Sept. 5, 1933. A. McL. NICOLSON 1,925,814

CONTINUOUS FACSIMILE TRANSMISSION SYSTEM

Filed Sept. 25, 1930 2 Sheets-Sheet 1

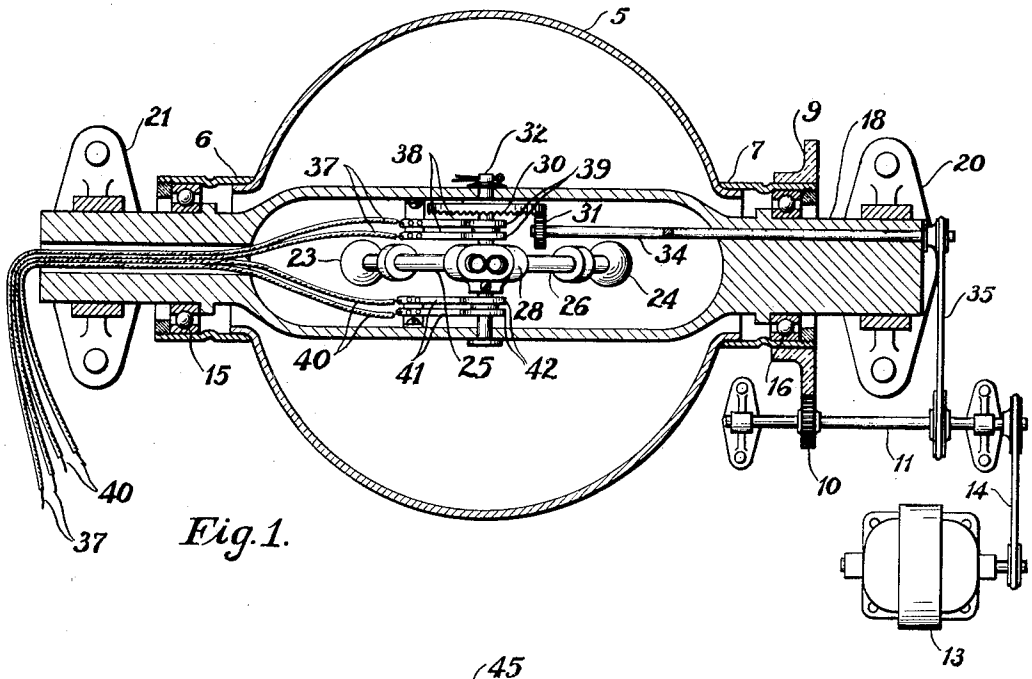


Fig. 1.

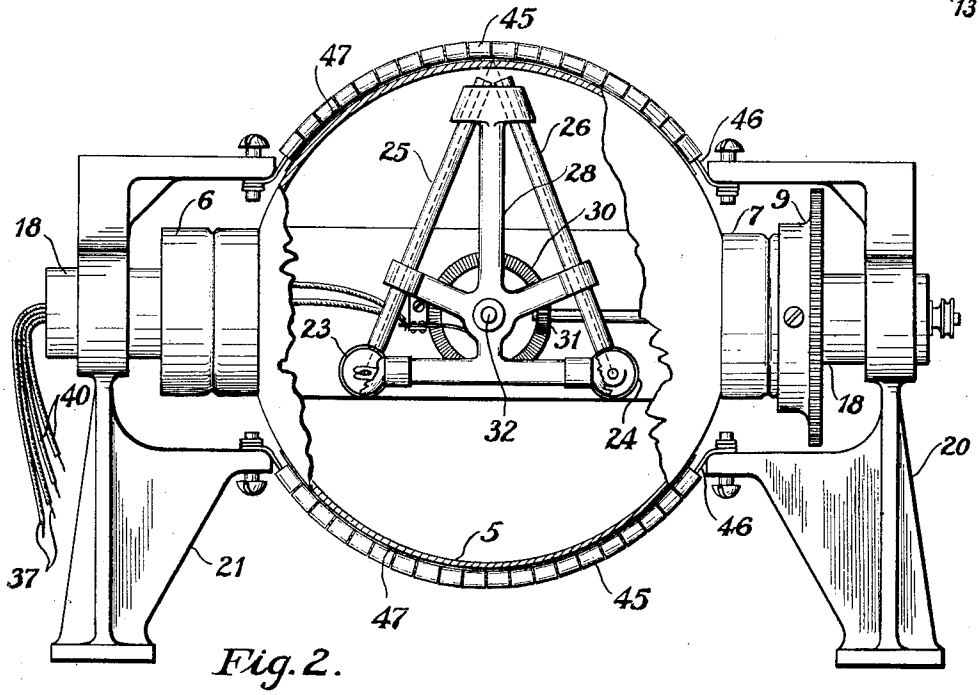


Fig. 2.

