

March 10, 1942.

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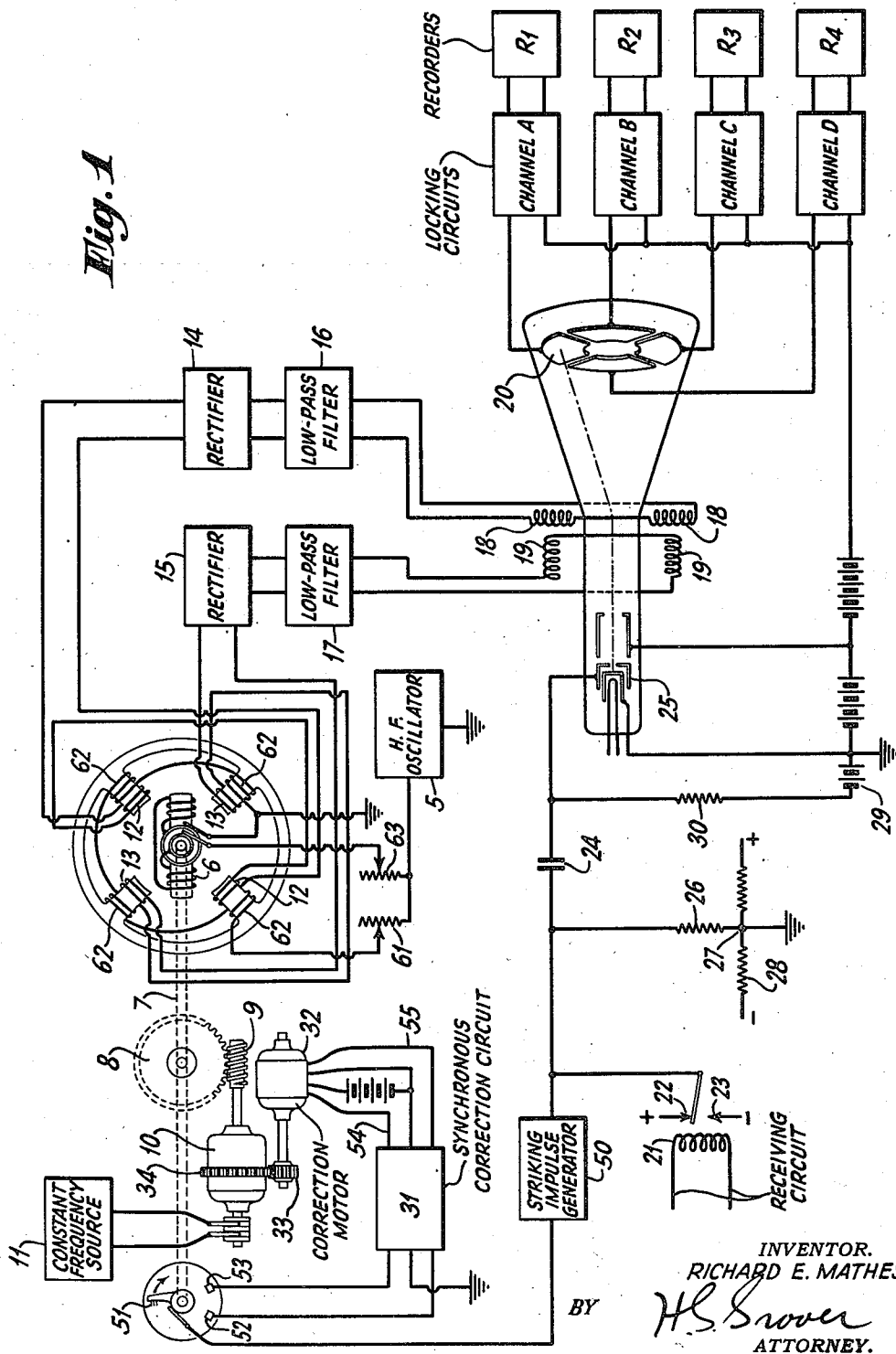
2,275,974

SWEEP CIRCUIT FOR CATHODE RAY TUBE DISTRIBUTOR

Filed Feb. 28, 1939

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Fig. 1



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March 10, 1942.

