

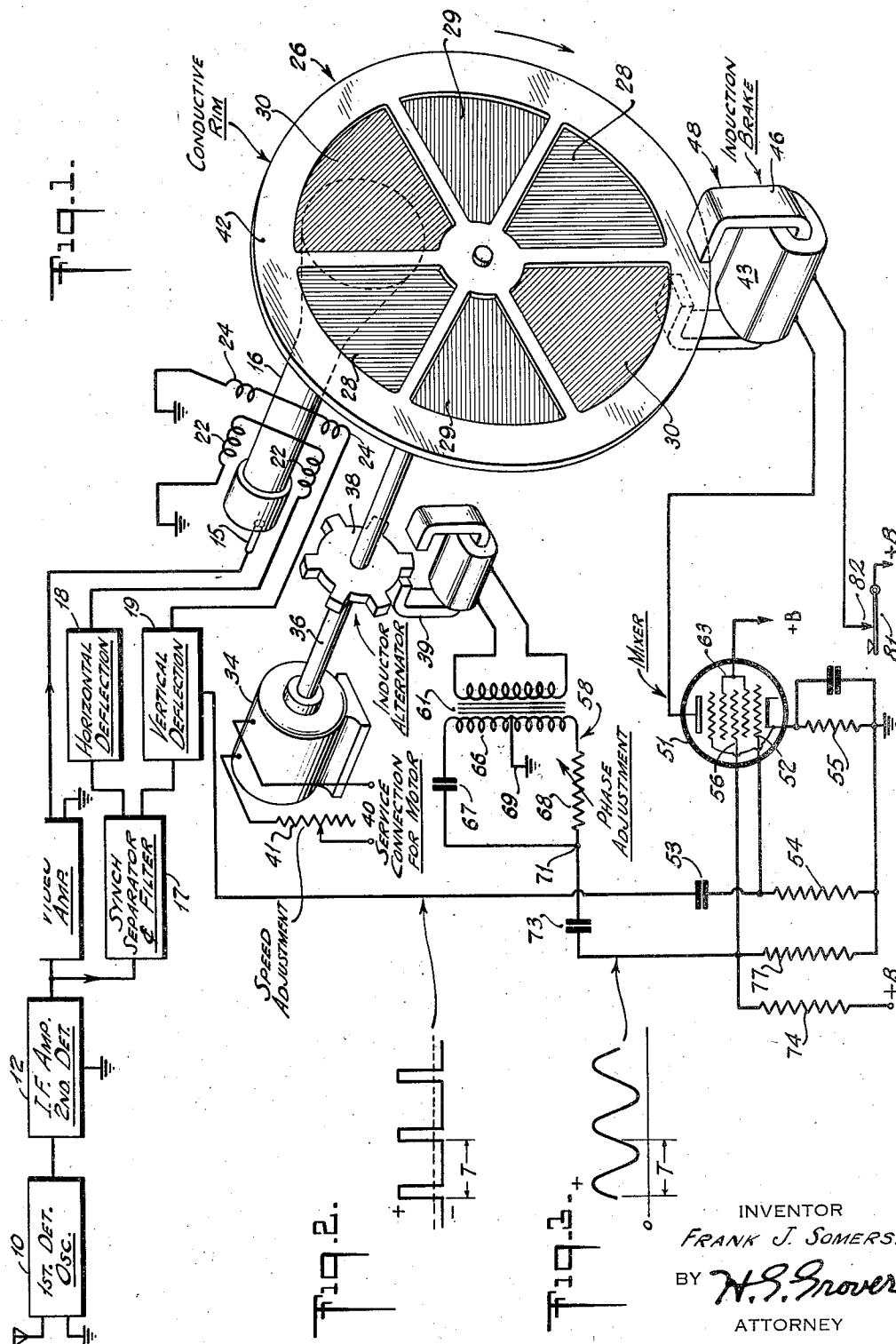
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SYNCHRONIZING IN COLOR TELEVISION

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SYNCHRONIZING IN COLOR TELEVISION

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The invention relates to means for controlling the speed of a moving member, and more particularly to such control circuits and associated apparatus as are applied to television receivers for maintaining a color separation filter disc, wheel, or drum in synchronism with a color field separating device at the transmitter.