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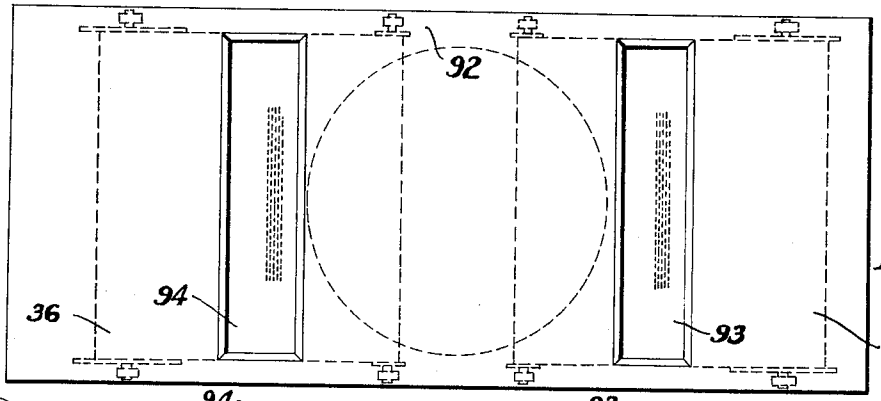


Fig. 4.

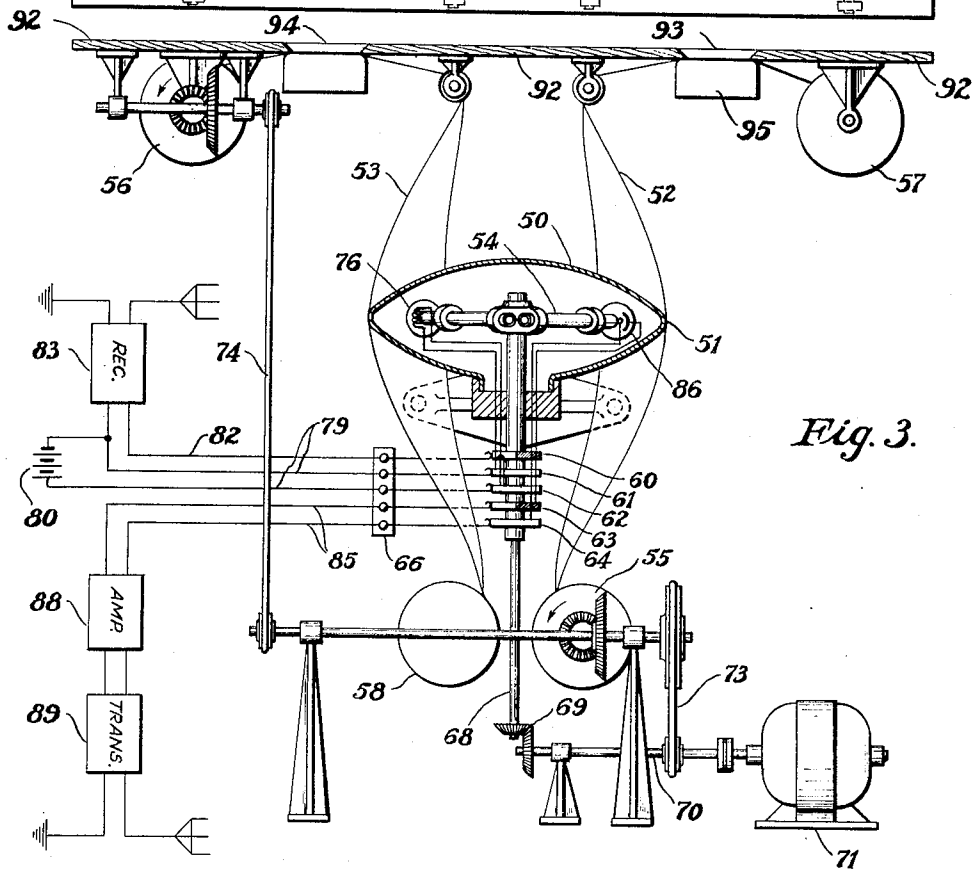


Fig. 3.

