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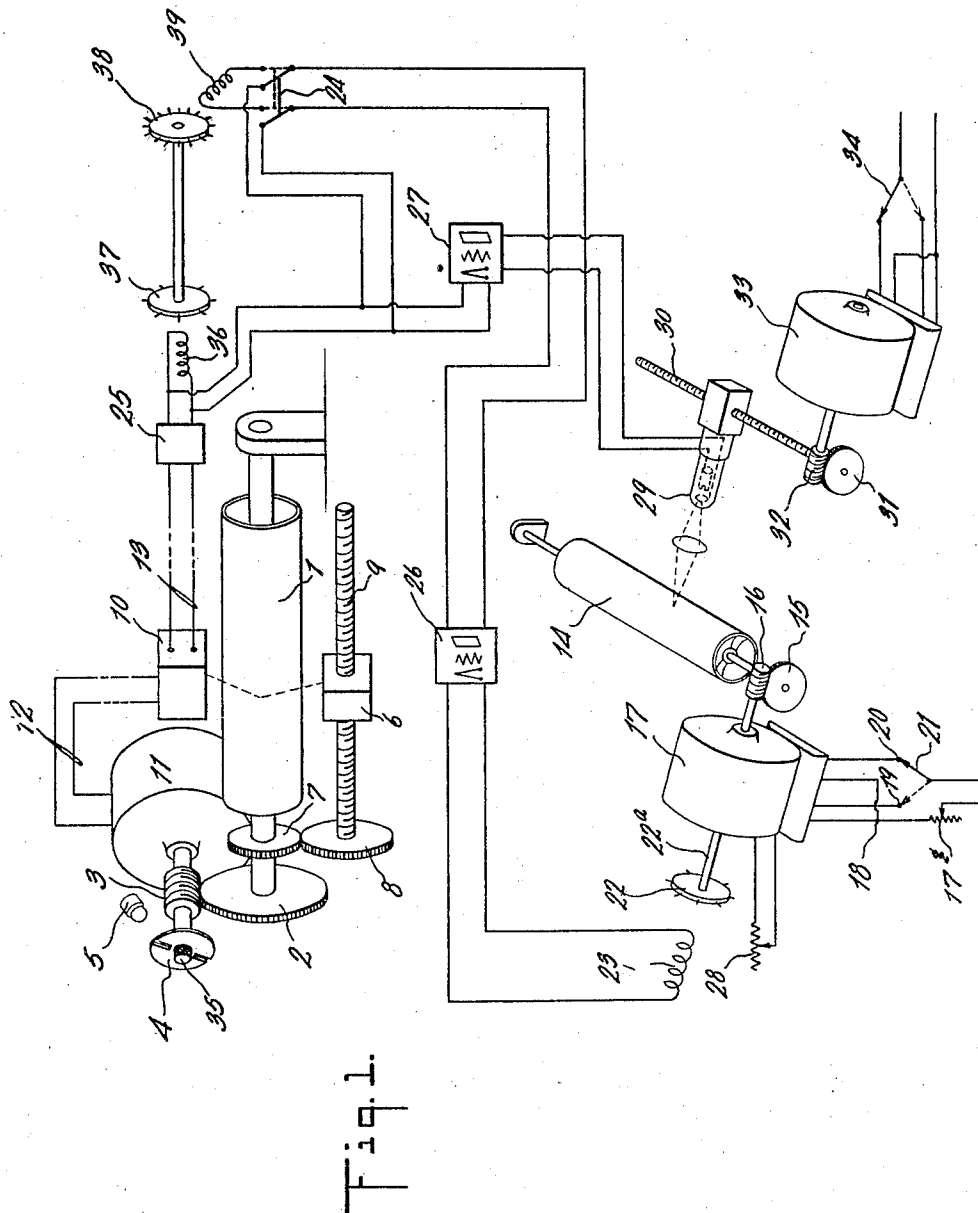
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2,280,688

