W. B. JACKSON.

SYNCHRONIZING DEVICE.

APPLICATION FILED MAY 19, 1913.

1,222,547. Patented Apr. 10, 1917.

Fig. 1.

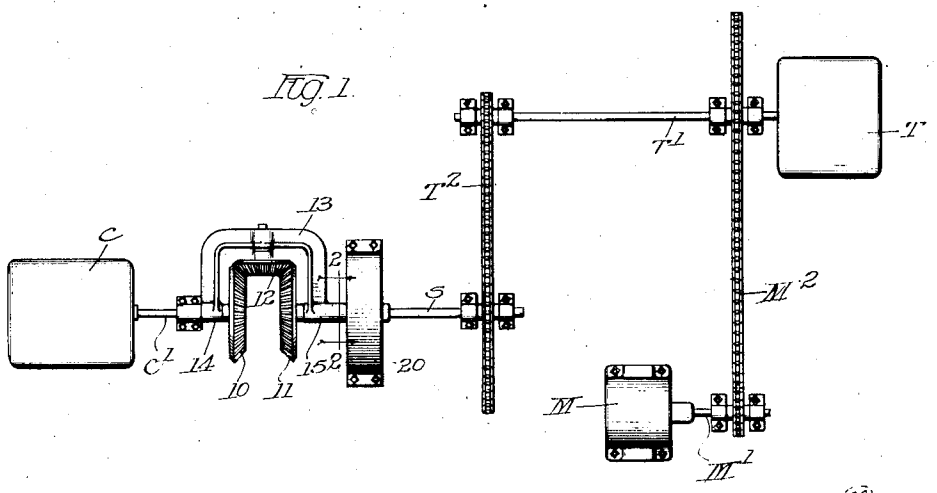


Fig. 4.

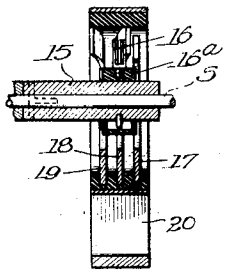


Fig. 2.

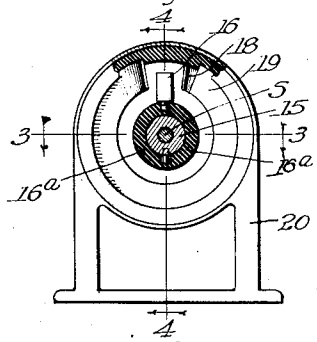


Fig. 5.

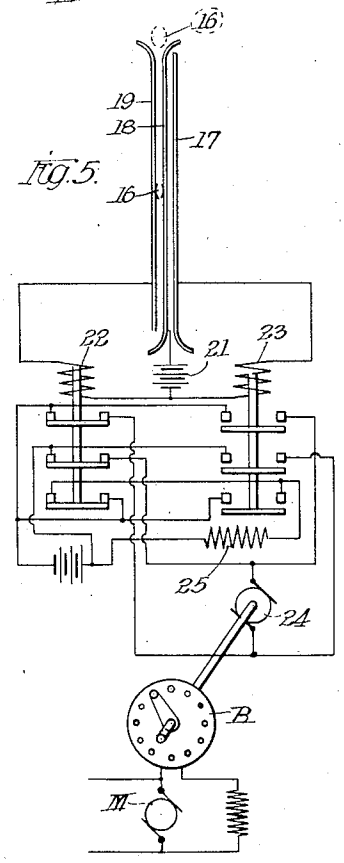


Fig. 6.

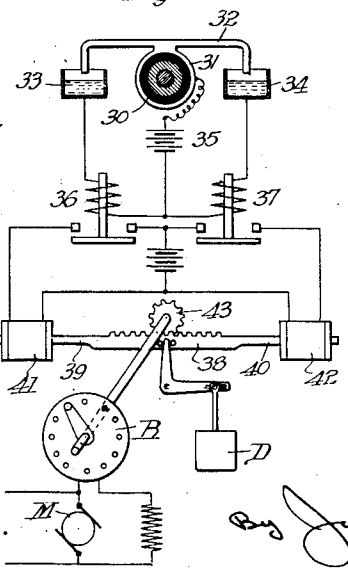
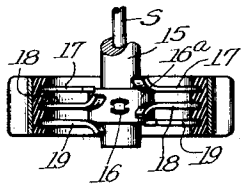


Fig. 3.



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UNITED STATES PATENT OFFICE.

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SYNCHRONIZING DEVICE.

1,222,547. Specification of Letters Patent. **Patented Apr. 10, 1917.**

Application filed May 19, 1913. Serial No. 768,561.

