Oct. 31, 1950 R. E. McCORMICK 2,527,562

APPARATUS FOR RECORDING OSCILLOSCOPIC SIGNAL TRACES

Filed Aug. 2, 1945 3 Sheets-Sheet 1

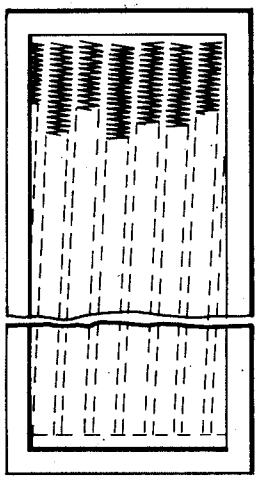

FIG. 6

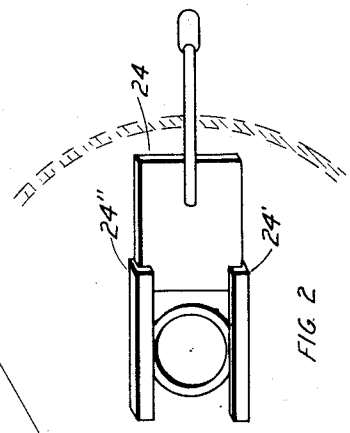

FIG 2

FIG 1

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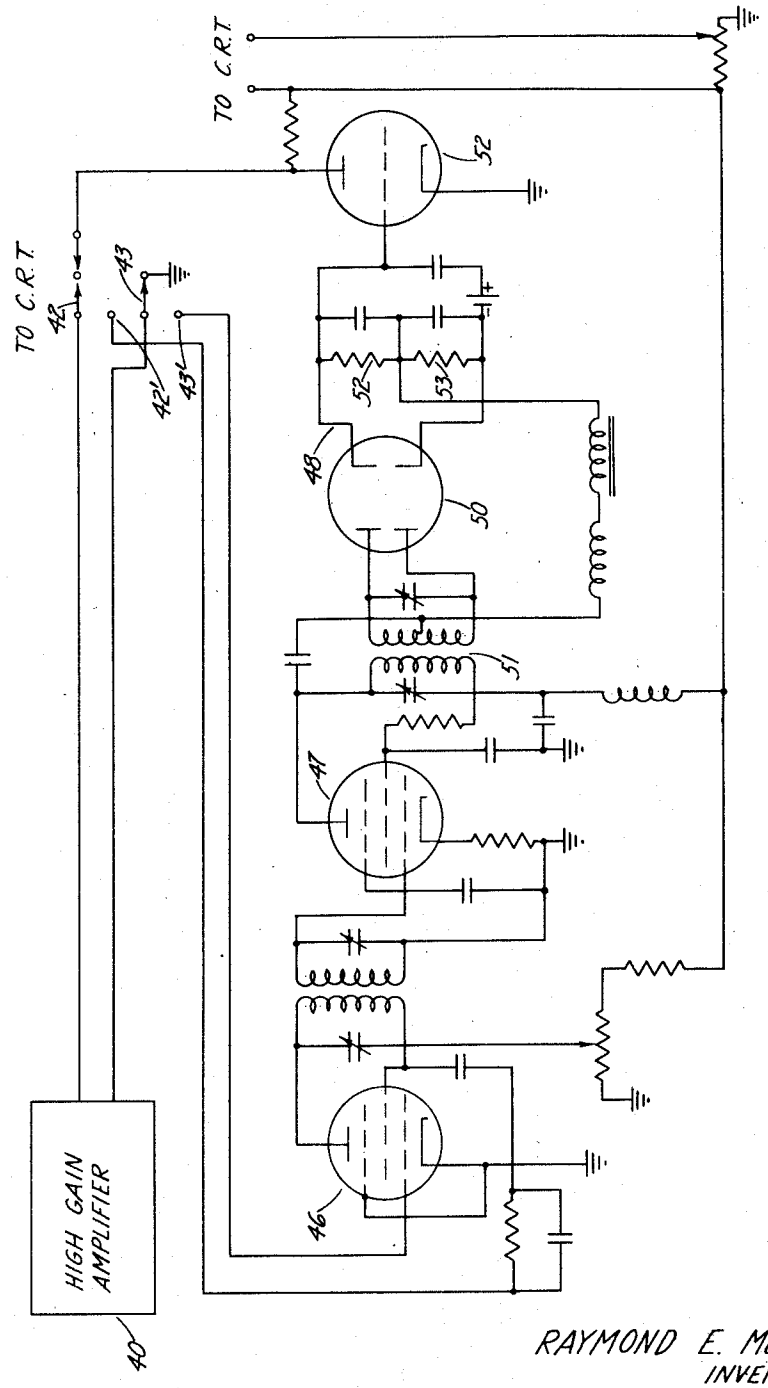