ELECTRO-OPTICAL TRANSMISSION SYSTEM AND APPARATUS

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

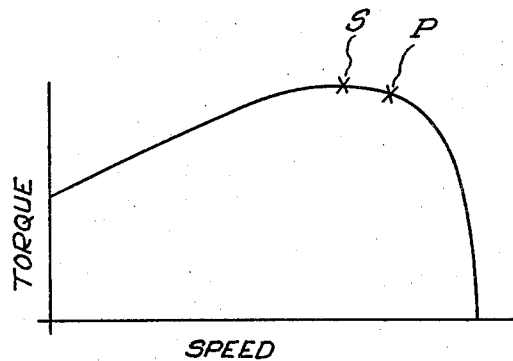
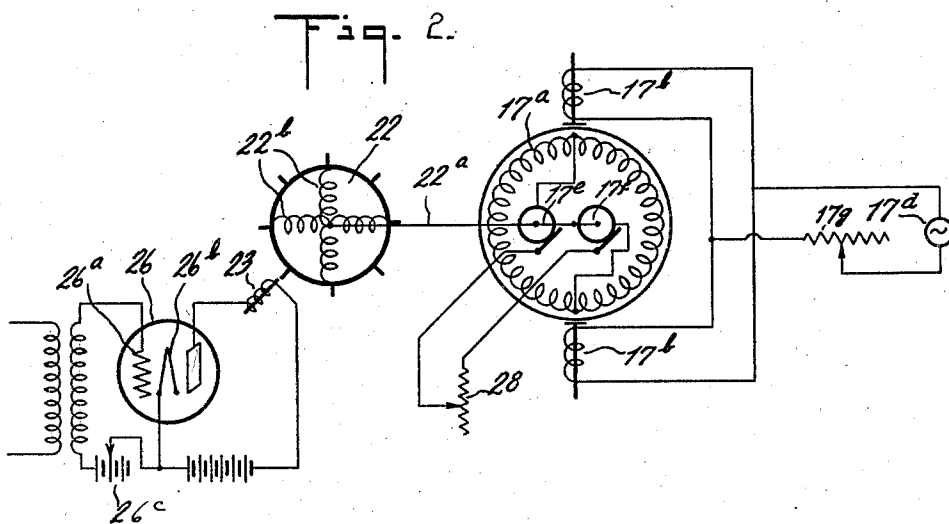


Fig. 3.

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ELECTRO-OPTICAL TRANSMISSION
SYSTEM AND APPARATUS

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2 Claims. (Cl. 178—69.5)

This invention relates to electro-optical systems, and more especially to systems for transmitting visual representations to a distance and reproducing facsimiles thereof by electro-optical means.

A principal object is to provide an improved motor drive for the scanning mechanism of a facsimile system or for the rotary signalling device of any other similar signalling system.

Another object is to provide an improved induction-motor-synchronous-motor combination to facilitate attaining and maintaining synchronous speed of associated signalling equipment.

Another object is to provide an induction-motor drive and method of adjusting the torque-speed characteristic so as to correlate it with the synchronous frequency of an associated synchronous motor.

A feature of the invention relates to the novel organization, arrangement and relative interconnection and adjustment of parts whereby a facsimile scanner or similar rotatable signalling device can be brought to, and maintained at, synchronous speed.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

In the drawings which show one preferred embodiment of the invention,

Fig. 1 is a schematic composite circuit and apparatus diagram to illustrate certain features of the invention.

Fig. 2 is a schematic diagram of the motor drive of Fig. 1 to explain the method of adjusting the characteristics of the induction-motor portion of the drive.

Fig. 3 is a curve explanatory of the operation of Fig. 2.

Referring to Fig. 1, there is shown in schematic form, a facsimile transmission system embodying the various features of the invention. The transmitting drum 1 around which the picture or other subject-matter is wrapped, is rotated about its axis, from the motor 11 through the worm wheel 2 and the replaceable worm drive 3. A stroboscopic indicator wheel 4 is also carried as a unit by the replaceable worm and is illuminated by the stroboscopic lamp 5 which may be energized by currents from a source whose frequency is known. The members 3 and 4 form a readily replaceable unit with the stroboscope wheel definitely related to the pitch of the worm 3. The line feed for the illuminating optical scanning system 6 is effected by gear wheel 7 and

gear wheel 8, the latter being fastened to the lead screw 9 to feed the system 6 which may be of any well-known construction.

Associated with the drum 1 is any well-known form of light sensitive pick-up and modulating arrangement 10. Preferably, although not necessarily, motor 11 drives an A. C. generator (not shown), for example a generator of 1800 cycle current which is fed to the apparatus 10 over the conductors 12 whereby the 1800 cycle current is modulated in the device 10 in accordance with the intensity of the light reflected from each successive elemental area of the picture on drum 1. A detailed description of such modulating system is given in Patent No. 2,015,742.

The amplified picture currents which are impressed on the transmission channel 13, therefore, have a carrier frequency which is locked to the speed of drum 1, since the motor which drives drum 1 also drives the A. C. generator. Consequently, as described in said Patent No. 2,015,742, these currents may be used to control the recording lamp at the receiver as well as to synchronize the receiving apparatus with the transmitter.

