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E. J. POITRAS ET AL
MOTION REPRODUCING UNIT

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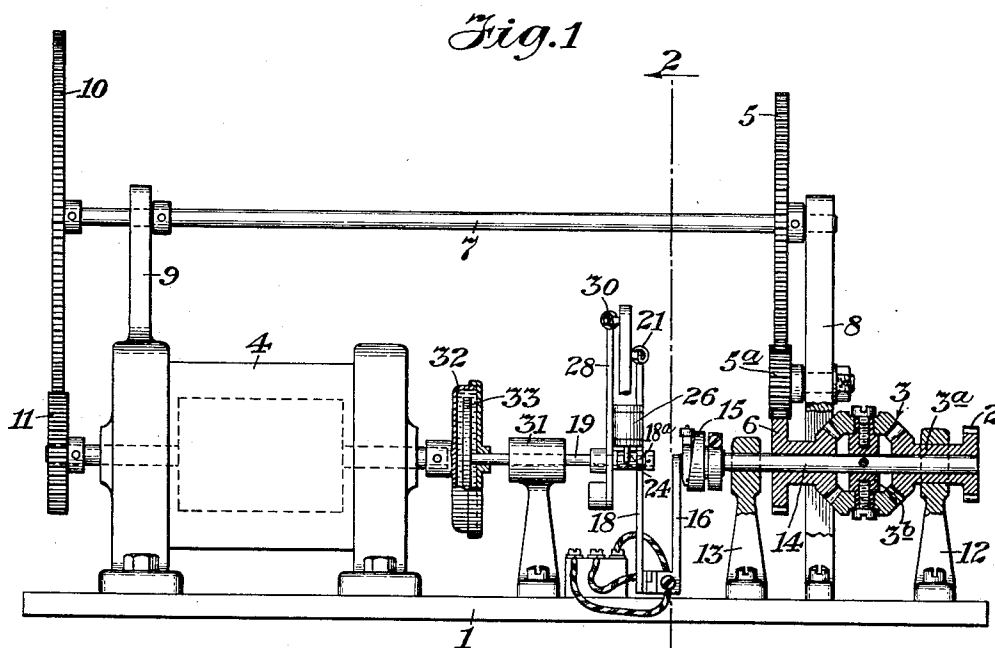


Fig. 2

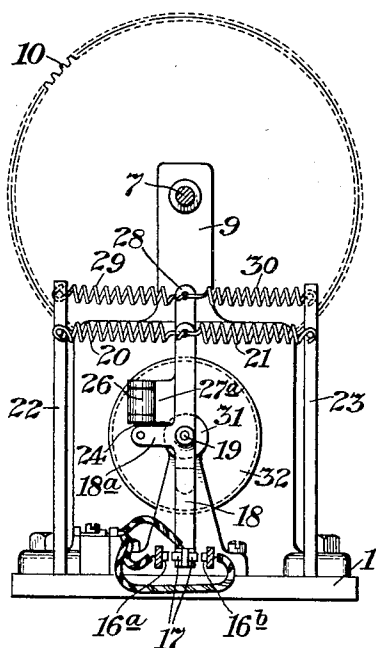


Fig. 3

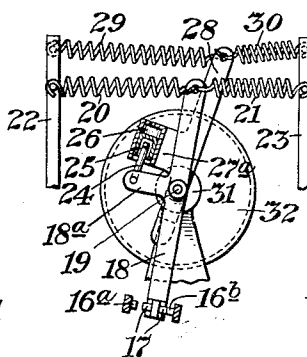
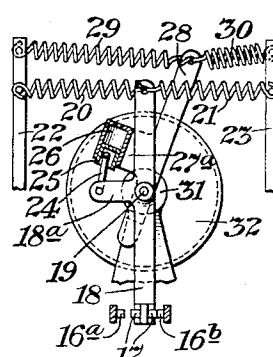


Fig. 4



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MOTION REPRODUCING UNIT

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13 Claims. (Cl. 172—239)

The invention herein disclosed relates to a motion reproducing unit in which the movement of one object is reproduced by another, the latter object being actuated by a prime mover.