FIG. 3

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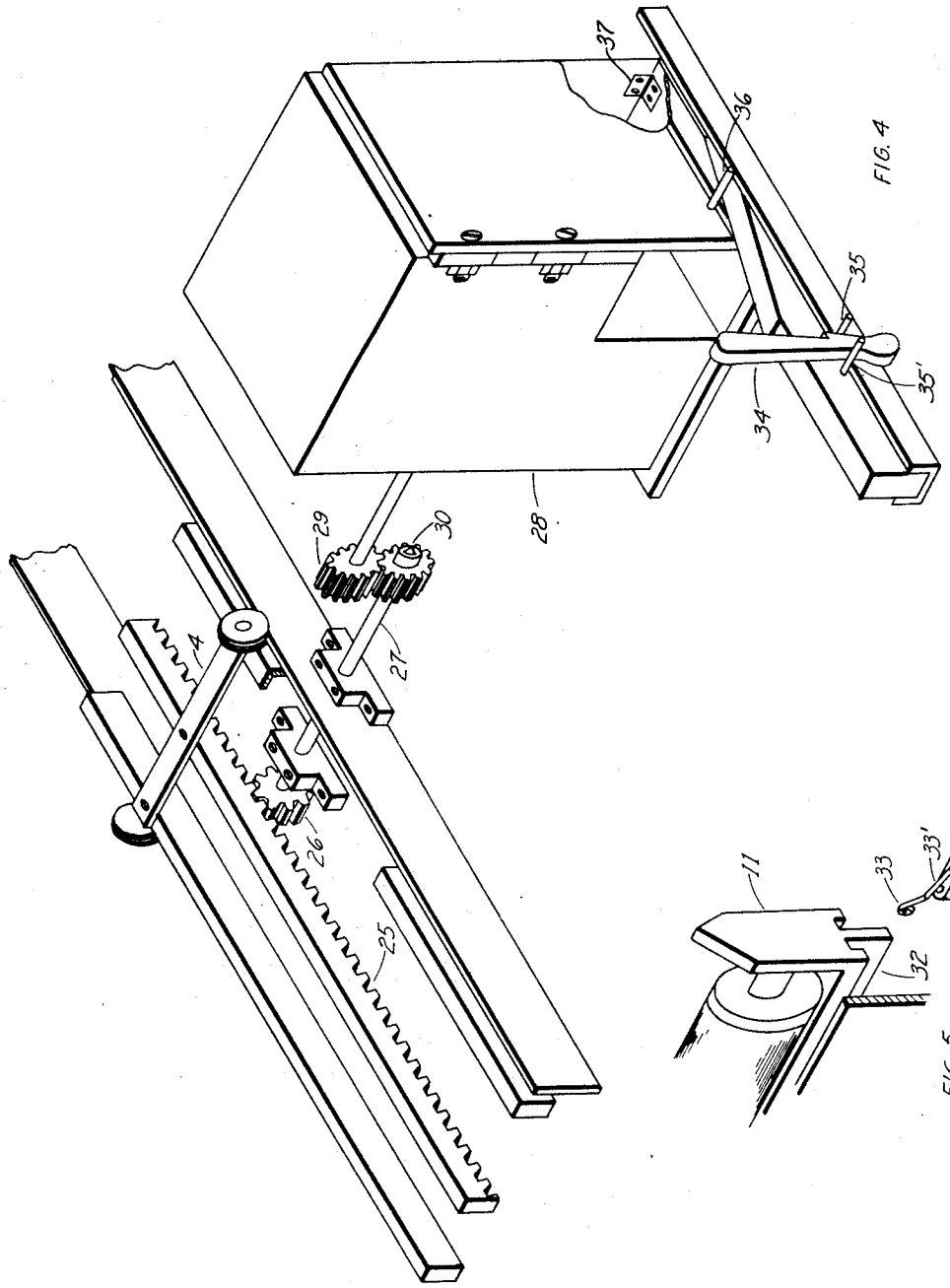