The receiver includes a rotatable drum 14 which is mounted for rotation about its axis in suitable bearings and is driven by a worm wheel 15 carried by the drum shaft, which worm wheel is driven by a worm 16. Drum 14 is brought up to speed by a two-speed induction motor 17 having two sets of windings for the respective speeds. A common terminal 18 is provided for both windings and individual terminals 19 and 20 are provided for the other windings, these latter terminals being selectively connectable to the supply line by a switch 21. Preferably, a variable resistance 17a is connected in circuit with the common terminal and the primary of motor 17, and a variable resistance 28 is connected in circuit with the secondary winding of motor 17, for purposes to be described.

When the switch 21 is in the full line position the motor 17 will rotate, for example at 1800 R. P. M. which would be equivalent to 45 R. P. M. for the drum 14. When the switch 21 is in the dotted position, the motor 17 rotates at 3600 R. P. M. which is equivalent to 90 R. P. M. for the drum 14. Induction motor 17 is mechanically connected to the rotor 22 of a synchronous motor which controls the synchronous speed of drum 14. With this arrangement, the induction motor 17 brings the drum up to or near synchronous speed and provides enough power to take care of part of the fixed load such as steady

friction from the various bearings, windage, etc. The remaining steady load and all load variations such as caused by slight speed changes at the transmitter, as well as power supply variations, are taken by the synchronous motor 22.

The stator winding 23 of the synchronous motor is supplied with part of the received picture carrier current through a double-pole switch 24 when the latter is in the full-line position shown. It will be understood of course, that the received signals are suitably amplified in amplifiers 25, 26, and preferably the amplifier 26 which feeds the stator 23 is biased as will be described in detail hereinbelow in connection with Figs. 2 and 3. This bias is related to the resistance 28 in circuit with the wound rotor of induction motor 17 as will also be described below so as to operate the motor 17 on a predetermined portion of its torque-speed characteristic curve. The motor 17 will then be constrained to run at or near the synchronous speed of the motor 22, the latter acting as a speed control for the induction motor. Consequently, as the drum 14 approaches the synchronous speeds, the motor 22 readily falls into step with the received signal.

The position of recording lamp 29 is controlled by the line feed screw 30 driven through worm-wheel 31 and worm 32 from a two-speed induction motor 33 similar to motor 17. Motor 33 is provided with a switch 34 so as to connect in circuit either the low or high speed winding as desired. The lamp 29 is energized from its associated amplifier 27.

It will be assumed for purposes of illustration, that in the arrangement as shown, drums 1 and 14 are being driven at 90 R. P. M. and that the generator which supplies the carrier current to device 10 delivers an A. C. of 1800 cycles. Under this assumption therefore, switches 21, 24 and 34, are in their dotted line positions whereby motors 17 and 33 rotate at approximately 3600 R. P. M. Should it be desired to change the speed of rotation of the drum 1 to 45 R. P. M., the double-thread worm and stroboscope assembly 3, 4, is removed by loosening thumb nut 35, and is replaced by a single-thread worm as described in detail in application Serial No. 261,184, filed March 11, 1939. When the switch is in this full line position, an 1800 cycle signal will be supplied to the synchronous motor 23, 22. When it is in the dotted line position, the coil 39 will pick up a 3600 cycle signal from the phonic wheel generator 38, 39, which is driven by the synchronous motor 36, 37. At the receiver, the speed can be reduced to 45 R. P. M. when the switch 24 is thrown to its full line position, so as to supply 1800 cycle signal to the motor 23, 22. Switches 21 and 34 will also have to be thrown to the full line position. When in this position, motor 17 will be brought up to a speed approximating synchronous speed of the motor 23, 22. At this point, the synchronous motor will take control of the speed of the drum. The speed of the line feed motor will also be changed to produce a scanning line feed corresponding to that of the transmitter.