There has been, heretofore, devised a unit of this type in which there is no hunting or appreciable overrunning of the following or driven object during rapid changes or reversals in the velocity of the element or motion receiving member which is followed by the driven member. In this unit, the prime mover actuating the driven member is controlled by two cooperating control elements, one of which is actuated in accordance with the driven member and the other of which is actuated in accordance with the motion receiving member. Relative movement of these cooperating control elements affects the operation of the prime mover. Upon movement of the motion receiving member, there is effected relative movement between the control elements and the operation of the motor is effected. Upon operation, the relation of the cooperating control elements is affected in accordance with the velocity of the prime mover so that the prime mover assumes a velocity proportional to the displacement of the control element actuated by the motion receiving member. A mechanism is also provided whereby the actual movement of the motor is proportional to the movement of the motion receiving member so that the driven object actuated by the motor has a movement corresponding to the movement of the motion receiving member.

While this unit eliminates the hunting and overrunning of the driven object, there is a lag of the driven object behind the motion receiving member. Consequently, where synchronous operation and positional agreement between the motion receiving and driven members are desirable, this unit is not suitable, and it is an object of this invention to provide a unit of this type in which the driven object is actuated in synchronous relation, or positional agreement with the motion receiving member.

In accordance with the invention, the relation of the control elements which affect the operation of the prime mover is modified in accordance with changes in the velocity of the prime mover, that is, in accordance with the second derivative of position of the prime mover. With this unit, the motion receiving and driven members are in positional agreement during operation at a constant velocity and the driven member lags behind

the motion receiving member only when there are rapid changes in velocity.

Such a unit is illustrated in the accompanying drawing in which:

Fig. 1 is a side elevation of the unit with certain parts removed;

Fig. 2 is a sectional end elevation taken on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 illustrating the control elements under conditions of acceleration; and

Fig. 4 is a figure similar to Fig. 2 illustrating the control elements during a condition of constant velocity of the motion receiving member.

The several parts of the unit illustrated in the drawing are mounted upon a base 1. The motion receiving member is represented as a gear 2 forming an input to one side of a differential 3. The other side of the differential is connected through back gearing to an electric motor 4. The back gearing consists of an idler 5a meshing with a gear 6 of the differential and a gear 5 secured on a shaft 7. The shaft 7 is journaled in bearing brackets 8 and 9, the bearing bracket 8 being secured to the base 1 and the bearing bracket 9 being formed on the motor. A gear 10 secured on the end of the shaft 7 meshes with a pinion 11 secured on the shaft of the motor which extends through both ends of the motor casing. The gear 10 drives the driven member and for the purposes of the disclosure may be taken as the driven member.

The differential 3 is mounted between bearing brackets 12 and 13 secured to the base 1. A hub 3a of one side of the differential on which the gear 2 is formed is journaled in the bearing bracket 12 and the central shaft 14 of the differential to which the spider 3b is secured is journaled in the bearing bracket 13. The shaft 14 of the differential is in axial alignment with the shaft of the motor 4.

On the end of the shaft 14, facing the motor, there is mounted a yieldable cam drive 15. Through this yieldable coupling there is driven a contact arm 16 which carries two spaced electrical contacts 16a and 16b. The gear ratio between the motor and the differential 3 is such that movement of the shaft 14, and the contact arm 16 secured thereto, represents the difference in movement between the driven object and the motion receiving member represented by the gear 2.

The contacts 16a and 16b cooperate with a double contact 17 mounted upon an arm 18, the double contact 17 extending between the two con-

tacts 16a and 16b. The arm 18 is rotatably mounted upon a shaft 19 and it is maintained in a vertical position by centering springs 20 and 21 which extend between the arm 18 and standards 22 and 23, respectively, secured to the base 1. The arm 18 includes a crank arm 18a which extends at right angles thereto. To this crank arm 18a there is pivotally secured one end of a piston rod 24, the other end of which is secured to a piston 25 of a dash pot 26.