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UNITED STATES PATENT OFFICE

1,925,814

CONTINUOUS FACSIMILE TRANSMISSION SYSTEM

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Application September 25, 1930
Serial No. 484,356

13 Claims. (Cl. 178—7)

This relates to the transmission of the outlines of copies or reproductions, and particularly to the continuous transmission of facsimile messages, designs, drawings, and the like.

An object of the invention is to electrically transmit information by the sense of sight.

Another object of the invention is to continuously transmit the outlines of written intelligence.

A further object of the invention is to simultaneously transmit and receive copies and reproductions of information in the form of facsimiles.

It is old in the art to transmit written intelligence in the form of copies or characters in a discontinuous or periodic manner, by passing the material to be transmitted over a cylindrical roll which is scanned by an electrode stylus or a source of light transversing the cylinder. The present invention is an improvement on the now existing apparatus for facsimile transmission by the addition of a spherical medium which encloses the scanning and detecting apparatus.

A particular feature of the present invention is the continuous forward movement of the copy to be reproduced at a receiving station, and the enclosure of the entire light and detecting mechanism within a spherical roll. This arrangement permits the continuous feeding of the copy itself over the sphere or the copy mounted on a continuous return belt, which travels at a constant speed.

Another feature of the invention is the simultaneous reception of facsimile messages during the transmission thereof, or the simultaneous transmission of two facsimile messages with the same apparatus with substantially no change in the circuit arrangement.

The source of scanning light and the detecting means are in the form of a light source and a photoelectric cell, respectively mounted within a spherically shaped rotating element, the light source and cell being rotated transversely of the movement of the spherical element. As the copy advances over the surface of the spherical carrier one scanning length, the scanning mechanism transverses the entire cross section of the copy, returning to it on the opposite side one scanning width away from its previous starting point. In this manner, the copy may be fed continuously over the roll, one-half of which is employed for transmission, and the other half carrying light sensitive paper for the printing of incoming messages. If simultaneous transmission of two messages is desired, the second half of the sphere may also carry copy to be transmitted.

The system is adapted to the rapid transmission of pictures since there is no reversal of any elements and the rotating elements may be speeded up to a considerable velocity before limited by centrifugal force. Furthermore, the scanning beam in the present system is directed along a defined path as well as the varying beam impinging upon the cell. By thus confining these light beams, not only is higher efficiency obtained but light dispersion and fogging is prevented providing good definition of the received facsimile.

The principles of the invention are also applicable to a roll in the shape of a disk which remains fixed as the paper is drawn over the edge thereof by a take-up roll. This system simplifies the internal mechanism necessary for rotating the source of light and detecting cell transversely of the motion of the belts and copy.

The invention will be more fully understood from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a plan cross-sectional view of one embodiment of the invention;

Fig. 2 is a cross-sectional view in elevation of the embodiment of Fig. 1;

Fig. 3 is a plan view of another embodiment of the invention; and

Fig. 4 is an end view of the embodiment of the invention shown in Fig. 3.

Referring particularly to Figs. 1 and 2 showing the first embodiment of the invention, a transparent or translucent medium 5 of glass, quartz or the like is shown in cross-section welded to supporting cylinders 6 and 7, which may be of metal or an insulating material of appreciable strength such as bakelite. On the cylinder 7 is mounted a toothed flange 9 which meshes with a driving gear 10. This gear is mounted on a shaft 11 and driven from a motor 13 over a belt and pulley system 14. The transparent sphere 5 is thereby rotated upon bearings 15 and 16 through the gear train and belt system just mentioned. The entire structure is mounted upon a fixed support 18 shown in cross-section which is expanded and hollowed out through the portion that is included within the sphere 5. The sphere 5 is constructed in two portions which are joined so that the seam is normal to the motion of the sphere. The support 18 is mounted upon standards 20 and 21.

Mounted within the expanded section of the

support 18 is a triangular arrangement of a light source 23 which is a concentrated filament incandescent lamp, a photoelectric cell 24, and two light transmitting mediums 25 and 26 which are preferably, of quartz but may be opaque hollow tubing. It has been found that the crater type neon lamp provides a light source which is sufficiently powerful to be used for scanning and which is sensitive enough for good quality modulation. These elements are mounted on a spider structure 28 and rotated within the hollowed portion of the support 18 by means of a circular rack gear 30 and driving pinion 31. The structure is mounted on a shaft 32 which rotates in bearings journaled in the flanges of the support 18. The pinion 31 is driven through a shaft 34 and from a pulley and belt system 35 connected to the shaft 11. The belt and pulley system 35 may be replaced by a gear train mechanism such as shown at 9 and 10 for driving the sphere 5.

