

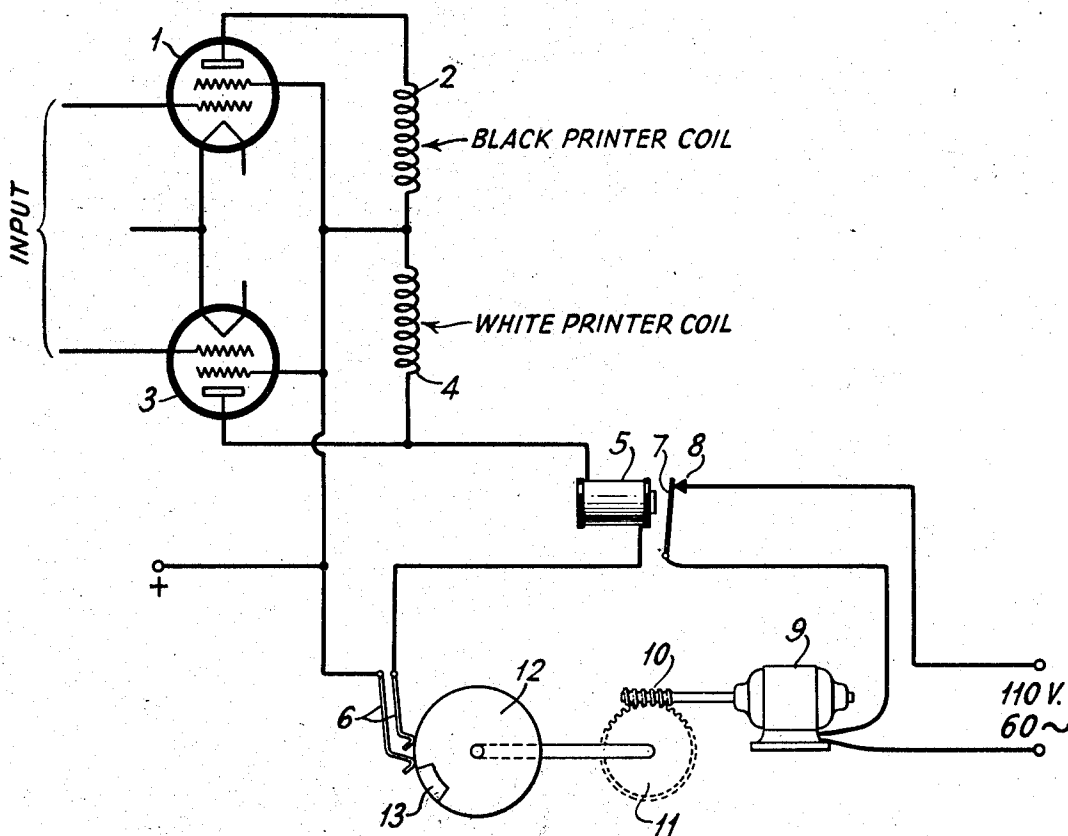
Feb. 4, 1941.

C. J. YOUNG

2,230,820

SYNCHRONIZING APPARATUS

Filed July 26, 1938



BY

INVENTOR.
CHARLES J. YOUNG

W. S. Swer
ATTORNEY.

UNITED STATES PATENT OFFICE

2,230,820

SYNCHRONIZING APPARATUS

Charles J. Young, Ardmore, Pa., assignor to Radio Corporation of America, a corporation of Delaware

Application July 26, 1938, Serial No. 221,300

4 Claims. (Cl. 178—69.5)

My invention relates in general to apparatus for maintaining two or more driven machines in synchronous relationship each to the other, and more particularly to such apparatus as applied to the idea of maintaining the operation of a facsimile recording machine synchronous with respect to the scanner.

