March 19, 1940. N. E. LINDENBLAD 2,193,875

SYSTEM FOR MULTIPLEX TRANSMISSION

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Fig. 1

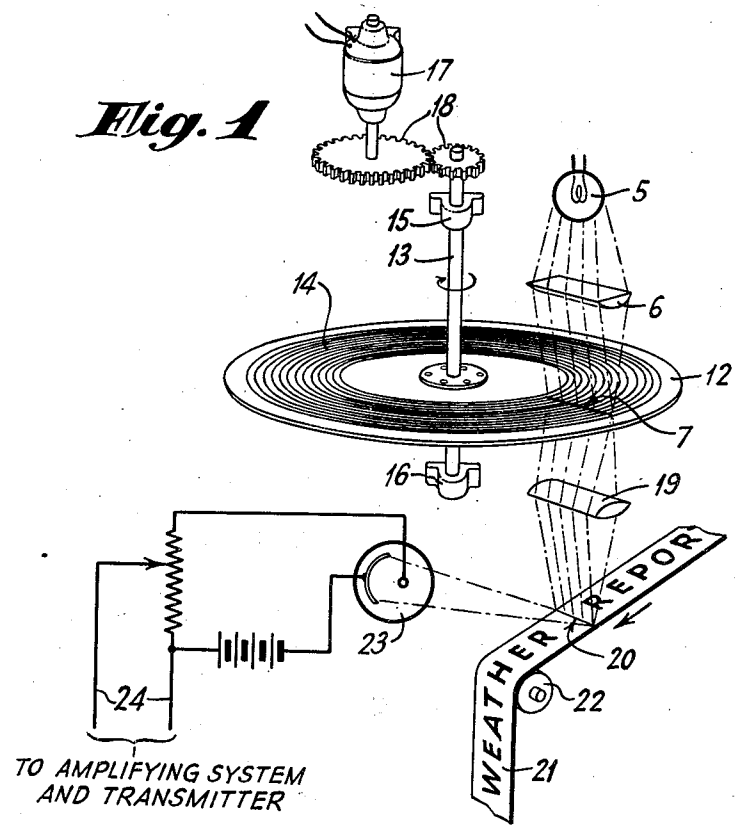
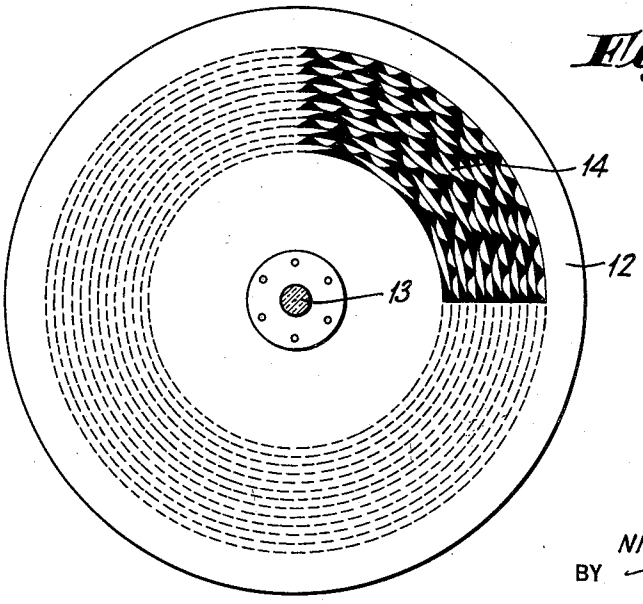


Fig. 2



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SYSTEM FOR MULTIPLEX TRANSMISSION

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7 Claims. (Cl. 178—7.1)

The present invention relates to a method and means for controlling light and it is especially applicable and adapted to systems used in the transmission of intelligence, such as pictures and the like for facsimile and television work. The term "pictures", of course, is meant to include the transmission of views, printed matter, checks, finger-prints, financial statements, newspaper articles, advertising, fashion plates, magazine articles, moving pictures and the like. In fact, all types of subject-matter wherein a visual representation thereof is possible, may be transmitted by the applicant's system.

