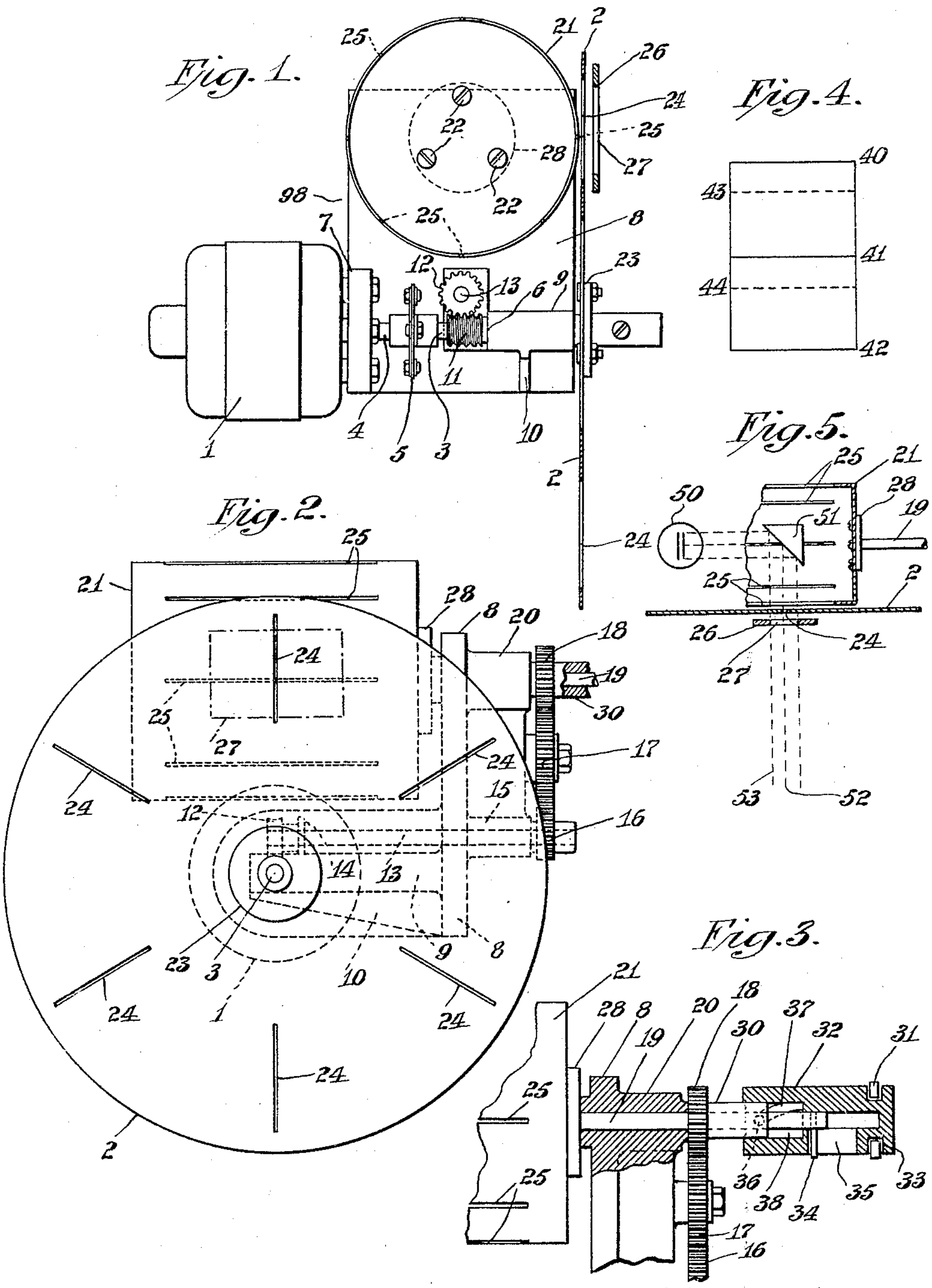
Jan. 24, 1933.

H. P. DONLE

1,894,944

TELEVISION APPARATUS AND METHOD

Filed Feb. 4, 1930



Harold P. Donle
INVENTOR

BY Robert S. Allyn
ATTORNEY

Patented Jan. 24, 1933 **1,894,944**

UNITED STATES PATENT OFFICE

HAROLD P. DONLE, OF MERIDEN, CONNECTICUT, ASSIGNOR TO RADIO INVENTIONS, INC., A CORPORATION OF NEW YORK

TELEVISION APPARATUS AND METHOD

Application filed February 4, 1930. Serial No. 425,785.

