding arm S of the centrifugal gear (Fig. 1.) In order to utilize the rotary movement of the arm S^1 , a weight O^1 (as in Figs. 4 5 and 5^a), may be mounted on the arm S^1 , but then the length L^2 of the arm S^2 must be greater than the length L^1 of the arm S^1 and the weight O^2 must be greater than the weight O^1 when L^2 is less than twice L^1 if a duplicate set of oppositely rotating mechanism is to be obviated.

If the weight O^1 is rotated in one direction and the weight O^2 is rotated in the opposite direction at twice the angular velocity of O^1 , then when O^1 moves from the position shown in Fig. 5 through either 90 or 270 degrees, the arm S^2 will overlap the arm S^1 , substantially as shown in Fig. 4, where O^1 has turned through just over 270 degrees from the position shown in Fig. 5. The weights O^1 and O^2 may be so related to the length of the arms S^1 and S^2 that the moments of the weights balance each other when the arms S^1 and S^2 overlap. Thus, for example, the weights O^1 and O^2 may be equal and the length L^2 of arm S^2 may be twice the length L^1 of arm S^1 . Then when the arms S^2 and S^1 overlap (substantially as shown in Fig. 4) the moments of the weights O^1 and O^2 will balance each other and there will be no tendency to move the pivot W^1 . If the pivot W^1 is to be moved for any purpose (as, for example, if the pivot W^1 is mounted on the wing of a vibrating wing flying machine) the moments of the weights O^1 and O^2 must be made unequal in the position referred to.

The arm S may be sub-divided into a plurality of jointed arms. Figs. 6 and 7 show a three-part arm in which the arms S^3 and S^2 are equal in length and the arm S^1 twice the length of the arm S^2 . The weights O^1 and O^3 in this case are together equal to the weight O^2 , so that, in the overlapping position (substantially as shown in Fig. 6) the moment of the weight O^2 balances the combined moments of the weights O^1 and O^3 whilst in the extended position (Fig. 7) the combined moments are equal to twelve times the weight of O^1 or O^3 multiplied by the length L^1 .

By increasing the diameter of the pivot W^1 , W^2 etc. the mechanism may assume the form of an eccentric. Figs. 8, 9 and 10 show an arrangement which corresponds to Figs. 4, 5 and 5^a, in which the dimensions of the pivots W^1 and W^2 transform the mechanism into eccentrics and in which the weights O^1 and O^2 are integral with the arms S^1 and S^2 of Figs. 4 and 5.

Whilst Figs. 8 9 and 10 are more suitable for apparatus which require to withstand the violent shocks of hammers and the like, the arrangements according to Figs 2 to 7 may be employed for devices which have to carry out comparatively large movements, free from shock, such as the wings of vibrating wing flying machines.

In the parent specification aforesaid, the driving means for the outer arm S^2 may be chain-and-chain wheel mechanism. Fig. 11 illustrates modified driving means. In Fig. 11, a planet wheel A carried by the arm S^1 and turning with the arm S^2 is driven by a fixed wheel B.

In Fig. 5^a, the body V to be reciprocated slides in a guide block C on which is mounted a motor D. The motor shaft M is connected by a universal joint H to a flexible shaft I having a universal joint connection K to the shaft W^1 which rotates in the body V. The shaft W^1 passes through a gear wheel L which is fixed to the side of the body V so that it does not rotate. The shaft W^1 carries the arm S^1 which has a stud R supporting an idle gear wheel N which rotates between the gear wheel L and a gear wheel P fixed upon the shaft W^2 which rotates in the weight O^1 and carries the arm S^2 and weight O^2 . The gear wheel N thus forms a planet wheel which turns around the fixed sun wheel L and drives the outer wheel P.

In Fig. 10, the shaft W^1 likewise rotates in the body V and passes through a gear wheel L fixed to the side of the body V. In this case, however, the shaft W^1 is fixed eccentrically to a disc forming the weight O^1 and to the side of the disc is fixed the stud R supporting the planet wheel N. The shaft W^2 supporting the outer wheel P passes centrally through the disc O^1 and rotates therein. On the side of the disc O^1 opposite to the wheel P, the shaft W^2 is connected to the arm S^2 , the outer end of which is fixed to an eccentric forming the weight O^2 and rotating on the disc O^1 .

In Fig. 12 a crank T^1 is provided which, by means of the connecting rod T^2 , sets the arm S^2 in the desired rotation. The crank and connecting rod T^1 , T^2 may be replaced by pin-and-slot mechanism as e. g. by dispensing with the rod T^2 and providing a longer crank T^1 with a pin on the end thereof to slide in a groove in the arm S^2 .