To all whom it may concern:

Be it known that I, WILLIAM B. JACKSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Synchronizing Devices, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention pertains to synchronizing devices for driving mechanisms, *i. e.*, to devices for maintaining a driving shaft in synchronism, as to the number of revolutions performed in a given time, with a governing mechanism. One of the important uses of my invention is in connection with workmen's time recorders and the like, for maintaining the shaft of the motor which drives the recorder in synchronism with a governing shaft, such as a clock shaft or the like. Other uses of the invention occur in those cases where it is desired that the total number of revolutions of one shaft shall bear a constant ratio with the total number of revolutions of another shaft in a given time.

A synchronizing device constructed in accordance with my invention, is described, by way of example, as applied to a workmen's time and wage recorder, in the following specification, and shown, together with a modification thereof, in the accompanying drawing. It is to be understood, however, that my invention may be embodied in numerous other constructions than those described and shown, and that many arrangements of circuits may be used other than those shown in connection with these embodiments, without exceeding the scope of the invention as defined in the appended claims.

In the drawing:

Figure 1 is a plan of a schematic nature, of one form of synchronizing device constructed in accordance with my invention;

Fig. 2 is an end view of the contact making and breaking device viewed from the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a horizontal section of the same, the section being taken on the line 3—3 of Fig. 2;

Fig. 4 is a vertical section of the same, the section being taken on the line 4—4 of Fig. 2;

Fig. 5 is a circuit diagram; and

Fig. 6 is a diagrammatic view showing a detail modification of the device, and a modified circuit arrangement.

Like reference characters refer to like parts throughout the following specification and in the several figures of the accompanying drawing.

Referring now to Figs. 1–5, which illustrates an embodiment of my invention as applied to a workmen's time and wage recorder, T designates a time and wage recorder which is to be driven synchronously with a governing shaft, such as a clock shaft or the like. M designates an electric motor, the shaft M^1 of which drives, through a chain M^2, the shaft T^1 of the recorder. The shaft T^1 drives, through a chain T^2, a shaft S. The ratio of the sprockets which carry the chains M^2 and T^2 is such that the shaft S is rotated at a speed which is as nearly as possible the same as that of the shaft C^1 of a clock mechanism C. The synchronizing device, now to be described, of my invention is for the purpose of maintaining the shaft S in synchronism with the shaft C^1—*i. e.*, insuring that the number of revolutions of the shaft S in a given time shall be exactly the same as the number of revolutions performed by the shaft C^1.

In the embodiment of my invention now being described, the shafts C^1 and S are disposed coaxially, and in longitudinal alinement with each other; and they are provided at their adjacent ends, with duplicate bevel wheels 10 and 11 respectively. Disposed between the bevel wheels 10 and 11, and meshing with each of them, is a bevel pinion 12, mounted to rotate in a bridge 13, having sleeves 14 and 15 at its ends, the sleeve 14 being rotatably mounted upon the shaft C^1, and the sleeve 15 being rotatably mounted upon the shaft S. The shafts S and C^1 rotate in opposite directions; and it will be seen, therefore, that the bridge 13 will remain stationary so long as the shafts C^1 and S are revolving at the same speed. As soon, however, as the shaft S begins to rotate at a greater speed than the shaft C^1, the bridge 13 will begin to swing in the direction of rotation of the shaft S. Likewise, as soon as the shaft S

begins to lag behind the shaft C^1, the bridge 13 will begin to swing in the direction of rotation of the shaft C^1. I provide means whereby this swinging of the bridge 13, due to variation in one direction or the other, of the speed of the shaft S, effects the cutting of resistance into, or out of, the field circuit of the motor.