The cylinder of the dash pot is carried by a crank arm 27a extending from an arm 28 secured to the shaft 19 for rotation therewith. The arm 28 is also normally maintained in a vertical position by centering springs 29 and 30 which extend between the arm 28 and the standards 22 and 23 respectively.

The shaft 19 is journaled in and extends through a bearing bracket 31 which is secured to the base 1. The end of the shaft 19 extends into the case of a viscous drag 32, and on the end of the shaft, within the case of the viscous drag, there is mounted on the shaft 19 a disk 33. The case 32 of the viscous drag is mounted upon the motor shaft for rotation therewith; the case is sealed and contains a viscous fluid such as oil. With this arrangement, there is exerted on the arm 28 a torque that is proportional to the velocity of the motor 4 and the arm 28 is displaced from its central or neutral position an amount that is proportional to the velocity of the motor.

The motor 4 is split phase motor and it is connected to the contacts 16 and 17 so that when the double contact 17 engages the fixed contact 16a the motor operates in one direction and when the double contact 17 engages the contact 16b the motor operates in the opposite direction.

In the operation of the unit, the gear 2 is rotated, this gear being connected to any element the motion of which it is desired to reproduce in the driven element. When the system is at rest, the electrical contacts are in the position illustrated in Figure 2. Upon movement of the motion receiving member, when the motor is at rest, the contact arm 16 is moved relative to the contact arm 18. Assuming that the motion receiving member 2 is turned in a clockwise direction when the system is viewed as illustrated in Figure 2, the contact arm 16 will move in a clockwise direction and the contacts 16b and 17 will engage. When these contacts engage, the motor begins operating. Through the viscous drag 32, the arm 28 is displaced from its neutral position as illustrated in Figure 3 an amount proportional to the velocity of the motor. Through the dash pot 26, the contact arm 18 is also displaced, being advanced in accordance with the arm 28. If the arms 18 and 28 were rigidly secured together, the arm 18 would be displaced or advanced an amount proportional to the velocity of the motor and the contact 17 would ride upon the contact 16b in a position angularly displaced from its neutral position an amount proportional to the velocity of the motor. The intermittent contact under the conditions assumed is just enough to keep the motor at a velocity proportional to the movement of the motion receiving member. The back gearing of course acts to offset the movement of the motion receiving member so that, under the conditions assumed, the contact arm 16 would be displaced from its neutral position only an amount sufficient to maintain the lag necessary to acquire the requisite velocity. However, the arm 18 tends to return to its neutral position, the dash pot permitting it

to return gradually so that the arms 18 and 28 assume a relative position, for a constant velocity of the motion receiving member as indicated in Figure 4. In moving to its neutral position, the arm 18 erases the lag between the driven object and the motion receiving member so that these members are in positional agreement when the motion receiving member is operating at a constant velocity. Upon rapid changes in velocity, the arm 18 follows the arm 28, but for gradual changes in velocity, the arm 18 is advanced in accordance with the changes in velocity so that the driven object and the motion receiving object are maintained in positional agreement. Operation of the unit in the opposite direction is the same as described above.

From the above it will be seen that there is produced in this unit an arrangement whereby the relation of the control elements or contacts is modified in accordance with changes in the velocity of the prime mover. The result is that the movable and driven objects are maintained in positional agreement for all conditions except those of rapid acceleration and deceleration when the driven object may lag slightly behind the motion receiving member. However, upon the cessation of these rapid changes in velocity, the driven object is quickly brought into positional agreement with the motion receiving member.

The yieldable drive coupling is provided between the shaft 14 and the arm 16 for the purpose of relieving any strain upon the control elements. It may be omitted in so far as the fundamental principle of operation of the unit is concerned.

It is obvious that various changes may be made by those skilled in the art in the details of the embodiment disclosed in the drawing and described in detail above within the principle and scope of the invention as expressed in the appended claims.