Synchronizing arrangements per se have been known in the prior art but they have suffered from various disadvantages. For instance, in one type of synchronous arrangements used, the prime mover or motor which operated the machine could very easily stop on dead center, that is to say, that the machine might assume such a position when stopped that synchronizing signals would not complete the driving motor energizing arrangement, and hence a severe disadvantage occurs.

Accordingly, it is one of the objects of this invention to provide an arrangement whereby the driving motor may be energized and maintained synchronously operating regardless of the relative positions of the apparatus when stopped.

Again, in at least one of the better known synchronizing arrangements, the driving motor is "jogged" at regular intervals unless a synchronizing signal is received which prevents such jogging. By jogging the driving motor, I mean that the speed is changed or varied from its normal operating speed for a short interval of time. The phenomenon of fading may easily prevent the receipt of such a signal, and hence while the machine may be in exact synchronism, nevertheless, the motor will be jogged due to the fact that no synchronizing signal actually has been received to prevent this occurrence, and as a result the machine actually may be thrown out of synchronizing relationship with the scanner in the case of facsimile transmission. Accordingly, it is another of the objects of my invention to provide a device whereby synchronous relationship may be maintained even if some of the synchronizing signals are not received.

Again, in the arrangement shown in the prior art, the synchronizing apparatus per se has been somewhat difficult to adjust, assemble and maintain correct adjustment. Accordingly, it is another of the objects of my invention to provide a synchronizing arrangement which is both simple, accurate, and easy to adjust.

Therefore, the objects of my invention are:

1. To provide an arrangement whereby the driving motor in a facsimile recorder may be energized and maintained synchronously operat-

ing regardless of the relative positions of the apparatus when stopped.

2. To provide a device whereby synchronous relationship may be maintained even if some of the synchronizing signals are not received, provided "signal on white" transmission is used.

3. To provide a synchronizing arrangement which is both simple, accurate, and easy to adjust.

In the art of facsimile transmission, it is common practice to place an image to be transmitted onto a drum known as the scanner drum, and as this drum is rotated electrical impulses are developed sequentially which are representative of the optical values along each linear strip of the image. Since, necessarily, the reconstruction of the facsimile of the optical image must be made line by line, the material on which the image is to be recorded is usually passed around, or adjacent to, a recording drum, which must operate synchronously with the movement of the scanner drum in order to reconstruct a true facsimile. One such type of recorder is shown in U. S. Reissue Patent #20,152, granted to C. J. Young on October 27, 1936.

In this patent, there is disclosed a recorder drum around which is provided a single turn helix. Adjacent the helix is positioned a presser bar, and between the presser bar and the helix there is passed a material on which the image may be recorded and a sheet of carbon paper, and the action of the presser bar is such as to leave a smudge of elementary area on the recording material where the bar strikes the helix. For more detailed information reference should be had to that patent.

The receiver for controlling the production of of the image with such a device is provided with two tubes, a so-called "black" tube and a so-called "white" tube. The "black" tube conducts when the said incoming signals are representative of black in the picture, and continues to conduct well up into the white section of the picture. On the other hand, the "white" tube does not begin to conduct until currents representative of a medium value of white are impressed thereon, and the action of these two tubes taken conjointly is such as to give a desirable linear, or accentuated, operation in reconstructing the picture. This arrangement per se is not the entire subject-matter of this invention, and reference should be had to co-pending application Serial No. 737,720, filed July 31, 1934, showing such an arrangement.

In accordance with my invention herein to be

described, synchronizing impulses are transmitted in a "black" sense. There is joined to the recorder in an appropriate position, either directly on the scanning drum or otherwise an insulating member which has a commutating segment connected thereto. Adjacent the commutating segment, there is provided a pair of contacts normally opened with respect to each other. The segment is positioned so that if the machine is in correct synchronous position, the commutator segment closes these contacts at the time the black synchronizing signal is received. The contacts themselves form part of a relay circuit which is adapted to be energized by current through the "white" tube. Since the contacts will be closed only during the time the commutating segment contacts each other, and further since the synchronizing signal is "black," and accordingly no current should be flowing through the "white" tube, no action is performed in energizing the relay. However, should the segment close the contacts when the machine is not in synchronous relationship, current will be flowing through the "white" tube due to the picture signals being impressed thereon, and this current serves to break, or jog, the driving motor circuit for a short interval of time so that in effect if the driving motor be a synchronous motor, a pole will be slipped.