In order that the swinging of the bridge 13 may result in the cutting of resistance into, or out of the motor field, I provide the sleeve 15 of the bridge 13 with a spring contact 16. The contact 16 is mounted upon an insulating collar 16^a carried by the sleeve 15 in such a manner that the collar is capable of a slight longitudinal movement. The spring contact 16 coöperates with three substantially annular contact strips 17, 18 and 19, which are mounted in a stand 20 so as to surround the sleeve 16^a, and so as to be insulated from each other. The contacts 17, 18 and 19, are cut away at their upper portions (Figs. 2–4), so that the contact 16 is not in engagement with any of them when the bridge 13 is in its vertical position. The ends of the contacts 17 and 18 are flared away from each other at the side of the device which is shown at the right of Fig. 3, so as to guide the spring contact 16 into position between them if the bridge 13 should swing in the direction of rotation of the shaft S. Likewise, the ends of the contacts 18 and 19 are flared away from each other at the side of the device shown at the left hand of Fig. 3, so as to guide the spring contact 16 into position between them in case the bridge 13 should swing in the direction of rotation of the shaft C^1. The endwise movement of the sleeve 16^a permits the contact 16 to enter between the contacts 17 and 18, or between the contacts 18 and 19, according as the bridge 13 swings in the direction of rotation of the shaft S, or in the direction of rotation of the shaft C^1. The ends of the contact strips 17 and 18 at the side of the device shown at the left of Fig. 3 are arranged so as to permit the contacts 16 to pass out from between them, in case, by some accident to the device, or by reason of improper adjustment, the sleeve 15 should make a complete revolution; and the ends of the contact strips 18 and 19 at the side of the device at the left of Fig. 3 are likewise arranged. By this means, I avoid the serious result which might otherwise attend an accident to the device, the stoppage of the clock mechanism or other improper adjustment. From the above it will be seen that, supposing the shafts S and C^1 to rotate in the direction of the arrows, the contact 16 will make connection between the contact strips 18 and 19 if the shaft S begins to lag behind the shaft C^1, and will make connection between the contact strips 17 and 18 if the shaft S begins to rotate faster than the shaft C^1. I provide means whereby, when connection is made between the contact strips 17 and 18, resistance is cut out from the field of the motor M, while, when connection is made between the contact strips 19 and 18, resistance is cut into the field of the motor M.

To the above end, I connect a battery 21, or other source of electrical energy, (Fig. 5) to the contact strip 18 and to one terminal each of a pair of relays 22 and 23, the other terminals of these relays being connected with the contact strips 19 and 17 respectively. It will be seen that when connection is made between the contact strips 18 and 19, the relay 22 will be operated, and that the relay 23 will be operated when connection is made between the contact strips 17 and 18. 24 designates the armature of a rheostat-actuating motor; and 25 designates the field thereof. The arrangement of the circuits is such that, when the relay 22 is energized, current is sent through the armature 24 and the field 25 in shunt therewith; and when the relay 23 is energized current is sent through the armature 24 in the opposite direction, but through the field 25 in the same direction. Thus, when the relay 23 is energized the motor 24, 25 is forced to rotate in a direction opposite to that in which it rotates when the relay 22 is energized. A rheostat R is mechanically connected with the motor 24, 25, and is connected in series with the field of the motor M. The rheostat R cuts resistance into, or out of, the field of the motor M, according as it is rotated in one direction or the other by the motor 24, 25.

It will be seen from the above that, when the shaft S begins to rotate faster than the shaft C^1, thus causing the contact 16 to enter between the contact strips 17 and 18, forming a bridge between them, the relay 23 will be energized causing the motor 24, 25 to turn the rheostat R in a direction to cut out resistance from the field of the motor M. In a like manner, when the shaft S begins to lag behind the shaft C^1, the contact 16 will bridge the contacts 18 and 19, and therefore cause the relay 22 to be energized, whereupon the motor 24, 25 will turn the rheostat R in a direction to cut resistance into the field of the motor M. In either event, the decrease, or increase of speed of the motor shaft M^1, due to the cutting out or in of resistance, effects a corresponding decrease or increase of speed of the shaft S, and will cause the contact 16 to return to its position between the ends of the contact strips, in which position, neither of the relays are energized. By this means, the rotation of the motor shaft M^1 is accurately synchronized with that of the clock shaft C^1, so that whenever the contact 16 is at the point midway between the ends of the contact strips, the

number of revolutions performed by the shaft C^1 since the time the contact was last in that position, must be precisely the same as the number of revolutions performed by the shaft S, even to the smallest fraction of a revolution. It will thus be seen that the shaft S cannot gain or lose a revolution with respect to the shaft C^1. This is due to the fact that as soon as the shaft S begins to rotate faster than the shaft C^1 its speed is immediately reduced, so as to exactly compensate for the gain it may have made over the shaft C^1; and as soon as the shaft S begins to lag behind the shaft C^1 its speed is immediately increased, so as to exactly compensate for the loss it may have sustained over the shaft C^1. The number of revolutions which the shaft S has performed in a given time is, therefore, of necessity, always the same as the number of revolutions which the shaft C^1 has performed in the same time. While I have described an arrangement in which a rheostat cuts resistance into, or out of, the field of the motor M, it is obvious that the same general result may be obtained by varying the resistance of the armature circuit, or in other ways well known in the art.