In older systems of facsimile transmission it has been customary to use only one transmission channel, and in such systems only one series or chain of signals may be sent at a time. In the present system, however, a plurality of transmission channels may be employed simultaneously in order that the rate of transmission of the characters, picture, or indicia may be materially increased. In using a multiplex or multi-channel system it is necessary, of course, to keep the channels separated and in order to do this separate series of signals are generally modulated at different frequencies so that, by the use of appropriate filter networks at the receiving station, the transmitted signals may be segregated in a proper manner to reproduce the picture transmitted.

In order to modulate the various series of signals a disc has been employed which is rotated at a high rate of speed and which has a plurality of concentric rings of perforations. The use of such a disc, however, results in a considerable waste of light with the result that the system in which such a disc is used is materially reduced in efficiency.

It is the purpose of the invention, therefore, to produce a multiplex facsimile transmission system which is high in efficiency.

It is a further purpose of the invention to produce a multiplex facsimile system wherein a large number of separate channels may be used for the simultaneous transmission of a plurality of signal series.

A still further purpose of the invention is to produce a modulating disc which, when rotated, will operate to control sinusoidally the passage of light therethrough or the reflection of light therefrom, or both.

A still further purpose of the invention is to provide a modulating disc which will reduce the possibility of partial fading of the subject-matter being transmitted due to band frequency fading.

Other purposes and objects of the invention will become apparent to those skilled in the art by considering the following specification and claims, particularly in connection with the accompanying drawing, wherein:

Fig. 1 represents schematically the multiplex transmission system, and

Fig. 2 shows a partial detail plan view of the modulating disc.

Referring now to the drawing, a source of light is shown at 5 which may be, for instance, an ordinary incandescent lamp and the light from this lamp is directed upon the cylindrical lens 6 by means of reflectors or other means not shown herein. The cylindrical lens causes a condensation of the light into a line 7 which is brought to focus upon the modulating disc 12. The modulating disc is shown partially in detail in Fig. 2 and comprises concentric rings or annular sinusoidal openings 14. The number of the sinusoidal openings in the various annular rings is based on an odd harmonic relationship such as is customary in harmonic multi-channel transmission circuits. The frequency of the modulation of light is, of course, a function of the speed of the disc and the number of sinusoidal openings in each of the concentric rings. The variation in the number of the openings in the separate rings or annuli is altered or staggered so that an annulus having a small number of openings is followed by an annulus having a large number of openings instead of starting at one side of the band of concentric rings with a small number of openings and progressing harmonically to the other side of the band of concentric rings. The purpose of so constructing the disc will become apparent in a further description of the system.

The disc is mounted on a shaft 13 which is journaled in bearing members 15 and 16 and it is rotated at a predetermined rate of speed by the motor 17 through the gears 18. As the disc is rotated the line of light 7 as produced by the source 5 and lens 6 is modulated by the sinusoidal openings of the modulating rings and, after the modulated light has passed through the disc, it is then focused by a lens system 19 on the surface of the tape which carries picture or characters to be transmitted. This modulated light is then reflected by the tape or picture bearing surface on to a single photoelectric cell 23, the output of which is a function of both the modulation of the light and the amount of light reflected by the picture and tape.

An appropriate and suitable amplifying system and transmitting system (not shown) is connected to the output of a photoelectric cell by connecting to the conductors 24 and the amplifier output energizes any appropriate form of transmitter apparatus.

The strip or tape which carries the picture or characters of which the replica is to be produced at desired receiving points is moved forward at a predetermined rate in the direction indicated by the arrow on the drawing, and this movement may be under the influence of a separate source

of power or may be connected to the motor 17 by appropriate reduction gearing.

From the above, therefore, it may be seen that a plurality of transmission channels are produced by the plurality of concentric rings of sinusoidal openings. Each of these channels in effect scan a line along the tape in its direction of movement and the size of the separate modulating rings or annuli and their number is so chosen as to give the proper desired definition and the desired number of scanning lines across the character bearing tape. In the disclosure shown twelve separate channels are used which scan an equal number of separate elements along the scanning line 20 although, obviously, any other number of channels and scanning lines may be used, whether the number be less than the assumed twelve (for less detail) or greater than the assumed twelve (for increased detail).