We claim:

1. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member, and means for controlling the prime mover including two relatively movable, cooperating control elements and means actuated by the relative movement thereof for affecting the operation of the prime mover, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means mechanically connecting the prime mover and one of the control elements for modifying the relation of said control elements in accordance with the acceleration of the prime mover.
2. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member, and means for controlling the prime mover including two relatively movable, cooperating control elements and means actuated by the relative movement thereof for affecting the operation of the prime mover, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means mechanically connecting the prime mover and one of the control elements for advancing one of said control elements in accordance with the acceleration of the prime mover.
3. In a unit of the type described, the combina-

tion comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member, and means for controlling the prime mover including two relatively movable, cooperating control elements and means actuated by the relative movement thereof for affecting the operation of the prime mover, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means mechanically connecting the prime mover and one of the control elements for modifying the relation of said control elements including means for creating a torque on one of said control elements proportional to the acceleration of the prime mover.

4. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member, and means for controlling the prime mover including two relatively movable, cooperating control elements and means actuated by the relative movement thereof for affecting the operation of the prime mover, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means for modifying the relation of said control elements including means for advancing one of said control elements comprising means displaceable in accordance with the velocity of the prime mover, and means displaceable thereby in accordance with the acceleration of the prime mover.

5. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the movable and driven members and means for affecting the operation of the prime mover including means operative in accordance with the velocity of the prime mover for affecting the relation of the control elements and introducing an error in the relation of the movable and driven members, and means for erasing the error.

6. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the movable and driven members and means for affecting the operation of the prime mover including means operative in accordance with the velocity of the prime mover for affecting the relation of the control elements and introducing an error in the relation of the movable and driven members, and means operative in accordance with the displacement between the movable and driven members for erasing the error.

7. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting movement

of one of the control elements upon relative movement between the motion receiving and driven members to affect the operation of the prime mover, and means for affecting the other of the control elements including means operative in accordance with the velocity of the prime mover and additional means operative in accordance with the velocity of said last mentioned means.

8. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means for affecting one of said control elements in accordance with changes in the velocity of the prime mover including means for effecting positional agreement between the movable and driven objects during operation of the prime mover at constant velocity.

9. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means for affecting one of said control elements in accordance with changes in the velocity of the prime mover including means for effecting positional agreement between the movable and driven objects during operation at constant velocity, said latter means comprising a flexible connection with the control element and means for positioning the control element.

10. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means for affecting one of said control elements in accordance with changes in the velocity of the prime mover including means displaceable in accordance with the velocity of the prime mover, a flexible connection connecting said displaceable means and the control element for movement of the control element upon movement of said displaceable means, and means for returning the control element during operation of the prime mover at constant velocity.

11. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means for affecting one of said control elements in accordance with changes in the velocity of the prime mover including a movably mounted element, means for displacing

the element in accordance with the velocity of the prime mover, a dash-pot interconnecting the movably mounted element and the control element, and centering springs acting to center the control element.

12. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members, and means introducing an error in the relation of the movable and driven members proportional to the velocity of the prime mover including means for erasing the error.

13. In a unit of the type described, the combination comprising a movably mounted motion receiving member, a movably mounted driven member, a prime mover for driving the driven member and control means for the prime mover including two relatively movable cooperating control elements, means for effecting relative movement of the control elements upon relative movement between the motion receiving and driven members to affect the operation of the prime mover, and means for introducing an error in the relation of the movable and driven members in accordance with the velocity of the prime mover, said last mentioned means including means operative in proportion to the error introduced for erasing the error.

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DISCLAIMER

2,025,122.—*Edward J. Poitras*, Jackson Heights, N. Y., and *James D. Tear*, Great Neck, N. Y. MOTION REPRODUCING UNIT. Patent dated December 24, 1935. Disclaimer filed September 18, 1937, by the assignee, *Ford Instrument Company, Inc.*

Hereby enters this disclaimer to claims 1, 2, and 3 of said Patent No. 2,025,122.
[*Official Gazette October 12, 1937.*]