FIG. 4

FIG. 5

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Patented Oct. 31, 1950 2,527,562

UNITED STATES PATENT OFFICE

2,527,562

APPARATUS FOR RECORDING OSCILLOSCOPIC SIGNAL TRACES

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Application August 2, 1945, Serial No. 608,565

2 Claims. (Cl. 346—109)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to improvements in recording devices and particularly is a novel means for photographing effectively wave traces appearing on the screen of a cathode ray oscilloscope.

The recorder is susceptible of many applications in laboratory and field; examples are the checking and comparison of all types of wave forms (pulses, sine waves, and square waves), examination of relay operation (timing and cleanness of the operation and closing of contacts), and examination of the characteristics and operation of continuous wave transmitters (keying, frequency stability and the like).

One object of this invention is to provide a means for producing an accurate photographic record of the output of a cathode ray tube.

Another object is to provide oscilloscopic circuits which will cause visual wave traces, suitable for photographing, to be projected on the cathode ray tube screen.

Additional objects will be apparent from a reading of the following specification and claims.

In the drawings:

Figure 1 is a perspective view, partly cut away, of the oscilloscopic recorder of my invention.

Figure 2 illustrates the means by which the cathode ray tube image is focused on a film or other sensitized surface.

Figure 3 illustrates a means for supplying signals of various types to a cathode ray tube.

Figure 4 is a perspective view of the means for driving the drum utilized in the invention past the image focusing means.

Figure 5 is a detail in perspective of one end of the carriage which carries the drum.

Figure 6 represents a sample film with oscilloscope tracings thereon.

Generally speaking, the device comprises a lens system and a sensitized film which is mounted upon a drum which rotates at a constant speed and which is driven axially, likewise at a constant speed.

The revolving drum assembly comprises a drum proper 10 adapted to carry a film or sensitized paper, a carriage 11 which supports the drum, a motor 12 for rotating the same, and tracks 13 and 14 upon which the carriage moves on wheels, as 15 and 16. A cover must be provided to keep stray light from the film or sensitized paper, but this cover does not appear in the drawings.

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Tracks 13 and 14 are so located with respect to a cathode ray tube oscilloscope 20 that the carriage 11 and the drum 10 will move parallel to and adjacent the oscillograph screen.

A trace appearing on the screen of the oscilloscope 20 is cast upon sensitized paper or film carried by the drum 10 through the lens 21 fixed in a tube 22 for movement toward and away from the oscilloscope 20. The movement of lens 21 provides for proper focusing of the image. Focus may be maintained by tightening the setscrew 23. The sensitized paper may be shielded from the cathode ray tube by means of a lightproof shutter 24 which moves in grooves 24′ and 24″ in front of the screen.

Beneath the carriage 11 and forming a part thereof is a rack 25 which cooperates with a pinion 26 and a shaft 27 (see Figure 4). This shaft is driven by a second motor 28 which produces rotation through suitable gearing 29 and 30 of the shaft 27. The speed at which the shaft 27 is to be driven and thus the ratio between the gears 29 and 30 depends upon the requirements of the apparatus, but the speed of the carriage may well be of the order of five eighths inch per second.

Two switches are utilized to control the travel of carriage 11. A suitable switch 31 is shown in Figure 5. As long as the camming surface 32 of carriage 11 bears upon the wheel 33 of switch 31, contact 33′ and its cooperating contact remain closed. As soon, however, as the carriage passes beyond the switch, the said contacts are opened, and motor 28 is stopped. Preferably, one such switching means stops the carriage at about the midpoint of its travel; another, at the end of its travel.

In the embodiment shown, carriage 11 is adapted to be moved manually back to its starting point after being stopped. This is accomplished by moving a lever 34 against a pin 35 thereby to move the slide 35′ beneath a pin 36, secured to the housing of motor 28. The housing is hinged at 37 along one of its edges (at the right in Figure 4). The motor 28, with its housing, is thus raised and gears 29 and 30 disengaged so that the gear train between rack 25 and motor 28 is broken.