This invention relates to improvements in television apparatus and consists in the mode of scanning an object for transmission purposes, the mode of analyzing a received signal in order to reconstruct the image, the constructions and combinations for securing this mode, as hereinafter described and claimed.

An object of the invention is to secure a larger picture area than is obtained by the usual size of so-called Nipkow disc, without increasing the diameter.

A further object is to obtain the usual picture size, while using a smaller diameter disc than is customary, without thereby necessitating the employment of speeds of rotation higher than practical and convenient. The consequent reduction of weight and vibration is of great aid in obtaining clear reproduction and easy synchronization, and contributes to economy of construction and quietness of operation.

A further object is to obtain in a more convenient form, both as regards size, relative dimensions and control, the scanning or analyzing mechanism of a television system.

Other objects and advantageous features of this mode of construction and operation will also be apparent from the following specifications.

My invention is shown in the accompanying drawing where:

Figure 1 is an end elevation of a device embodying my invention.

Figure 2 is a side elevation of the device.

Figure 3 is a sectional view of a mechanical phase shifting device which may be employed to change the rotational angular relationship of the drum and the disc, thereby framing the picture in a receiver utilizing my invention.

Figure 4 illustrates the principle underlying another method of framing the image in a receiver employing my invention.

Figure 5 illustrates one method of employing a fixed light sensitive cell or reproducing light source exterior to the drum.

In Figures 1 and 2, 1 is the motor or other device furnishing mechanical energy to rotate the transmitting or receiving mechanisms. The type of this motor is preferably, but not necessarily, made to agree at the transmitter and the receiver, for more readily securing synchronization of the two mechanisms.

The disc 2 is mounted rigidly by the collar 23 near one end of the shaft 3 and substantially with its diameter at right angles to the axis of said shaft.

This shaft 3 is coupled to the motor shaft 4 by means of the coupling 5 which may be sufficiently laterally flexible to allow the shaft 3 to be properly supported by the bearing 6 without demanding absolute alignment of all the bearing surfaces, but should be so constructed that the rotational relationship between the motor shaft and the driven shaft shall be unchanging both in respect to the number of revolutions per unit time, of these two members, and with respect to the angular displacement of rotation of points upon the peripheries of the respective shafts.

A supporting framework 98 is provided, rigidly fastened to the frame of the motor, as indicated at 7, and comprising such support members, bearings, collars, and other parts as are needed for the secure and substantially vibrationless support of the other portions of the mechanism already described or hereinafter indicated. This framework includes the vertical portion 8, the horizontal support 9 which supports bearing 6, the web 10 securing still greater rigidity to this bearing and such other portions as are hereinafter specifically pointed out, as well as such portions, not so mentioned, as may be needed to complete its supporting action for the mechanism and to give it the needed mechanical strength and rigidity. Furthermore, this framework is constructed of such materials as to aid in securing strength and rigidity.

At a convenient point upon the shaft 3 is placed the worm 11, meshing with the gear 12. This gear 12 is securely fastened to a shaft 13 rotating within bearings 14 and 15 near either end of the shaft. Its motion is transmitted through the train of gears 16, 17, 18 to the shaft 19 rotating in the bearing 20 and in turn rotating the drum 21 firmly fastened to the face plate 28 at the end of the shaft 19 by screws 22. The size of these parts, and their relationship to one another is such that the angular velocities of disc 2 and drum 21 shall bear a constant ratio to one another, said ratio being preferably identical at the transmitter and receiver, and designed to co-operate with the slits hereinafter described to secure the desired relationship of vertical and horizontal scanning. Within the drum may be placed the light-sensitive cell or the light reproducing device or light reflecting device, as hereinafter described.

The disc 2 is provided with radially disposed slits 24, and the drum 21 with longitudinally disposed slits 25. The size, number and relationship of these slits in these two members, i. e. the drum and the disc, as well as their relative motion when adjacent to each other, may determine the size of the elementary picture areas and the size of the resultant picture as a whole. 26 is a mask with aperture 27 which may be used to limit the field of view of the desired image, either in conjunction with the length of the slits, or, as shown, independently thereof.