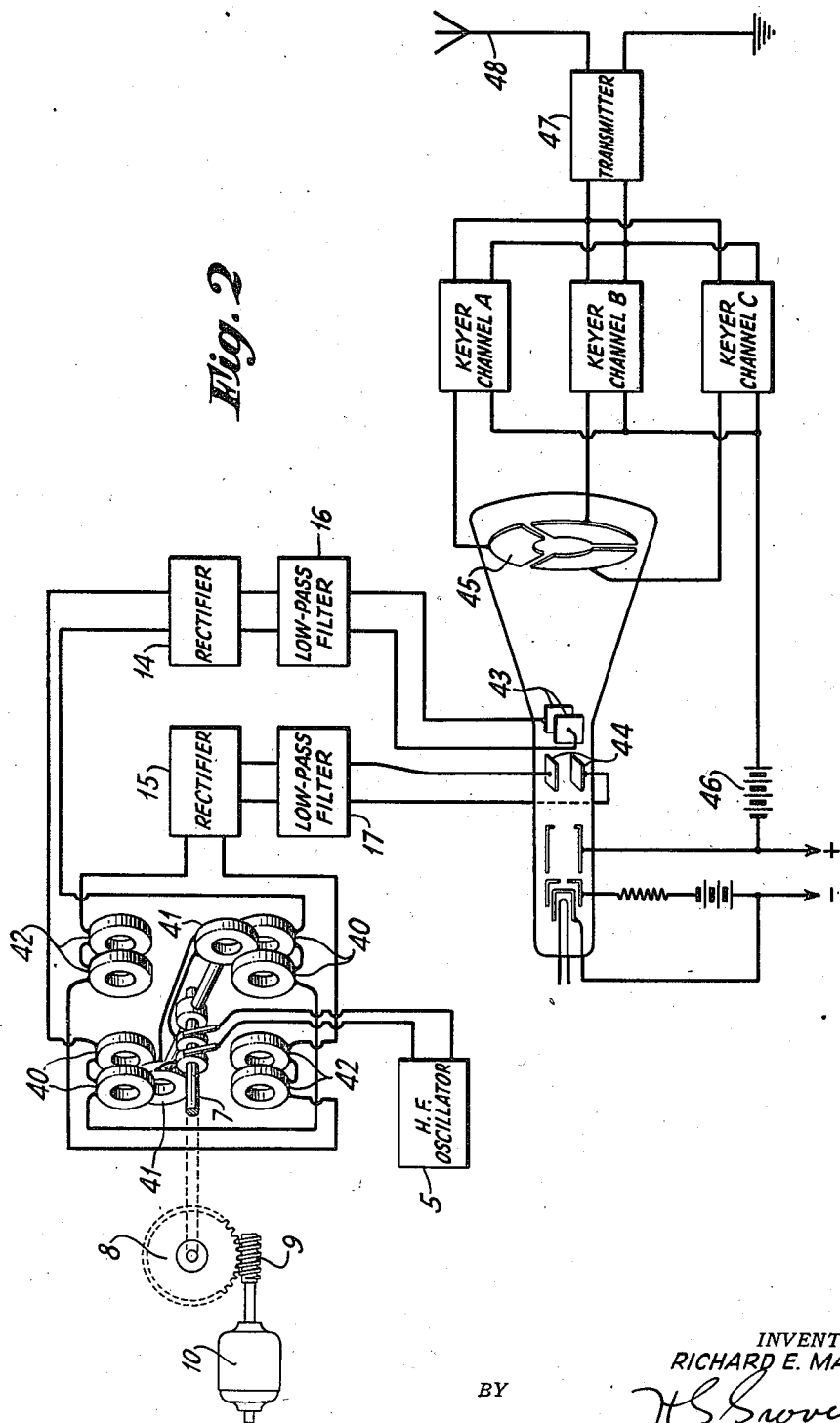
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UNITED STATES PATENT OFFICE

2,275,974

SWEEP CIRCUIT FOR CATHODE RAY TUBE DISTRIBUTORS

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Application February 28, 1939, Serial No. 258,870

13 Claims. (Cl. 178—52)

This invention relates to sweep circuits for cathode ray tube distributors. Electronic distributors are well known in the art. Some types of these distributors comprise a cathode ray tube having an array of targets against which an electron beam is projected by an electron gun. The beam itself is deflected so as to impinge successively on different targets. A preferred system is one in which the targets are arranged in a circle and the beam is deflected in a rotary path over the segmentary targets thereby to control different external circuits. A primary use for such a system of distribution is in the communications field where multiplex telegraph channels are involved. When the apparatus of my invention is so used, the cathode ray tube distributor constitutes a substitute for any of the well known types of distributors, which include face plates and brushes rotating thereover, or which comprise cam operated contact springs.

It is an object of my invention to provide a novel sweep circuit for controlling the deflection of an electron beam in a cathode ray tube.

It is a further object of my invention to provide a cathode ray tube and associated circuits suitably adapted for use as a multiplex distributor in a telegraph system.