In place of the contact making device described above, a beam 32 may be employed, such beam being mounted on the sleeve 15 so as to rock therewith. Such a construction is shown in Fig. 6. As shown in this figure the beam 32 is carried by a ring 31 mounted on an insulating collar 30 secured to the sleeve 15. The ends of the beam 32 dip into one or the other of a pair of mercury cups 33 and 34, according as the bridge 13, and consequently the sleeve 15, is rocked in one direction or the other. One terminal of a battery 35, or other source of electric current, is connected with the beam 32, the other terminal of this battery being connected, through relays 36 and 37, with the mercury cups 33 and 34 respectively. It will be seen that, when the beam 32 is tilted so that its end enters the mercury cup 33, the relay 36 will be energized; and, when the beam 32 is tilted so that its opposite end enters the mercury cup 34, the relay 37 will be energized. 38 designates a rack, the ends 39 and 40 of which form the cores of solenoid coils 41 and 42, the solenoid 41 being adapted to be energized when the relay 36 is actuated, and the solenoid 42 being adapted to be energized when the relay 37 is actuated. Meshing with the teeth of the rack 38 is a pinion 43, which is rotated in one direction or the other according to the direction of movement of the rack. Mechanically connected with the pinion 43 is a rheostat R connected in the field circuit of the motor M. A dashpot D is connected with the rack 38 for retarding the movements of the latter. When the shaft S begins to rotate faster than the shaft C^1 the beam 32 dips into the mercury cup 34, the relay 37 being thus energized, and causing the energizing of the solenoid coil 42. The effect of the solenoid coil 42 being energized is that the rack 38 is drawn to the right (Fig. 6), thereby turning the pinion 43 and the arm of the rheostat R in a contra-clockwise direction. Such rotation of the rheostat R has the effect of cutting resistance out of the field of the motor M, thereby slowing up the motor. The opposite result occurs when the beam 32 dips into the mercury cup 33, the rheostat R being then rotated in a clockwise direction, so as to cut resistance into the field of the motor M, causing the motor shaft to speed up.

While I have described in detail two constructions of synchronizing device in which my invention may be embodied, I wish it distinctly understood that the invention may be embodied in many other forms than those described and shown, and that the invention may be employed in other connections than that described, what I claim being:

1. In a device of the class described, a controlling motor and a controlled motor, and first means, driven from both said motors and oppositely actuated thereby so as to be stationary in its normal position when the motors are running synchronously, and second means, for increasing and decreasing the speed of said controlled motor, and power means whereby when said first means are moved from normal position due to the controlled motor getting ahead of the controlling motor, said second means will be put in operation to progressively decrease the speed of the controlled motor to cause said first means to move back to said normal position, and whereby when said first means are moved from normal position due to the controlled motor getting behind the controlling motor said second means will be put in operation to progressively increase the speed of the controlled motor to cause said first means to move back to said normal position.

2. In a device of the class described, a controlling motor and a controlled motor, and first means, driven from both said motors and oppositely actuated thereby so as to be stationary in its normal position when the motors are running synchronously, and second means, for increasing and decreasing the speed of said controlled motor, and electromotive means for actuating said second means, and a third means, whereby when said first means are moved from normal position due to the controlled motor getting ahead of the controlling motor a circuit will be established which will cause said electromotive means to progressively actuate said second means to decrease the speed of the controlled motor to cause said first means to move back to said normal position, and

whereby when said first means are moved from normal position due to the controlled motor getting behind the controlling motor a circuit will be established which will cause said electromotive means to progressively actuate said second means to increase the speed of the controlled motor to cause said first means to move back to said normal position.

3. In a device of the class described, a controlling motor and a controlled motor, and first means, driven from both of said motors and actuated thereby so as to be stationary in an intermediate normal position when the motors are running in perfect synchronism and so as to move in one direction when the controlled motor increases in speed and to move in the other direction when it decreases in speed relatively with the controlling motor, second means, for increasing and decreasing the speed of said controlled motor, and third means whereby, when said first means is moved from its intermediate position due to the controlled motor getting behind in speed, said first means in conjunction with said third means will put into operation said second means to tend to continuously decrease the speed of the controlled motor until the controlled motor has made up the revolutions which it has lost, when the first means will have returned to its intermediate normal position, and whereby when said first means is moved from its intermediate position due to the controlled motor getting ahead in speed, said first means in conjunction with said third means will cause said second means to tend to continuously increase the speed of the controlled motor until the controlled motor has lost the revolutions which it had gained over the controlling motor when the first means will again be in its intermediate normal position.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

WM. B. JACKSON.

Witnesses:
BERT H. PECK,
A. R. KING.