The arrangement shown in Fig. 12 may be adopted for multiple-divided arms such as shown in Figs. 6 and 7, thus obtaining a form of lazy-tongs device.

Fig. 13 shows an arrangement similar to Fig. 12 applied to eccentrics. The eccentric O^1 is driven by the bevel wheel F and the eccentric O^2 by the bevel wheel E and crank T^2 . In this case, in order to obtain uniform angular velocity the distance x between the centres of the crank pins is preferred.

ably made equal to the eccentricity and to avoid dead points a plurality of (say four) cranks T^2 are distributed equally about the circumference.

In Fig. 13 the forces produced by the eccentrics O^1 and O^2 , which are to displace the body V , act thereon at a point outside the centre of gravity of the body V , because the eccentrics O^1 and O^2 are unilaterally mounted on the axis W^1 . That is generally possible where, as in flapping wings, the body V swings about a pivot or the tendency of the body V to carry out a rotational movement about its own centre of gravity is counter-acted by guides. If this is not the case, the eccentrics O^1 and O^2 must be so arranged that their centre line passes through the centre of gravity of the body V , in which case the axis W^1 may be held in a fork. This fork, however, is not desirable if (as in the case of a hammer) the fork is liable to be highly stressed by shocks or to hinder the movement of the eccentrics, should the latter be of considerable diameter. In such case the eccentrics O^1 and O^2 would preferably be sub-divided into two parts and these parts so disposed that their common centre plane passes through the centre of gravity of the body V .

In order then to dispense with separate driving gear for the parts of the eccentrics, the arrangement according to Fig. 14 may be adopted. In this case the axle W^1 is made hollow and the separate eccentrics are connected together through the hollow axle W^1 so that a single driving gear only is necessary and the separate eccentrics co-act as a single one. This arrangement is of fundamental importance and may be applied also where the eccentric O^2 is dispensed with, in which case a centrifugal gear is obtained.

Fig. 15 is a view in section at right angles to Fig. 14 in which the eccentrics O^1 and O^2 are constructed as hollow chambers and in order to displace their centres of gravity as far as possible outwardly, two of the chambers P^1 and P^2 are filled with a heavy metal such as lead.

The turning moment which is necessary for driving the centrifugal weights or eccentrics varies very considerably throughout one complete revolution, particularly with hammers where the arising shock also reacts on the weights. It is therefore desirable and in fact frequently indispensable, for the protection of the driving gear, to interpose a means of storing energy between the driving gear and the centrifugal weights, in the form of a spring or springs, either a single spring or one for each centrifugal weight.

Fig. 16 shows such an arrangement where a spring F (diagrammatically illustrated as

an ordinary spiral spring) is inserted between the centrifugal arm S and the driving arm A .

Claims.

1. Mechanism for converting rotary into reciprocatory motion comprising a reciprocatory member, an arm pivoted to said member and sub-divided into three or more parts jointed together, driving connections between the arm parts for rotating each arm part relative to the adjacent arm part, means for rotating the innermost arm part and a weight on the outer part of said arm.

2. Mechanism for converting rotary into reciprocatory motion comprising a reciprocatory member, an arm pivoted to said member, means for rotating said arm, a weight carried by said arm, an outer arm jointed to the outer end of the inner arm, means for rotating the outer arm relative to the inner arm and a weight carried by the outer arm.

3. Mechanism as specified in claim 1 having a weight carried by each of the inner parts of the arm.

4. Mechanism as specified in claim 2 in which the inner and outer arms and weights are so related that the turning moments thereof substantially counter-balance each other when the arms are in overlapping positions.

5. Mechanism as specified in claim 1 having a weight carried by each of the inner parts of the arm and means for rotating the parts relative to each other, the weights and arm parts being so related that the turning moments thereof substantially counterbalance when the arms are in overlapping positions.

6. Mechanism for converting rotary into reciprocatory motion comprising a reciprocatory member, an eccentric pivoted thereto, means for rotating said eccentric, a second eccentric rotatable on the first eccentric and means for rotating the second eccentric on the first eccentric.

7. Mechanism as specified in claim 2 in which the outer arm is driven by planet gearing.

8. Mechanism as specified in claim 6 in which the second eccentric is driven by planet gearing.

9. Mechanism as specified in claim 6 in which the second eccentric is driven by a crank from planet gearing.

10. Mechanism as specified in claim 6 in which the first eccentric is mounted on a hollow journal on the reciprocatory member.

11. Mechanism as specified in claim 6 in which the eccentrics are each constructed in the form of hollow chambers eccentrically weighted by filling with heavy metal.

In testimony whereof I hereunto affix my signature.

RUDOLF GOLDSCHMIDT.