Light source 23 is energized over conductors 37 which are connected to brushes 38 in contact with slip rings 39, the slip rings 39 being connected to the terminals of the light source 23. For transmitting the electrical vibrations generated in the photoelectric cell a pair of conductors 40 are connected to brushes 41 in contact with slip rings 42, the slip rings being in turn connected to the terminals of the photoelectric cell 24.

The energization of the motor 13 will rotate the sphere 5 in one direction, and the light source and photoelectric cell in a transverse direction within the sphere. The driving gears have such a ratio that the sphere 5 moves one scanning width during one complete rotation of the light source and photoelectric cell. For instance, should the scanning width be $\frac{1}{52}$ of an inch, then during the movement of the copy on the sphere this distance, the light cell and light source will make one complete rotation. In this manner continuous motion may be imparted to the sphere 5 and to the internal mechanism. The direction of motion is always the same, there being no reversal of parts to limit the speed at which scanning can be accomplished, the limitation being only that of the strength of the structure of the rotating mechanism. The confining of the light to a definite beam both for projection to the copy and reflection therefrom prevents fogging and produces an extremely clear and defined facsimile at the receiver. In Fig. 2 is shown the means for maintaining the copy in contact with the scanning surface of the sphere 5. This means is a built up roll 45 of rubber mounted on a metallic rod or wire 46. Two of these are provided, one to form the belt passing over the upper portion of the sphere, and one to serve a similar purpose for the belt passing over the lower portion of the sphere. This pressure roll may be in the form of a pneumatic mat covering a substantial surface of the sphere to light proof the scanning portion of the copy. The mat may rotate or be fixed and the copy slipped between it and the sphere. Copy either in the form of a belt or paper 47 is shown between the rolls 45 and the sphere 5. It is realized, of course, that a certain slippage occurs at the edges of the belt over the sphere 5 because of the varying loci of rotation, but this slippage does not interfere with the scanning process which produces a straight scanning line.

Referring to Figs. 3 and 4, another type of facsimile transmitter receiver is shown, in which a disk shaped housing 50, which may be of opaque material except the tip portion 51 which is of transparent or translucent material such as glass or quartz. Differing from the embodiment shown in Figs. 1 and 2, the disk 50 is fixed, belts 52 and 53 being slipped over by the take-up rolls 55 and 56. The belts in this system are supplied from supply rollers 57 and 58. An internal construction 54 similar to that shown in Figs. 1 and 2, is employed in the present system from which conductors are lead to a plurality of slip rings 60, 61, 62, 63 and 64, rings 60 and 63 being insulated over one-half of their circumference to form commutators. These rings contact with a corresponding plurality of brushes attached to a supporting plate 66.

The internal mechanism 54 of the disk 50 is driven through its mounting shaft 68, bevel gears 69, and shaft 70 from a motor 71. The motor 71 also drives the take-up rolls 55 and 56 over the belt and pulley systems 73 and 74. These belt and pulley systems may be replaced by gear mechanisms in any well known manner.

The conductors from the light source 76 terminate in slip rings 60, 61 and 62, one conductor being common to commutator ring 60 and slip ring 62. Conductors 79 from a constant supply source 80 are connected through slip rings 61 and 62 to the light 76. Over this circuit the light source 76 is supplied with a constant voltage from the source 80 at all times, while over the conductor 82 and one of the conductors 79 connected to a receiver 83 for detecting incoming facsimile electrical vibrations, the light source is supplied with the incoming electrical vibrations during one-half of its rotating cycle. The commutator ring 60 controls the impression of the receiver output on the light source. Over conductors 85, the output of the photoelectric cell 86 is fed to an amplifier 88, and then to transmitter 89 for transmission to a receiving system. This exact circuit may be used in the embodiment of the invention shown in Figs. 1 and 2 although a simplified arrangement is contemplated. In this embodiment of the invention the supply roll or reel 57 and the take-up reel 56 are mounted upon a support 92 having openings 93 and 94 therein. The opening 93 is provided as a writing space wherein a person may write a message to be transmitted. To form a solid backing, a block 95 is positioned directly behind the opening 93. The apparatus may be mounted so that the position of the support 92 is horizontal and directly in front of the operator, or it may be mounted in a vertical position for reading the message being received as it passes from the disk 50 to the take-up roll 56. This procedure is similar to that used in a teleautograph system.

