

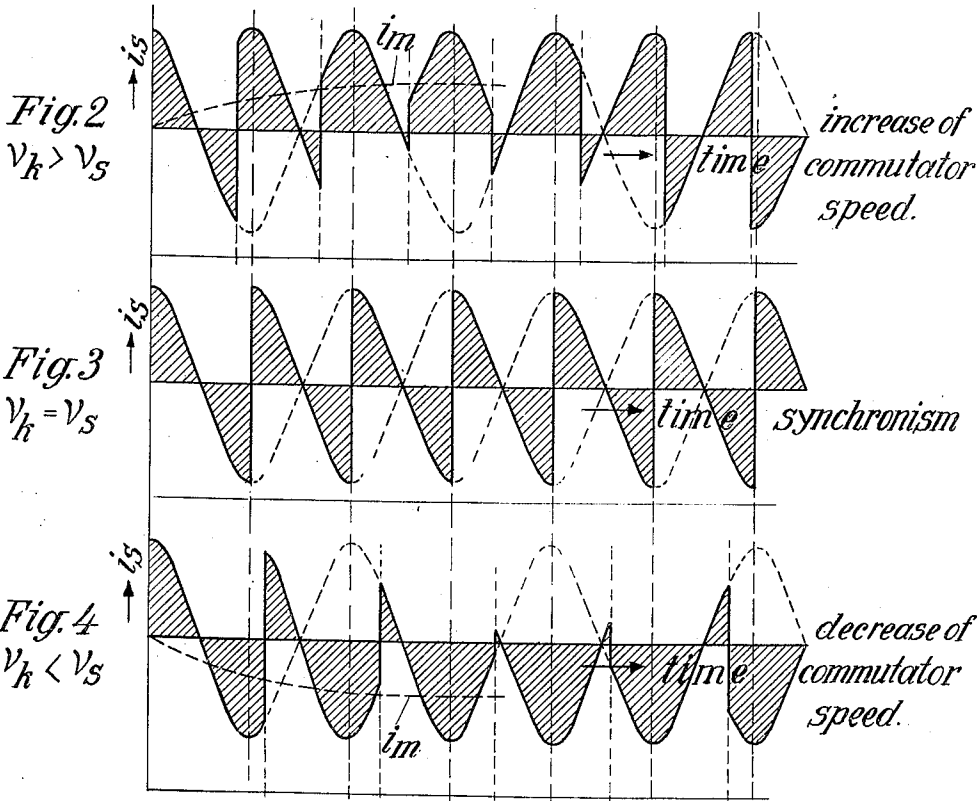
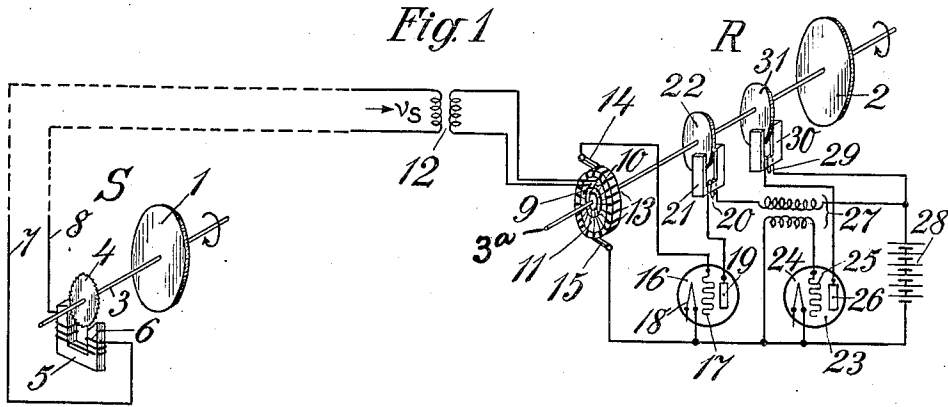
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SYNCHRONIZING DEVICE

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SYNCHRONIZING DEVICE.

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The present invention relates to an apparatus for synchronously operating two or more rotating devices, such as are used in telegraphy, in telegraphic picture transmission, television, and the like.