Further objects and advantages of my invention will be set forth in the following detailed description. The description itself will be made clear by reference to the accompanying drawings, in which:

Figure 1 shows schematically a preferred circuit arrangement including various elements in combination for carrying out the objects of the invention; and

Fig. 2 shows an alternative embodiment of the system.

One of the problems encountered in designing a suitable sweep circuit for the control of a cathode ray tube which is to be employed in a multiplex telegraph system is to produce beam deflection in a rotary path at a relatively slow speed. In practice it may be necessary to provide a two-phase current of sine wave characteristic the frequency of which must be maintained constant at as low a value as one or even one-half cycle per second. It is apparent that ordinary methods of oscillation generation and coupling of circuits for the transfer of energy at such a low frequency would involve special considerations. A pure sine wave of such low frequency would lack the necessary power to energize the deflecting coils of the cathode ray tube if developed by ordinary transformation methods. I have, therefore, resorted to a high audio frequency monotone generator as a source of sweep circuit power, and the output from such a generator is suitably modulated at the desired low frequency, so that, when the high frequency component is fil-

tered out, this low frequency becomes available for actuating the deflecting coils or electrostatic plates of the cathode ray tube.

Referring first to Fig. 1, I show therein a high frequency oscillator 5 which may be of any well known type. Part of the output from this oscillator is fed to a set of polarizing coils 62 whose cores are here shown as the four stator poles of a rotary machine. The windings 62 are so directed as to render the physically opposed pole faces opposite in instantaneous polarity. Another part of the output from the oscillator 5 is fed to an armature coil 6. The armature pole faces are presented alternately to the horizontal and vertical poles of the stator field. A potentiometer 61 is in circuit with the field coils, and another potentiometer 63 is similarly disposed in the armature circuit. These potentiometers can be so adjusted as to neutralize the magnetism in the vertical stator poles in one position of the armature and to produce maximum magnetization thereof when the armature is turned through 180°. The same is true of the horizontal stator poles. Currents are, therefore, induced in the coils 12 and 13.

Coils 12 are series-connected to a rectifier 14, while coils 13 are likewise series-connected to another rectifier 15. The amplitude variations in the two circuits have a phase difference of 90°. The output from the rectifiers is fed to different low pass filters 16 and 17 where the high frequency component is filtered out, leaving only the low frequency component which represents the modulation envelope, or frequency of rotation of the armature 6. This low frequency component is what is required for energizing the deflecting coils 18 and 19 of the cathode ray tube. The rotary scanning action upon the electron beam is thus obtained and the revolution frequency of the beam deflection corresponds with that of the armature of the rotary modulator.

The low frequency components of the output from the filters 16 and 17 are in 90° phase relation to one another so that the beam in the cathode ray tube is deflected rotatively.

A relay winding 21 is disposed in a telegraph receiving circuit. The armature of this relay plays between a positive contact 22 and a negative contact 23 so as to impress positive marking impulses across a condenser 24 and to apply the same to a control grid 25 within the cathode ray tube in response to the reception of marking and spacing impulses. The positive and negative potentials which are impressed upon the relay armature produce a potential drop across a resistor 26 leading to a grounded neutral point 27 of a potentiometer 28, the latter being connected between the plus and minus terminals of a direct current source. The control grid 25 is suitably negatively biased with respect to the cathode of

the cathode ray tube by means of a biasing source 29 and a resistor 30.

Locking circuits for channels A, B, C and D respectively are shown in block diagram and each in circuit with one of the anode targets 20 of the cathode ray tube. The details of the locking circuits are well known in the art and are, therefore, not shown in detail herein. An example of a locking circuit which I have used advantageously in this connection is one that was constructed in accordance with the disclosure of James J. Finch in his United States Patent 1,844,950, granted February 16, 1932. It will be understood, however, that these locking circuits may be connected to any suitable recorders such as R₁ R₂ R₃ and R₄, as shown in Fig. 1.

In order that synchronism may be maintained between the incoming signals and the rotation of the rotor 6, a striking impulse generator 50, a commutator 51, a synchronous correction circuit 31 and correction motor 32 are provided. The striking impulse generator 50 is under control of the incoming signals as derived from the receiving relay 21. Short impulses are generated with each shift of the armature of relay 21. These impulses are fed to a commutator brush 51 mounted on the shaft 7. When true synchronism and phase are maintained, the striking impulses are applied to the brush 51 at the moment of its passage over an insulation gap between two commutator segments 52 and 53. When the phase of the shaft 7 leads or lags, however, then segment 52 or segment 53 receives the striking impulse, which is then fed to a correction circuit 31 for actuating a polarized relay therein. Such correction circuits are well known in the art. They usually include thermionic devices, as illustrated in my United States Patent 2,038,375, granted April 21, 1936. The polarized relay, though not shown herein, will be understood to control two circuits 54 and 55 leading to the field windings of the correction motor 32, for reversibly actuating the same.