The operation of the embodiment shown in Figs. 1 and 2 is a follows: The leads 37 are connected to a constant source of voltage for supplying the light source 23 with energy. These leads are also connected to the incoming receiving apparatus for impressing on the source 23, the facsimile current variations. The conductors 40 which are connected to the photoelectric cell 24 are in turn connected to an amplifier and a transmitting system for the transmission of the varying light and shade intensities of the facsimile copy. Upon energization of the motor 13, the structure 28 is rotated within the sphere 5. The copy to be transmitted will be scanned during the period when the termi-

nals of the light conveying tubes 25 and 26 are passing thereacross, and in this case during the time when the tubes transverse the upper portion of the sphere. Through synchronism with a similar system, no impulses will be received over the incoming circuit during this period, and the light source will have thereon a constant voltage providing a constant light intensity. The light intensity will be varied, however, upon the photoelectric cell 24 in accordance with the light and shade intensities of the copy. These variations generated in the cell will be impressed upon the outgoing amplifier and transmission circuit. When the internal structure is passing the lower portion of the sphere upon which sensitized paper is positioned, impulses will be received over the conductors 37 and impressed upon the light source 23. These varying light impulses will effect the sensitized paper accordingly, and the received message will be printed upon the paper. It is to be understood, of course, that numerous methods of direct and indirect printing and developing of this paper may be employed in the present invention, these methods being well known in the art, although direct printing is preferable. During this time the photoelectric cell circuit may be disconnected from the transmission system, or a thermionic switching arrangement well known in the art for alternating the functions of the transmission receiver may be employed.

In the operation of the system disclosed in Figs. 3 and 4, by the provision of commutator rings 60 and 63, the incoming impulses are impressed on the light source positively during only one-half revolution of the apparatus internal of the disk 50. Furthermore, the outgoing impulses are positively connected and disconnected from the outgoing system. Such a circuit may be employed in the embodiment shown in Figs. 1 and 2, but it is unnecessary when two systems of this type are properly synchronized.

To effectively transmit two facsimile messages simultaneously, all that is required is the disconnection of conductors 37 from the receiving apparatus and the application of copy in place of the sensitized paper. There will then be a substantially continuous transmission of current variations which when impressed on synchronized receiving apparatus will reproduce the two originals.

The above facsimile systems are especially well adapted to the transmission of written messages and the reception thereof for such uses as interoffice communication or intercity communication where records of the transactions are desired, and at the same time rapid transmission of the messages is an important factor. The date of the messages may be placed thereon at the time of their writing, and the roll preserved in files for future reference. Since the received message is an exact copy of the original, there is a perfect interchange of writing between two parties. The system may also be used for the rapid transmission of photographs, drawings, and the like, by placing them on a continuous belt arrangement passing over the sphere 5 of the disk 50. Since the speed of transmission is limited only by the rotation of the internal structure of the systems, an extremely rapid rate of transmission may be obtained.

The invention has been disclosed in two of its preferred embodiments, but it is understood that there are other systems contemplated to be within the scope of the appended claims.

What is claimed is:

1. In an electrical transmission system, a rotating element bearing written intelligence to be transmitted, means for rotating said element, a source of scanning light, means for detecting variations in light and shade of said written intelligence, means for rotating said light source and said detecting means within said supporting element and transversely of the motion thereof, and means for changing said source of light from one of constant intensity to one of varying intensity to accomplish both transmission and reception during the time interval required for transmission alone.

2. In an electrical transmission system, a transparent medium for supporting a facsimile to be transmitted, a source of light of constant intensity for scanning said facsimile, means for detecting varying light intensities thereof, means for rotating said medium, said source of light and said detecting means in synchronism, the motion of said transparent medium being normal to that of said light and detecting means, and means for modulating said light during certain portions of its travel to accomplish reception during the period of transmission.

3. In a facsimile transmission system, a roll for supporting copy to be transmitted, a source of scanning light of constant intensity and detecting means located within said roll, light confining means for transmitting light to a unit area of said copy, means for rotating said light source and detecting means transversely of said roll, light confining means for transmitting reflected light from said unit area to said detecting means, and means for changing said light source from one of constant intensity to one of modulated intensity during each revolution thereof to accomplish both transmission and reception during the time interval required for transmission.