Motor 12 is driven from any desired type of constant frequency power supply. A conventional tuning fork controlled amplifier may be utilized.

The circuits for controlling the deflecting plates (not shown) of the oscilloscope 20 may be seen in Figure 3. The first appears merely as a block 40 and comprises a high gain ampli-

fier of any conventional type, the output of which may be applied directly across the horizontal deflecting plates.

The other portion of Figure 3 is utilized to show frequency deviations in the signal being studied. Input to the circuit is from amplifier 40, through switches 42 and 43, and contacts 42' and 43' respectively. The circuit includes a limiter 46 in which plate saturation occurs at a low predetermined level so that signal amplitude increases beyond this level do not affect the plate current. The output of the limiter is passed through an amplifier 47 which is transformer coupled to a discriminator circuit 48. The transformer has a tuned primary and secondary with a coefficient of coupling determined by the width of the band of frequencies it is desired to pass.

The voltage applied to rectifier 50 consists of two components, that fed into the center of the secondary winding of transformer 51, and that induced in the secondary. The phase relationship between the two is such that at resonance the currents are equal in value but flow in opposite directions in resistors 52 and 53 so that the net voltage across the horizontal deflecting plates of oscilloscope 20 is zero under these conditions. When the carrier deviates from resonance, the induced secondary current either lags or leads depending upon whether deviation is to the high side or to the low side of resonance, and this phase shift causes the induced current to combine with that fed into the secondary winding of transformer 51 in such a way that the output of one half of rectifier 50 is higher than that of the other. A voltage which represents the difference between the outputs of the two halves of rectifier 50 is amplified at 52 and applied across the horizontal deflecting plates of oscilloscope 20.

To record a representation of a desired signal, the signal is applied to the amplifier 40, Figure 3, and directly to oscilloscope 20 or, after proper manipulation of switches 42 and 43, through amplifier 40 and the frequency modulation section of the oscilloscope control. At no signal, the cathode ray will be focused at the vertical center of the tube, since the vertical deflecting plates are grounded. As the signal to be recorded is applied across the deflecting plates, the cathode ray is deflected proportionately.

Lens 21 is adjusted to provide an image of the desired size, preferably on the order of a quarter inch, and secured by tightening the screw 23. Film is put upon drum 10, and motors 12 and 28 started, and, as the drum revolves and moves across the end of tube 22, the oscilloscopic trace is recorded on the film. When the drum assembly has reached the midpoint of its travel, switch 33' is actuated by lug 32 and brings the assembly to a halt. The drum assembly may then be moved manually back to its starting position, as explained, rotatory motion of the drum (which results in a spiral recording path) assuring that a new recording will not be superimposed upon the first.

The rotating drum forms a mechanical sweep circuit taking the place of the electrical sweep used in a standard oscilliscope, the screen of

which is intended to be viewed instead of photographed.

Because the drum is driven by a motor which is supplied from a constant frequency source, time measurements may be made directly on the film without the need for superimposing a time base.

Figure 6 requires no extended explanation, it being included merely to show the appearance of a completed record made by the present invention. The tracings are made normally column by column; the regularity of the record and the ease of comparison are readily apparent.

The foregoing description is in specific terms, but, since many modifications obviously can be made without departing from the spirit of the invention, it should not be construed as limiting the invention otherwise than in the light of the appended claims.

I claim:

1. In an apparatus of the nature described, the combination of means for projecting an oscilloscopic trace or the like, a track arranged before said projecting means in spaced relation thereto, a carriage mounted on said track for movement thereon relative to said projecting means, a rotatable drum on said carriage for carrying a recording medium, means for focusing said trace upon said drum, means for rotating said drum, a rack secured to said carriage parallel to said track, a pinion engaged with said rack and adapted when rotated to drive said rack and said carriage along said track, and means including a motor for rotating said pinion said last-mentioned means being disengageable from said pinion and when disengaged permitting manually controlled movement of said carriage upon said track.

2. The invention of claim 1, further characterized in that said last-mentioned means includes a support for said motor hinged along one of its edges whereby the support and motor may be rotatably lifted upon said hinge.

RAYMOND E. McCORMICK.

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