As described above, in connection with Fig. 1, the assembly comprising the induction motor 17 and the synchronous motor 22-23, is preferably adjusted so as to operate on a particular portion of the speed-torque characteristic curve of the induction motor. A typical speed-torque characteristic of such a motor is shown in Fig. 3, and preferably, the motor is designed and is

provided with adjustable means so as to enable it to run at the proper point. Since the synchronous speed is to be determined by the speed of the received carrier current, the synchronous motor rotor 22 is mechanically connected to the shaft 22a of the A. C. induction motor 17. It is desirable that the synchronous motor 22 should come into synchronism with the received carrier without any unnecessary attention on the part of an attendant, and also in the event that the synchronizing signal should fail for a short time, that the motor 17 automatically will fall into synchronism when the synchronizing signal is reestablished. For this purpose, the incoming signal received over line 13 is fed into an amplifier 26 which has its control grid 26a biased preferably negatively with respect to the cathode 26b, for example by the negative grid battery 26c, so that in the absence of a synchronizing signal applied to the grid 26a, a steady magnetizing current flows through winding 23. The anode circuit of tube 26 includes the stator winding 23 of the synchronous motor. The induction motor may comprise the wire wound secondary 17a and a primary winding 17b, the latter being connected to a source of power 17d of fixed frequency or through an adjustable resistor 17g to a source of power of a controllable frequency. The slip rings 17e, 17f, connect the secondary winding 17a with the variable resistance 28 to permit adjustment of the torque-speed characteristic of the motor. The resistance 28 is adjusted so that when no signal is applied to the stator winding 23 of the synchronous motor, the induction motor 17 drives the assembly at slightly above synchronous speed at which time the motor operates at point P of its characteristic curve (Fig. 3). The induction motor will not tend to run much above this point in speed, because the torque will limit the speed to the indicated point. In cases where the resistance 28 can be fixed at a given point, it is desirable to include the resistance in the rotor itself to eliminate the necessity of the slip rings 17e and 17f. This can be done in any conventional manner; such as using brass bars in a squirrel cage rotor, or spacing the bars away from the rim of the rotor, or increasing the air gap between the rotor and stator. When the synchronizing signal is applied to the stator 23, there will be exerted an electro-magnetic drag on the rotor 22 which causes the assembly to slow down gradually. As the speed of the assembly approaches synchronous speed, that is, the synchronous speed of rotor 22, the motor 17 readily falls into step with the applied signal, which point is indicated by the letter "S" (Fig. 3). Preferably, the rotor 22 is coupled to the shaft 22a by any well-known form of spring coupling diagrammatically indicated by the numeral 22b.

While in the foregoing description the method of operation has been predicated upon the continuous operation of the induction motor 17 which is maintained at synchronous speed by the synchronous rotor 22 this is not necessary in all cases. For example, if the synchronous motor 22, 23, is of the type disclosed in application Serial No. 299,955, filed October 18, 1939, it may be made of such high efficiency that by itself it will provide sufficient power to maintain the drum 14 in synchronism in which event the switch 21 will be moved to open circuit position when the drum 14 has been brought to synchronous speed and the received synchronizing im-

pulses will maintain the drum operating at the synchronous speed. Furthermore, while in the foregoing description, it has been mentioned that the induction motor 17 is adjusted so that its slip speed is slightly above the synchronous speed of the synchronous motor, it will be understood that the invention may also be employed by adjusting the resistance 28 or designing the induction motor 17 so that its slip speed is slightly below the said synchronous speed. Under these circumstances, the induction motor merely serves to bring the drum 14 nearly up to synchronous speed whereupon the synchronous motor 22 which is driven by the received synchronizing impulses, brings the mechanical system including drum 14 to synchronous speed. In this arrangement, the spring coupling 22b has been found important since without it, it would be very difficult for the synchronous motor to pull the mechanical system including the rotor of induction motor 17 up to the proper synchronous speed. Preferably, although not necessarily, the spring coupling 22b between the synchronous motor shaft and the induction motor shaft is provided with any well-known form of dampening means in order further to insure the proper operation of the mechanism.

While certain specific embodiments have been described herein, it will be understood that various changes and modifications may be made

without departing from the spirit and scope of the invention. This application is a continuation-in-part of application Serial No. 261,184, filed March 11, 1939.

What we claim is:

1. In combination, a synchronous motor having a toothed rotor and a stator winding adapted to be normally excited by D. C. polarizing currents, means to receive synchronizing impulses, a grid-controlled amplifier tube upon which said impulses are impressed, the said stator winding being connected in the plate circuit of said tube to be excited by the normal steady space current thereof even in the absence of synchronizing signals, an induction motor, the rotor of said synchronous motor being resiliently coupled to the rotor of said induction motor, and means to adjust the characteristics of the induction motor so that it normally runs at a speed slightly higher than the maximum torque-speed in the absence of said synchronizing signals.

2. The combination according to claim 1 in which the control grid of said tube is biased to permit a polarizing current to flow through the stator of the synchronous motor.

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