4. A facsimile system in accordance with claim 3, in which said light confining means comprises quartz rods, said rods having the intersections of their axes in said copy.

5. In a facsimile transmission system, a transparent roll for supporting copy to be transmitted, a scanning light and detecting means unitarily mounted within said roll and adapted to rotate transversely thereof, means for rotating said roll, and means for applying copy to one portion of said roll for transmission, a light sensitive medium, means for applying said light sensitive medium to the diametrically opposite portion thereof for reception of facsimiles, and means for maintaining said scanning light at a constant intensity during its projection on said copy and impressing modulated currents thereon during its projection on said light sensitive medium to accomplish both transmission and reception with the transmission apparatus during the time interval required for transmission.

6. In a two-way facsimile transmission system, means for supporting copy to be transmitted and a light sensitive medium for the reception of facsimile, means for passing said copy and said medium over said supporting means, an internal structure including a light source and a photoelectric cell for scanning said copy and detecting light and shade variations thereof, said light source further effecting said light sensitive medium, means for intermittently disconnecting said photoelectric cell,

means for maintaining said light source at a constant intensity during its projection on said copy and impressing modulated currents thereon during its projection on said light sensitive medium when said modulating currents are impressed on said light source, means for writing on said copy during movement thereof, and means for viewing said light sensitive medium after printing thereof.

7. A facsimile system in accordance with claim 6, in which said external structure is rotated transversely of the motion of said copy and said light sensitive medium, said rotating mechanism disconnecting and connecting said photoelectric cell from an outgoing circuit periodically during each half cycle.

8. In a facsimile system, receiving apparatus, transmission apparatus associated therewith, a photoelectric cell connected to said transmission apparatus, a light source connected to the output of said receiving apparatus, said light source and said photoelectric cell being unitarily mounted and adapted to rotate, a constant voltage source, and a plurality of commutating brushes for disconnecting said light source from said receiver during the period when said photoelectric cell is connected to said transmitter and for disconnecting said photoelectric cell from said transmitter when said light source is disconnected from said receiver and connected to said constant voltage source to accomplish both transmission and reception during the time interval required for transmission alone.

9. In a two-way facsimile transmission system, a support for copy to be transmitted, said support serving to carry a light sensitive medium for receiving facsimile, a source of light for successively scanning said copy and said light sensitive medium, a receiving system for incoming facsimile currents, a constant voltage source, and means for connecting said light source of said constant voltage source to maintain a constant light intensity when scanning said copy and to the output of said receiving system to modulate said light source when scanning said light sensitive medium to accomplish both transmission and reception during the time interval required for reception alone.

10. In a two-way facsimile system, a home station having a support for copy to be transmitted and a light sensitive medium, an internal structure within said support adapted to rotate transversely thereof, a light source and a photoelectric cell co-operatively mounted on said structure, duplicate apparatus at a distant station, sources of constant potential for said light sources at said stations, a receiving circuit at each of said stations, and means at each of said stations for connecting the photoelectric cell at said home station to the light source at said distant station alternately with the connection of the light source at said home station and the photoelectric cell a said distant station.

11. In a two-way facsimile transmission system, a roll for mounting copy to be transmitted and for mounting a light sensitive medium for receiving facsimile transmission, the combination of a source of light, means for detecting light and shade intensities in said copy mounted within said roll, means for rotating said roll transversely of said light source and detecting means, and means for maintaining said light source at a constant intensity for scanning said copy to be transmitted and modulating said light source for effecting said sensitive medium to accomplish both transmission and reception during the time interval usually required for transmission alone.

12. In a two-way facsimile transmission system, means for supporting copy to be transmitted and a light sensitive medium for the reception of facsimile, means for passing said copy and said medium over said supporting means, an internal structure including a light source and a light sensitive device for scanning said copy and detecting light and shade variations thereof, said light source further affecting said light sensitive medium, and means for changing said light source from one of constant intensity during projection on said copy to one of varying intensity during projection on said light sensitive medium.

13. In a two-way facsimile transmission system, means for supporting copy to be transmitted and a light sensitive medium for the reception of facsimile, means for passing said copy and said medium over said supporting means, an internal structure including a light source and a light sensitive device for scanning said copy and detecting light and shade variations thereof, said light source further affecting said light sensitive medium, and means for changing said light source from one of constant intensity during projection on said copy to one of varying intensity during projection on said light sensitive medium.

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