In Fig. 3 is shown a device for controlling the angular displacement of rotation between the drum and the disc. If there are n slits in the drum, it is evident that an angular displacement of $360/n$ degrees would be the maximum required to secure any angle of displacement needed for the individual slit. This comparatively small amount is readily secured and altered at will as follows: Gear 18 is carried by collar 30, which rotates readily upon shaft 19. This shaft 19 has the drum 21 securely fastened thereto. Collar 32 is recessed at 38 to allow lateral motion upon collar 30, and it slides upon shaft 19 to an extent limited by the slot 35, through which pin 34, forming part of the shaft, projects. The lateral relationship of collar 32 and shaft 19 may be varied by a fork 31, lying in a groove 33 of the collar, and manually or automatically controlled by external means. This lateral motion causes pin 36, fastened to collar 30 to take up varying positions within slot 37, which is cut approximately spirally in collar 32. These varying positions cause a change in the angular relationship of gear 18 with respect to shaft 19, and since gear 18 is driven by gear 17 and the latter gear, as shown in Fig. 2, through a train of gearing from the shaft bearing the disc, accordingly the angular relationship of disc and drum is determined at will by the shifting of fork 31, thus framing the received image.

Fig. 4 illustrates the principle involved in another method of securing framing of the image. The physical dimensions of the scanner are chosen such that the drum is increased in diameter relative to the form of Figs. 1 and 2, and the slits 24 in the disc elongated relative to the form of Figs. 1 and 2 so that they slightly exceed twice the vertical dimensions of the image. In this manner the image appears re-duplicated in the vertical direction. Only by a coincidental relationship between transmitter and receiver will two complete images bounded vertically by lines 40—41 and 41—42 appear. Usually a complete image will occupy some intermediate position, with fractional images above and below, e. g. bounded by 43—44. The mask 26 of Fig. 1 may then be moved vertically until its opening 27 embraces this complete image, this simple vertical motion thus serving to frame the received image.

Fig. 5 shows a method of transferring the rays of light, from the light reproducing device 50 to the observer at 52 by means of a reflecting device 51 mounted within the drum 21. The path of a single beam is shown at 52, passing through the slot in disc 2. The total width of the path of light rays will be determined by the width of the aperture 27 in the mask 26, and the total vertical dimension of the path by the height of that aperture.

The operation of scanning is well understood and requires no explanation of its elementary principles. The following dimensions may be taken as illustrating a useful combination of scanning elements and time elements, but any other desired combination may be used.

In this case there are four revolutions of a disc with six slots during the time one slot in the drum passes across the field of view. For the minimum of 15 complete pictures per second, which is considered good practice, equivalent to 900 pictures per minute, a disc speed of 3600 R. P. M. is required, giving 24 line scanning. The drum has eight slots and therefore operates at 3600 divided by four times eight or $\frac{1}{32}$ the speed of the disc, which is secured by a worm reduction of 1:20 and an additional gear reduction of 10:16. The width of the drum slot is made $\frac{1}{24}$ of the picture height and the slot in the disc about 10 mils in width. The circumference of the drum will be eight times the vertical dimension of the reproduced image, i. e. 12 inches. This combination gives a ratio of vertical to horizontal dimensions of 3:4, corresponding closely to the ratio usual in motion picture film. The received image will be approximately 1.5″ x 2.0″, and cover about four times the area of the standard motion picture film, although the overall dimensions of the device are only about 8″ in each direction, thus illustrating the compactness of this assembly.

This device functions as a scanner of images for purposes of transmission or reception and can therefore be used in any of the ways in which scanning discs or other devices have hitherto been employed. The relative position of image and viewing light cell can be reversed at the transmitter by the use of a system similar to the one shown in Fig. 5, which system has as one of its objects the removal of the necessity for the presence of a physical device other than a reflector, within the actual rotating drum.

A light sensitive cell can be placed exteriorly to the apparatus and operate by light reflected from the image to be transmitted, this scanning device then operating to produce a scanning beam of light, in the fashion well understood in the art.