It has been the practice in many instances in television systems for transmitting color images to utilize color filters at both transmitter and receiver, these filters being mounted on discs, wheels, or drums which are rotated in synchronism with one another, as may be accomplished by means of synchronous motors operated from interconnected power sources. In systems employed in this way, the synchronous motors are relatively large and expensive, this being true even when part of the mechanical power is supplied by a non-synchronous motor.

The disadvantage in relying on interconnected power sources is that in some localities not served by an interconnected system, a color receiver cannot be operated. If synchronizing power for a synchronous motor is obtained from a circuit controlled by pulses transmitted and amplified after reception to a degree sufficient to drive the motor, such a circuit is wasteful of power and is expensive because it must supply a fairly large amount of power to the synchronous motor.

An object of the present invention, accordingly, is to provide a novel and improved method of and means for maintaining color discs, wheels, drums, or the like in synchronism in a television system.

A further object of the invention is to provide an improved speed control system for television or the like apparatus.

A still further object of the invention is to provide an improved method of and means for controlling the speed of any non-synchronous motor.

In a preferred embodiment of the invention, the color wheel at the television receiver is driven by a motor of any type which has a reasonably constant speed characteristic, and the speed of the color separation filter unit is maintained in synchronism under control of received signals by employing an induction braking effect in a novel manner. The synchronizing control voltage, which provides the induction braking effect, is obtained by mixing pulses from an inductor alternator or the like rotating with the color wheel together with received or locally generated pulses. The mixing is accomplished by a vacuum tube, the plate current of which flows through the coil

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of the stationary element of the induction brake. An appropriate portion of the color wheel serves as the moving element of the brake.

Other objects and advantages of the invention will, of course, become apparent and immediately suggest themselves to those skilled in the art to which the invention is directed from a reading of the following specification in connection with the accompanying drawing in which:

Fig. 1 shows, schematically, a television receiver embodying the invention; and

Figs. 2 and 3 are curves used in explaining the operation of the invention.

Referring to Fig. 1 of the drawing, a television receiver is shown illustratively and schematically which is of a well-known type comprising a first detector and a tunable oscillator indicated at 10, an intermediate frequency amplifier and a second detector indicated at 12, a video amplifier 14, and an image producing device such as a cathode ray tube 16. The output of the video amplifier is supplied in the usual manner to the cathode ray tube 16, a terminal 15 of which is shown illustratively and schematically, and it will be understood that means are present for providing the usual biasing voltages for the several elements of this tube. The receiver is designed for the reception of the usual composite signal comprising image signals and horizontal and vertical sync pulses, a horizontal sync pulse following each scanning line, and a vertical sync pulse occurring at the end of each vertical deflection.

This composite signal is supplied both to the cathode ray tube 16 and to a suitable sync pulse separating and filtering circuit indicated at 17. Usual and well-known blanking methods (not shown) cause the tube 16 to respond only to the image signal. From the circuit 17, horizontal sync pulses are supplied to a horizontal deflecting circuit 18, and vertical sync pulses are supplied to a vertical deflecting circuit 19. These deflecting circuits provide the usual oscillator triggering pulses and current waves of sawtooth shape in the horizontal and vertical deflecting coils 22 and 24, respectively.

A rotary filter or color wheel 26 is shown by way of example, and it will be noted that this wheel is positioned so that it chops and filters the light emitted by the tube 16 by means of the filter sections 28, 29, and 30. In the tricolor color arrangement selected by way of example, these three filter sections are usually the component colors red, blue, and green of an additive color system, and they are repeated on the

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other half of the wheel so that there is a total of six filter sections.

The equipment for sequential scanning of the original in different colors is not disclosed herein, but it will be understood that any system of scanning may be employed for applying a series of signals to the appropriate electrode or electrodes of the tube 16 in timed relationship with the presentation of the colored sectors 28 to 30 or their equivalent. An arrangement for effecting television scanings at the transmitter end of a tricolor system wherein a storage type cathode ray television camera tube is used to resolve the light image into signals for transmission is shown in Patent No. 2,297,524, granted September 29, 1942, which may be regarded as illustrative of one form of transmitter system. It will be understood that the arrangement to be described in detail, which constitutes the invention, may be applied at the transmitter if a color wheel is employed.