The correction motor 32 has a pinion 33 mounted on its shaft. This pinion engages with a gear 34 attached to the field frame of the motor 10. By rotating this field frame suitable phase correction is applied for maintaining the necessary synchronism between the equipment at the transmitter and that at the receiver.

Accurate phase adjustment of the modulator rotor on which the coil 6 is mounted is obtained by means of a gear reduction which includes the worm 9 on the shaft of the motor 10, and a worm wheel 8 on the armature shaft 7. The motor 10 is preferably driven by current from a constant frequency source 11.

Referring now to Fig. 2, I show a modified sweep circuit arrangement for a telegraph distributor. Certain of the units therein employed have the same functions as those of corresponding units shown in Fig. 1. The substitution of these alternative units may be made individually and independently of one another.

In place of the four-pole modulator system as shown in Fig. 1 I have shown an arrangement of doughnut coils in Fig. 2. These coils include four pairs of stator coils and one pair of rotor coils. The coils are inter-connected in three circuits. The rotor coils 41 are preferably inter-connected in accordance with a "figure-of-8" type of winding and the circuit therefor is connected to the high frequency oscillator 5. These rotor coils 41 are driven by the motor 10 so as to induce currents in the stator coils 40 and 42

in succession and with a 90° phase difference between the moments of maximum energy transfer. In Fig. 2 the same arrangement of rectifiers 14 and 15 and low pass filters 16 and 17 may be employed as previously described in connection with Fig. 1. As a modification of the circuit arrangement, however, electrostatic deflecting plates 43 and 44 are shown in place of the deflecting coils 18 and 19. As a further modification, the cathode ray tube distributor comprises only three target electrodes 45 each occupying approximately a 120° segment as would be required for three-channel multiplex distribution. Each of the segments 45 is connected to a different keyer circuit for channels A, B and C respectively. Anode potential is supplied to the targets 45 of the cathode ray tube from a source 46.

The keyers of Fig. 2 are shown in block diagram since the details of such devices are well known in the art and do not constitute any part of the instant invention. The output circuits for these keyers may, however, be connected in common to any suitable transmitter such as that shown diagrammatically at 47 and having an output circuit feeding to a radio antenna 48.

Any of the alternatively used pieces of equipment such as shown in Fig. 2 may be employed in connection with receiving devices as well as for transmitting, and contrariwise the apparatus such as shown in Fig. 1 may be employed at a transmitter as well as at a receiver. Where this apparatus is used for transmission, however, the use of a synchronous correction circuit and correction motor may be dispensed with.

Various other modifications of my invention will readily suggest themselves to those skilled in the art in view of the foregoing description. The scope of the invention itself is, therefore, limited only in accordance with the claims.

I claim:

1. In a telegraph system a source of alternating current of a relatively high frequency, rotary converter means for applying variable attenuation to said current at a relatively low frequency cyclic rate, a pair of output circuits connected to said converter means, means for maintaining a quadrature phase displacement between the attenuation envelopes of the currents in said output circuits, means for deriving sine wave currents corresponding in frequency to that of said attenuation envelopes, means for deflecting an electron stream rotatively under control of said sine wave currents, and means responsive to telegraph signals for keying said electron stream.

2. Apparatus according to claim 1 in combination with an adjustable phase correction device operatively associated with said converter means, and means responsive to said telegraph signals for adjusting said phase correction device.

3. In a telegraph system including a device for producing a very low frequency rotative deflecting force to be applied to the deflecting elements of a cathode ray tube, a source of high audio frequency current, cyclically operable means for varying the amplitude of said current, and for producing two envelopes thereof, one of said envelopes being in quadrature phase relation to the other of said envelopes, rectifying and filtering means for converting the electromotive forces within said envelopes into sine waves of said very low frequency, means including connections from said filtering means to said deflecting elements whereby said sine waves are utilized as said rotative deflecting force in synchronism with incoming telegraph signals, and means for con-

ducting said telegraph signals through the discharge path of said cathode ray tube.