It is not unusual, particularly in long distance transmission work, that selective fading will occur in a particular band of frequencies and if the number of sinusoidal openings in the rings increases in numerical order the result will be that a portion of the reproduced image will be blanked out. However, if the order of the modulating rings is irregular as suggested above, selective frequency fading will cause a slight loss of detail over the whole image, yet the image will not be unrecognizable since the particular attenuated frequency bands will not occur at adjacent element portions of the picture.

If the cylindrical lens 11 is not sufficient to properly focus the beam of light into a narrow line such as shown at 7, it is to be understood that a small line aperture may be used for this purpose whereby the size of the line of light along the modulating disc may be properly confined.

It is to be further understood that the system may be used by modulating the light after it has been reflected from the tape or picture bearing surface instead of before, in which case the incandescent lamp 5 would occupy a position corresponding to that of the photoelectric cell 23, and the photoelectric cell would be placed at a position corresponding to that of the incandescent lamp. When such change is made, the lens system will, of course, be changed accordingly to accommodate such conditions.

It is further to be understood that the lens system may also comprise certain spherical lenses as well as the cylindrical lenses in order that an enlargement of the character picture may be produced to thereby increase the definition of the reproduced image. It is also to be understood that the applicant's transmitting apparatus may be used with present existing multiplex receivers without substantial modification.

It is obvious that the modulating disc may be made in several different ways such as by photographic reproduction, etching, punching, plating, etc. the preferred method being by the first mentioned manner. When such a method is employed the modulating disc may be secured to a transparent disc for support or between two transparent discs. Also, it is conceivable that the modulating disc could be silvered, in which case the light rays would be reflected from the disc rather than being transmitted therethrough. A combination of reflecting and light transmitting areas may also be used. This same alteration may also be made with respect to the picture bearing surface; i. e. light may be transmitted through the tape to the light sensitive cell or radiant energy responsive member rather than reflected therefrom.

In making the modulating disc, especially when photographic methods are employed and where high efficiency is desired, separate annuli may be made to have a definite minimum dimension greater than zero such that that dimension (in a radial direction) varies sinusoidally from a minimum to a maximum.

Various other modifications and alterations may be made in the disclosed device without departing from the invention, and, it is desired that any and all of such modifications be considered within the scope of the invention except as limited by the hereinafter appended claims.

What I claim is:

1. A light modulating disc of opaque material having a plurality of concentrically arranged rows of sinusoidal openings.

2. A light modulating disc comprising a disc having a plurality of concentric annular areas, each area composed of circumferential portions which sinusoidally vary in light transmitting value.

3. In a multiplex system for indicia transmission, a modulating disc having a plurality of concentrically arranged series of sinusoidal openings about its periphery whereby light directed thereagainst is modulated in intensity.

4. In communication systems actuated in accordance with varying intensities of modulated light, a light source arranged to project the issuing light beams along a predetermined path, an opaque disc, means for positioning said disc so that its periphery falls at the focus of said projected light, a plurality of concentric bands of sinusoidal openings positioned about the periphery of said disc, means for rotating said disc whereby the light passing through the openings will be modulated, and means for projecting said modulated light onto an indicia bearing surface and photo-sensitive means for receiving light from said surface.

5. In an indicia or picture transmitting system, a source of light for illuminating a picture surface, means for concentrating the light from said source into a line, a disc, means for positioning said disc such that the line of concentrated light falls on the surface thereof, means for rotating said disc, said disc having a plurality of concentric areas, each area being so constituted as to sinusoidally modulate the light directed thereon, means for directing the modulated light onto the picture surface, and a radiant energy responsive means adapted to receive light from the picture surface.

6. In communicating systems actuated in accordance with varying intensities of modulated light, an opaque disc, and a plurality of concentric bands of sinusoidal openings positioned about the periphery of said disc, each band including a different number of openings than the number included in any other band, the different concentric bands being arranged at random radially on the disc as to number of openings contained in each band.

7. A light modulating disc comprising a disc having a plurality of concentric annular areas each area including a different number of uniformly spaced arcuate sections each of which sinusoidally vary in light transmitting value, the different annular areas being arranged at random radially on the disc as to number of sections contained in each area.

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