The color wheel 26 is driven by a motor 34 which preferably has a reasonably constant speed characteristic. The motor 34 is mechanically connected to the wheel 26, for example by a shaft 36 which is mechanically connected to or carries the toothed rotor 38 of an inductor alternator 39. A service connection 40 is provided for the motor 34 which, it will be understood, may be the usual and appropriate commercial supply source, such as the 60-cycle mains. A coarse speed adjustment for the motor 34 is provided by a rheostat 41. If the motor is of the alternating induction type, this source may be of the usual commercial frequency, the voltage rating of the motor being selected to suit.

The wheel 26 is designed to have a rim 42 of conductive material which is preferably of light weight. Aluminum is suitable for this purpose. Likewise, the entire structure of the wheel which supports the filter sections may be constructed of this material. It will be understood by those skilled in the art that when the coil 43 of the stationary magnetic element 46 of an induction brake indicated in its entirety by reference character 48 is energized, a retarding effect must be produced upon the wheel 26.

The coil 43 is in the plate circuit of a vacuum tube 51 of the multigrid type, for example a 6L7 tube. The No. 1 grid 52 is connected to an appropriate part of the vertical deflection circuit 19, for example to the blocking oscillator (not shown) therein. This connection is made by way of a coupling condenser 53 and a grid resistor 54. A cathode biasing resistor 55 maintains the grid 52 negative with respect to the cathode. The No. 3 grid 56 is connected to a phase adjusting network indicated generally by reference character 58. The output of the inductor alternator 39 is coupled to the network 58 by way of a transformer 61. The No. 2 and 4 grids 63 serve in the usual manner as a screen.

The phase adjusting network comprises the transformer secondary 66 which is shunted by a condenser 67 and an adjustable resistor 68 in series. The output of a network 58 is taken across the transformer tap 69 and the junction of the condenser and resistor 71. This output is applied to the grid 56 by way of a coupling condenser 73. A positive bias is applied to the grid 56 by means of a voltage divider comprising elements 74 and 77. The bias on the grid 52 may be small.

In operation of the system, the motor 34 is arranged to drive the wheel 26 at a speed which

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is slightly above synchronous speed. The inductor alternator 39 generates a sine wave of the same frequency as the vertical sync signals derived from the incoming television signal and applied to the grid 56 when it runs at the exact speed for proper color rendition. The output current of the tube 51 will vary plus or minus above or below the average plate current depending on the relative phase of the sync pulse and the sine wave. The output current of the tube, as previously stated, passes through the coil 43 and applies a braking force at the rim 42 of the wheel 26. This braking force is varied in accordance with the speed of the wheel acting through the inductor alternator 39. The tendency of the motor to operate at a speed higher than the exact speed desired may be controlled by the speed adjustment 41, and a fine adjustment of the exact phase position of the wheel 26 may be obtained by varying the value of the resistor 68.

Considering in detail the steps of the operation, the plate current in the tube 51 is held at a low value by the negative bias on the grid 52 in the absence of sync pulses applied with positive polarity to this grid. Each sync pulse will cause the plate current of the tube to increase for the duration of the pulse. Figs. 2 and 3 of the drawings show the time relationship of the sync pulses and the sine wave produced by the inductor alternator 39. It will be seen that the time period T of the sync pulses is equal to the time of a single cycle of the sine wave which is generated. The magnitude of the increase in plate current, however, depends on the phase relationship between the sine wave applied to the grid 56 with respect to the pulses applied to the grid 52. Therefore, a braking action is applied to the color wheel in proportion to this phase difference, and if the free running speed of the wheel 26, as adjusted by the device 41, is near to synchronism with the incoming field frequency sync pulses, this braking action will be sufficient to hold the wheel in step. In the event that the relative angularity or cophasal position of the filter segments of the wheel 26 do not correspond to the scanning, the angular position of the wheel may be shifted by adjustment of the phase control adjustment 68.