4. In a telegraph system including a sweep circuit for a cathode ray tube distributor, an oscillation generator, means for modulating the output energy from said generator thereby to produce two relatively low constant frequency envelopes having a 90° phase difference between their respective moments of maximum amplitude, means for rectifying the modulated energies, means including a pair of low pass filters for deriving 90° phase-displaced sine waves of said low constant frequency envelopes free from the frequency component of said oscillation generator, a cathode ray tube having horizontal and vertical deflecting elements combined therewith, means for energizing the horizontal deflecting elements with one of said sine waves, means for energizing the vertical deflecting elements with the other of said sine waves, and a plurality of conductive targets in said tube arranged to receive an electronic stream which is keyed by telegraph signals.

5. In combination, two sets of stator coils, a set of rotor coils, a source of relatively high frequency energy for exciting said rotor coils, means including a constant speed motor for driving said rotor coils in inductive relation to said stator coils and for causing currents of cyclically variable attenuation to be induced in said stator coils, means for maintaining a quadrature phase relation between the instants of like attenuation of the currents induced in the two sets of stator coils, means for converting said currents into sine wave currents of a frequency corresponding to the cycles of variable attenuation, a utilization device comprising a cathode ray tube having horizontal and vertical beam deflecting means operable by one and the other of said sine wave currents respectively to produce rotary beam deflection, and distributor means in said cathode ray tube for assigning multiplex telegraph signals to their respective channels according to said rotary beam deflection.

6. In a telegraph system including apparatus for applying relatively slow alternations of electromotive force to the horizontal and vertical deflecting means of a cathode ray tube, the method of distributing telegraph signals to different channels which method comprises causing the telegraph signals to control the emission in said cathode ray tube and to traverse the space path therein, producing a relatively high frequency current, inducing currents of said high frequency in two separate circuits, causing said induced currents to be cyclically attenuated at a frequency corresponding to relatively slow alternations, causing the cycles of attenuation in one of said circuits to lag 90° behind corresponding cycles in the other of said circuits, rectifying and filtering said induced currents to produce sine waves having the frequency of said slow alternations, and utilizing said sine waves separately to control said horizontal and vertical deflecting means thereby to produce a rotary scanning action in said tube.

7. In a telegraph system, a source of relatively high frequency waves, means for modulating part of the energy from said source by a relatively low frequency, means for modulating another part of the energy from said source by the same relatively low frequency, means for main-

taining a quadrature phase relation between the low frequency components of the energies thus separately modulated, two rectifiers each fed respectively with energy from an appropriate one of said modulating means, a cathode ray tube distributor having a horizontal deflecting device controlled by output energy from one of said rectifiers and a vertical deflecting device controlled by output energy from the other of said rectifiers, said distributor having anodal targets arranged to be scanned by an electron beam under control of said deflecting devices and means for keying the emission in said distributor by a train of telegraph signals.

8. Apparatus comprising the combination set forth in claim 7 and including two low-pass filters, one in circuit with the horizontal deflecting device and one in circuit with the vertical deflecting device.

9. The method of distributing telegraph signals to different multiplex channels by rotative deflection of an electron beam in a cathode ray tube which comprises generating a relatively high frequency, producing two 90° phase-displaced components of a relatively low frequency, separately modulating different portions of said relatively high frequency each by one of said low frequency components respectively, separately rectifying said modulated portions to derive two substantially 90° phase-displaced wave trains of said low frequency, filtering out the residual high frequency components in said wave trains, applying one of said wave trains for deflection of said beam in a horizontal direction, and applying the other of said wave trains for deflection of said beam in a vertical direction, and keying the emission in said cathode ray tube by means of said telegraph signals.

10. An electronic distributor for a multiplex telegraph system, comprising a source of alternating current of relatively high frequency, a relatively low frequency modulator arranged to apply cyclically variable attenuation to said current, said modulator being characterized as a phase-splitting device operable to produce two derivatives of said current and to maintain quadrature phase displacement between the attenuation envelopes of said derivatives, means for separately rectifying said derivatives, thereby to produce two quadrature phase related currents of said low frequency, an electron discharge device having an electron gun, beam deflecting means, and circularly disposed target electrodes, means including a source of telegraph signals for impulsively controlling the action of said electron gun, and circuits for so feeding said low frequency currents to said beam deflecting means as to produce rotative beam deflection, thereby to cause successive impulses of electronic emission corresponding to said telegraph signals to be distributed to appropriate ones of said target electrodes.

11. An electronic distributor in accordance with claim 10, in combination with means responsive to said telegraph signals for regulating the speed of said modulator.

12. An electronic distributor according to claim 10 and having magnetic deflecting coils in said beam deflecting means.

13. An electronic distributor according to claim 10, and having electrostatic deflecting plates in said beam deflecting means.

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