My invention will best be understood by reference to the figure which shows one embodiment of my invention.

Referring to the figure, there is shown a pair of thermionic vacuum tubes 1 and 3, the former being identified as the "black" tube and the latter being identified as the "white" tube. These tubes, as has been hereinbefore explained, are appropriately biased and operated so that the "black" tube responds very well to currents representing black in the picture, and this response gradually drops off as the currents approach white in the picture. On the other hand, the tube 3 is so biased and operated that it does not conduct for currents in the black region of the picture, but begins to conduct as the light sections are approached, and then takes hold, so-to-speak, very rapidly. Each of these tubes is connected to a coil which when energized forms an arrangement for driving the "presser bar" in a machine of the nature as shown in the above mentioned Reissue Patent #20,152 and, accordingly, in the output circuit of tube 1, there is connected a "black" printer coil 2, and in the output circuit of tube 3 there is connected a "white" printer coil 4.

Connected substantially in parallel with the "white" printer coil is a series circuit comprising a relay member 5 and a pair of contacts 6, 6. In turn this series circuit is connected to the plate potential supply indicated by plus, the negative of which is not indicated for purposes of simplicity.

Positioned adjacent the core of the relay 5 is an armature 7 and a contact 8, the armature and contact member being joined in series in the driving motor 9 energizing circuit whereby a breaking of the contact between the contact and armature acts to open the driving motor energizing circuit. It will be appreciated that this driving motor must operate synchronously with the driving motor of the scanner in order that an undistorted facsimile reproduction may be made. Hence, an opening of the driving motor circuit even momentarily will tend to jog the motor or, in other words, slow down the motor until by a series of joggings it may be pulled

into a framed relationship with the scanner motor.

Connected to the driving motor shaft is a worm gear 10 driving a gear 11, which in turn operates an insulating disc 12. On the outer periphery of the disc, or on the face thereof as illustrated here, there is fastened a conducting segment 13, and its position is such that once for each revolution of the disc 12 the contacts 6, 6 are closed. It should be appreciated that this showing is entirely schematic and that many departures may be made therefrom without departing from the spirit and scope of my invention since I am not in any fashion limited to the particular gear arrangement nor the particular location of the insulating disc, nor conducting segment.

It, therefore, will be seen that should the conducting segment 13 close the circuit of the contacts 6, 6 the relay 5 will be normally energized by current from the "white" tube and the driving motor circuit will be opened. Since the synchronizing signals are transmitted entirely in the "black" direction, and further since the "white" tube is inoperative for "black" signals, it will be appreciated that the location of the conducting segment is such that when a synchronizing signal is received the conducting segment should close the circuit of the contact 6, and since no current will flow through the winding of the relay 5 due to the fact that the "white" tube is then non-conducting, the driving motor circuit remains unaltered in its operation. However, should the machine be out of synchronized relationship with the scanner, then the conducting segment 13 will not complete the circuit of the contacts 6, 6 at the time the synchronizing signal arrives but will be out of position with respect thereto. At the completion of the synchronizing signal at the scanner, the normal scanning operation for a line of the picture takes place and picture signals are developed and hence the "white" tube is conducting. Hence, when the segment 13 does close the circuit of the contacts 6, 6 the relay 5 will be energized by current through the "white" tube and the armature 7 will be retracted, thus jogging the motor, or opening the motor circuit whereby the speed of the motor is changed by a slight amount for a short interval of time. A series of these joggings will gradually pull the motor into a relationship whereby the segment 13 completes the circuit of the contacts 6, 6 when the synchronizing signal arrives, and no action will take place in so far as the driving motor is concerned, and the machine will thus be maintained in synchronous relationship with the transmitter.