For correct color rendition, it is essential that when a color field is scanned at the transmitter, the filter corresponding to this color be in position before the tube 16. This is true at both the transmitter and receiver and, as pointed out hereinbefore, the invention may be applied to both the transmitter scanner and the receiver scanner or either. To provide for obtaining the result of correct color rendition, a switch 81 having a break contact 82 may be operated momentarily if the operator observes an incorrect color rendition. The switch may be of any desired type, but it is indicated as being in the form of a readily operated key. Operation of the switch 81 to open its contacts momentarily removes the braking action from the wheel 26 and permits it to advance one or more filter segments to a new relative angular position. Following this, the operation will be as above stated, and the wheel will be maintained in synchronism and in its correct relative angular position.

It has been ascertained that a very small braking torque will keep the wheel 26 accurately in step. The additional load on the motor 34, therefore, is very slight, which is a distinct advantage over arrangements which employ braking devices

relying on variable and unpredictable effects such as mechanical friction. An instantaneous braking action is achieved by arrangements embodying this invention.

Various modifications of the invention shown and described herein by way of example are possible without departing from the spirit and scope of the invention described herein, and it is desired that any and all of such modifications be considered within the purview of the present invention defined by the hereinafter appended claims.

Having now described the invention, what is claimed and desired to be secured by Letters Patent is the following:

1. In combination, a motor which is to run in synchronism with a synchronizing signal, means actuated by said motor for producing a control signal in fixed time relation to the speed thereof, a phase comparison device to which said control signal and said synchronizing signal are applied, a color filter wheel driven by said motor and having an electrically conducting portion thereof serving as the moving section of an electro-magnetic eddy current brake, a magnetic member cooperating with said wheel section, a coil on said magnetic member, and a connection from said phase comparison device to said coil.

2. In a television receiver in combination, a color filter wheel, a non-synchronous motor for driving said wheel, said wheel having a conductive portion to serve as the moving member of an electro-magnetic brake, a magnet having a coil cooperating with said conductive section, means for producing an electromotive force having a frequency proportional to the speed of said wheel, means for providing a signal in step with the framing frequency of received television signals, and means including a vacuum tube mixer for comparing the frequency of said signals and varying the current through said coil in accordance with said comparison.

3. In a television receiver in combination, a color filter wheel, a variable speed motor for driving said wheel, said wheel having a portion to serve as the moving member of a brake, means having a winding for serving as the stationary component of the brake, a source of E. M. F. having a sinusoidal output the frequency of which is proportional to the speed of said wheel, a source of synchronizing signal pulses of predetermined frequency, a multigrid vacuum tube for comparing the phase of said alternator output and said synchronizing signal pulses, said winding being included in the output circuit of said tube, means

to bias one of said grids negative, means to apply said synchronizing signal pulses to said negatively biased grid, means to apply said sinusoidal output to another of said grids, said synchronizing signal pulses causing said tube to become conductive to thereby increase the plate current of said tube, the amount of said increase being determined by the relative phase relationship of said pulses and said sinusoidal frequency.

4. In a television receiver in combination, a color filter wheel, a variable speed motor for driving said wheel, said wheel having a portion to serve as the moving member of a brake, means having a winding for serving as the stationary component of the brake, an alternator having a sinusoidal output the frequency of which is proportional to the speed of said wheel, a source of synchronizing signal pulses of predetermined frequency, a multigrid vacuum tube for comparing the phase of said alternator output and said synchronizing signal pulses, said winding being included in the output circuit of said tube, means to bias one of said grids negative, means to apply said synchronizing signal pulses to said negatively biased grid, means to apply said alternator output to another of said grids, said synchronizing signal pulses causing said tube to become conductive to thereby increase the plate current of said tube the amount of said increase being determined by the relative phase relationship of said pulses and said sinusoidal frequency.

5. In combination, a motor which is to run in synchronism with a synchronizing signal, means actuated by said motor for producing a control signal in fixed time relationship to the speed thereof, means comprising a phase shifting circuit for adjusting the phase of said control signal, a phase comparison device to which said control signal and said synchronizing signal are applied, a color filter wheel driven by said motor, said wheel having an electrically conducting portion thereof serving as the moving section of an electromagnetic eddy current brake, a magnetic member cooperating with said wheel section, a coil on said magnetic member, and a connection from said phase comparison device to said coil.

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The following references are of record in the file of this patent:

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