According to my invention, two rotating bodies at two different places or stations may be synchronized by transmitting an alternating synchronizing current which has the same periodicity as, and a distinct phase relation with respect to, the rotating device at the transmitting station in a well-known manner, such as by line wire, by wireless or by wired wireless transmission, to the other rotating device at the receiving station which is provided with a rotating commutator, to which the alternating current is supplied. This commutated current may, by virtue of its mean value, influence, by suitable controlling means, the speed of a driving motor in such a way as to restore complete synchronism in all cases when the speed has not the desired value which is necessary for synchronism and operation in phase. In order to produce this action in a more effective way, one or several relays may be interposed, for which purpose vacuum tube amplifiers are especially adapted. By complete synchronism is meant that the two rotating bodies not only maintain precisely the same speed, but that at any instant of time they are in like phase difference, e. g., maintain the same relative position of their revolving parts. An example for this is presented by an apparatus for the electric transmission of pictures, the picture to be transmitted being divided into small elements by means of auxiliary apparatus operated mechanically at the transmission station, which picture elements successively influence in rapid succession a light sensitive cell and thereby modulate or produce in an electric circuit varying impulses corresponding to their luminous intensities. The transmitted current or wave on reaching the receiving station controls the formation of the picture elements corresponding to the originals, which are put together in rapid succession by mechanically operated reproducing means in such way that they reproduce the original picture. These means arranged at the receiving station for the assembling of the picture elements may include means identical with those means serving for distributing (scanning) the picture at the transmit-

ting station, e. g., may be two cylinders rotating in fixed paths or their axes or rotating while simultaneously moved in directions parallel with their axes, which cylinders at the respective stations must therefore be moved uniformly, that is to say, in exact synchronism. If the movement is not synchronous the picture elements at the receiver would not appear at the proper points for association, but would be displaced therefrom, e. g., a shadow would be at the place which should be occupied by a point of light, the result being that of an incorrect or distorted picture.

In order to make clear the novel features of my invention, a detailed description is hereinafter presented, reference being taken to the accompanying drawings, in which Figure 1 shows an apparatus embodying the salient elements of my invention, and Figures 2-4 show curves illustrative of the principles of operation.

Referring to Figure 1, S is a transmitting station and R a receiving station, a rotating body 2 (cylinder of picture transmission apparatus) at the receiving station being required to move synchronously with a similar body 1 at the transmitting station. The two rotating bodies 1 and 2 may be driven by any suitable prime movers (not indicated in the drawing for simplicity's sake). An alternating current generator coupled to the body 1 at station S, consisting, in the example shown, of a toothed wheel 4 mounted with the body 1 on a common shaft or axis 3 and a magnet 5 carrying a winding 6, sends a synchronizing current of a distinct frequency and phase relation across the lines 7 and 8, and through the slip-rings 9 and 10 to a mechanically rotating commutator 11, which is mounted with the body 2 on a common shaft or axis 3^a at the receiving station, which shaft or axis receives driving motion from any suitable source of power. 12 is a repeater transformer interposed between the lines 7, 8 and the receiving commutator. The slip-rings 9 and 10 of the commutator are connected to the commutator segments 13 alternately, on which ride commutator brushes 14 and 15 receiving the commutated current. This current is applied to the grid 17 of a vacuum tube 16 having an incandescent cathode 18 and anode 19. The plate current is controlled accordingly, whereby to influ-

ence the action of means controlling the speed of the shaft 3^a as, for example, by the coil 20 of the braking magnet 21 of an eddy-current brake including a brake disk 22 on the shaft 3^a, whereby an acceleration or a retardation necessary for maintaining a speed of said shaft synchronous with the speed of shaft 3 is attained. The commutator 11 is adjusted to commutate the current each time when it reaches its maximum value in the event that complete synchronism exists, such as represented by the illustrative curves of Figure 3, where cycles per second of the synchronizing current is and commutating cycles are equal, ($\nu_k = \nu_s$). It will be seen that the mean value in this case is zero, the areas formed by the current curve and the axis of time being equal and alternately of opposite sign. As soon, however, as the said conditions of complete synchronism cease to exist, the two areas of opposite sign will no longer be equal, indicating the existence of a mean value i_m of the current in one direction or the other, as represented by Figures 2 and 4, the former showing an increase of the commutator speed, i. e., an increase of the commutating cycles with respect to the current cycles, and therefore a mean value i_m of the commutated current starting in one direction, making the grid 17 positive with respect to the cathode 18 and thus increasing the plate current and enforcing a greater braking action which tends to retard the speed and bring it back to its normal synchronous value. The opposite phenomena take place if the commutator speed decreases (Fig. 4), the commutating cycles becoming less than the current cycles. Here a decrease of the mean grid voltage takes place resulting in a decrease of the braking action and acceleration of speed so as to restore synchronous speed. It will thus be apparent that a speed controlling device, such, for example, as an eddy-current brake, as shown, may be employed in such manner as to be influenced by variations of the mean current value so as to obtain a smooth and reliable speed controlling action without the use of inductances, condensers, or other devices for smoothing out variations in the commutated current, as is required in previous types of apparatus.