By the combination of suitable optical devices the received image may be enlarged. For example in Fig. 5, light reproducer 50 may have its luminous output concentrated to entirely impinge upon 51, which may be designed so as to give the path of light rays, 53 a divergent character, with the result that the image may be enlarged after passing through the aperture 27, to any desired extent, and may appear upon a viewing screen if desired. Instead of a diverging mirror an appropriate projection lens system can be used.

Devices similar to either Fig. 3 or Fig. 4 may be used to frame the picture in a horizontal sense. Under certain conditions of proper phase relationship, such as the use of identical transmitters and receivers, operated by synchronous motors from the same power lines, no special framing devices may be required. It is also possible by rotation of the motor field assembly relative to the shaft, to secure horizontal framing.

Synchronization of transmitter and receiver motor may be secured by any method desired, for example as shown in my co-pending application #322,360.

Any convenient form of light-sensitive cell or light-reproducing device may be employed. In place of the neon tube with flat electrodes illustrated at 50, a form having two concentric cylinders may be employed, thus facilitating the use of a lamp within the drum and even allowing its rotation with the drum, by the employment of sliding contacts.

It is possible by rotation of the entire apparatus at both receiver and transmitter through an angle of 90 degrees, with such mechanical changes as demanded by this new position, to secure an image with its vertical and horizontal dimensions reversed and to likewise scan it rapidly in a vertical sense, and slowly in a horizontal sense.

By arranging the motor to drive the drum rapidly and the disc slowly, the scanning speeds in the vertical and horizontal senses may be reversed without reversal of picture dimensions, but the arrangement shown is preferred for mechanical reasons, and also because it will scan the image received from a transmitter employing the customary Nipkow type of disc, provided the elemental area-time relationship of the two is made to agree.

Such a ratio of the two dimensions of the image may be chosen, as will coincide with the usual ratio of motion picture film dimensions, thus allowing the convenient employment of such films at either transmitter or receiver.

Many other variations of this apparatus can be employed without departing from the spirit of the invention which consists broadly in the employment of two sets of slits, the one radially disposed upon a disc and the other set longitudinally disposed upon a drum, so positioned and moved that the light aperture occurring at their intersection shall scan an optical image.

I claim:

1. In a television apparatus, a drum shaped member having longitudinally disposed elongated slits and a disc shaped member having radially disposed elongated slits, the slits in the respective members being so proportioned and positioned relative to each other as to allow by their relative motions the transmission of light in a manner adapted to scan an optical image.

2. In a television apparatus, a rotatable drum with a plurality of elongated slits, a disc with a plurality of elongated radial slits rotating in a plane substantially tangential to the surface of the drum, the two sets of slits cooperating to allow the passage of light thru the apparatus in such a fashion as to scan an image optically and defining an elemental area by said cooperation.

3. In television apparatus, a rotating drum shaped member provided with longitudinal elongated slits, a rotating disc shaped member with radial elongated slits, coupling devices for maintaining a fixed relationship between their respective rotations, means for causing their rotation, and a normally fixed field limiting aperture member, said rotating members defining and causing a constructive aperture to scan an optical image, and said fixed member causing the delimiting of the optical scanning action to a desired field.

4. A television apparatus comprising a drum for causing a plurality of elongated slits circumferentially disposed to move substantially at right angles to their longitudinal dimension, a disc for causing a plurality of elongated slits radially disposed to move substantially at right angles to their longitudinal dimension, means for positioning and coordinating the respective planes of movement of these two sets of slits so that their intersection shall produce an elemental optical aperture, means for coordinating the phase relationship of movement of the said sets of slits so that said optical aperture shall scan an image to be electrically transmitted or received.

5. A television transmitter having a light source device and an optical electrical light translating device and means for causing the optical interaction of said two devices includ-

ing a drum member having a circumferentially disposed set of elongated slits and a disc member having a radially disposed set of elongated slits, said elongated slits being so positioned and moved as to allow the optical aperture formed by their intersection to scan elemental areas of an image to be transmitted.

6. Television scanning apparatus including means for producing successive laminæ of light rays arranged substantially as radial spokes, means for moving said laminæ in a substantially circular path, so that their thickness determines one dimension of an elementary scanning area, means including a disc with elongated slits radially disposed thereon, and means for moving said slits substantially at right angles to the thickness of said laminæ, so that the width of said slits determines the other dimension of said elementary scanning area.

HAROLD P. DONLE.