In practice, there is sometimes a tendency of the relay to spark slightly when it reaches a point of operation where the opening time is too short to slip the motor another pole. This is eliminated by sending out first a short line framing signal and then, after all of the machines have had sufficient time to gain a framed relationship, increasing the length of the impulse during the succeeding program facsimile transmission. In view of the fact that the apparatus works very quickly to synchronize correctly the recording machine, and further since at the present time a considerable length of time is involved in transmitting one complete page or picture, the machines having once attained synchronism may be continued synchronously operating by the long pulses.

It should be understood that when I speak of

the scanner and recorder operating in synchronous relationship, what is meant is not only that the driving motors are running at equal speeds, but that the scanner drum and the recorder drum are being operated in phase.

It also should be understood that when I speak of transmission on "white," I mean that the signal amplitude increases as the scanned picture point gets lighter in shade. A signal on a "black" system naturally would be the reverse.

What I claim is:

1. In synchronizing apparatus wherein a plurality of machines are to be kept operating in synchronous relationship and wherein electrical impulses are transmitted and a portion of which is indicative of the operating position of one of said machines, means for receiving said impulse, a prime mover for driving the machine to be synchronized, an insulating member operated by said machine, the position of said member being indicative of the operating position of said machine, a commutating segment operated by said insulating member, means adjacent to and in contact with said insulating member and said commutating segment during at least a portion of the cycle of movement of said members, means for impressing the received signal onto said latter means, and means operable by said latter means to interrupt the normal driving of the prime mover for a short interval of time when said latter means and said insulating segment are in contact with each other during receipt of said synchronizing signal, said means being actuated by the remaining portion of the electrical impulses.

2. In synchronizing apparatus for facsimile apparatus wherein a plurality of machines are to be kept in synchronous relationship, and wherein picture and synchronizing impulses are sequentially transmitted, means for receiving said impulses, a prime mover, means for energizing said prime mover, a plurality of amplifying means one of which is responsive to picture signals only, means cyclically operable by said prime mover for controlling the prime mover energizing circuit, and means energized by the amplifier responsive to picture signals only for interrupting the prime mover energizing circuit at one interval of the cycle thereof.

3. Synchronizing apparatus for facsimile recorders wherein synchronizing signals representative of picture black and picture signals are transmitted sequentially, means for receiving said signals, a driving motor, a source of energy for operating said motor, a vacuum tube amplifier responsive only from lower values of white to white in said picture, means for impressing said signals onto said tube, a commutator operable by said driving motor, the position of said commutator being indicative of the operating position of said recorder, means energized by said amplifier tube for interrupting said driving motor energizing means, and means for controlling the operation of said latter means in accordance with the position of said commutator segment.

4. Synchronizing apparatus for facsimile recorders wherein synchronizing signals representative of picture black and picture signals are transmitted sequentially, means for receiving said signals, a driving motor, a source of energy for operating said motor, a vacuum tube amplifier responsive only from lower values of white to white in said picture, means for impressing said signals onto said tube, an insulating disc member cyclically operable by said driving motor, a commutator segment connected to said insulating disc and so positioned that for synchronous position of said recorder said segment is at a definite predetermined position in its cycle of operation, a pair of normally open conducting contact members positioned adjacent said insulating disc and said conducting segment and in contact therewith, an amplifier tube biased so as to be responsive to picture signals only, means for impressing both picture and synchronizing signals onto the input circuit of said vacuum tube, a series circuit comprising the anode of said tube, a relay and said normally open contact members, an armature member positioned adjacent said relay, a contact member normally held in contact with said armature member, and a series circuit comprising said armature member, the latter contact member and the driving motor energizing means.

CHARLES J. YOUNG.