Where desired or required the braking action to be applied to shaft 3^a may be increased by the use of two or more eddy-current brakes and controlling vacuum tubes, one for each brake, as shown in Figure 1, wherein two such brakes and two vacuum tubes arranged in cascade are disclosed. As shown, in addition to the vacuum tube 16 and the brake device 20—21—22 controlled thereby, there is provided a second vacuum tube 23 having a cathode 24, a grid 25 and an anode 26, whose grid 25 is controlled by the secondary winding of a transformer 27, whose primary is inserted in the plate circuit

of the first tube 16. 29 is the brake winding of the second eddy-current brake actuated by the second tube, of which brake 30 is the braking magnet and 31 the associated brake disk on shaft 3^a. 28 is a plate current source in the brake controlling circuit in which the tubes and windings are arranged.

What I claim to be secured by Letters Patent in the United States is:—

1. Apparatus for maintaining two or more rotating bodies in complete synchronism, comprising, in combination, means for producing a synchronizing alternating current with a periodicity corresponding to the speed of one rotating body and having a distinct phase relation with respect to it, means to transmit said synchronizing current to another rotating body to be operated synchronously with said first-mentioned rotating body, a rotating commutator driven with said second rotating body to be synchronized and operating to commutate the arriving synchronizing current each time it reaches its maximum value in a state of complete synchronism, and a speed controlling device acting on the rotating body to be synchronized operated by the mean value of the commutated current supplied by said commutator.

2. Apparatus for maintaining two or more rotating bodies in complete synchronism, comprising, in combination, means for producing a synchronizing alternating current with a periodicity corresponding to the speed of one rotating body and having a distinct phase relation with respect to it, means to transmit said synchronizing current to another rotating body to be operated synchronously with said first-mentioned rotating body, a rotating commutator driven with said second rotating body to be synchronized and operating to commutate the arriving synchronizing current each time it reaches its maximum value in a state of complete synchronism, a control circuit including a three-electrode vacuum tube having its grid and filament influenced by the mean value of said commutated current, and a speed controlling device acting on the rotating body to be synchronized and governed by the plate current of the said vacuum tube.

3. Apparatus for maintaining two or more rotating bodies in complete synchronism, comprising, in combination, means for producing a synchronizing alternating current with a periodicity corresponding to the speed of one rotating body and having a distinct phase relation with respect to it, means to transmit said synchronizing current to another rotating body to be operated synchronously with said first-mentioned rotating body, a rotating commutator driven with said second rotating body to be synchronized and operating to commutate the arriving synchronizing current each time it reaches its maximum value in a state of complete synchronism, a

control circuit including a three-electrode vacuum tube having its grid and filament influenced by the mean value of said commutated current, and an eddy-current brake for controlling the speed of the rotating body to be synchronized and governed by the plate current of said vacuum tube.

4. Apparatus for maintaining two or more rotating bodies in complete synchronism, comprising, in combination, means for producing a synchronizing alternating current with a periodicity corresponding to the speed of one rotating body and having a distinct phase relation with respect to it, means to transmit said synchronizing current to another rotating body to be operated synchronously with said first-mentioned rotating body, a rotating commutator driven with said second rotating body to be synchronized and operating to commutate the arriving synchronizing current each time it reaches its maximum value in a state of complete synchronism, a control circuit including a three-electrode vacuum tube having its grid and filament influenced by the mean value of said commutated current, and means responsive to resulting variations in the plate current of

the tube for governing the speed of the rotating body to be synchronized.

5. Apparatus for maintaining two or more rotating bodies in complete synchronism, comprising, in combination, means for producing a synchronizing alternating current with a periodicity corresponding to the speed of one rotating body and having a distinct phase relation with respect to it, means to transmit said synchronizing current for controlling another rotating body to be operated synchronously with said first-mentioned body, a rotating commutator driven with said second rotating body and operating to commutate the arriving synchronizing current each time it reaches its maximum value in a state of complete synchronism, two three-electrode vacuum tubes arranged in cascade, the first having its grid influenced by the mean value of said commutated current, and two eddy-current braking devices controlling the speed of the rotating body to be synchronized and responsive to the plate currents of the respective vacuum tubes.

In testimony whereof I have affixed my signature.

JOHANNES VOPEL.