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FACSIMILE TRANSMISSION SYSTEM AND METHOD

Filed May 14, 1928

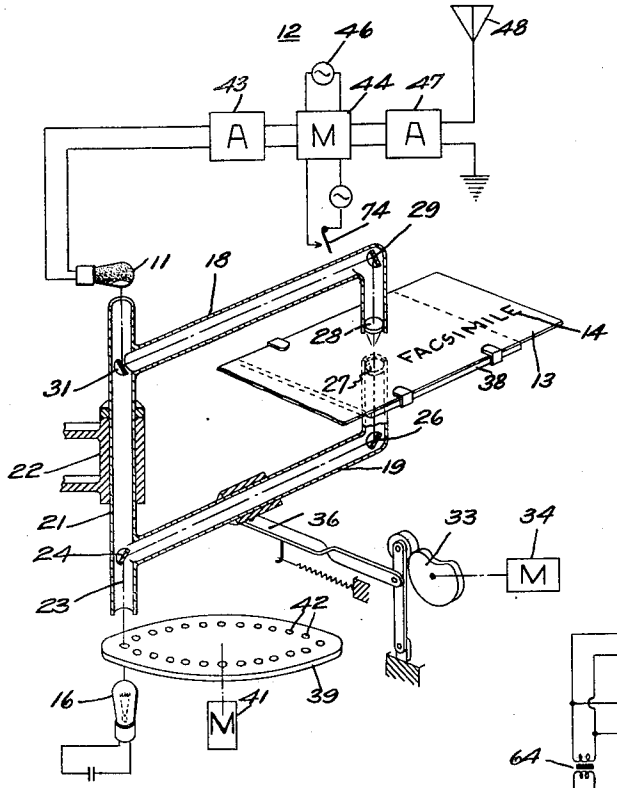


FIG. 1.

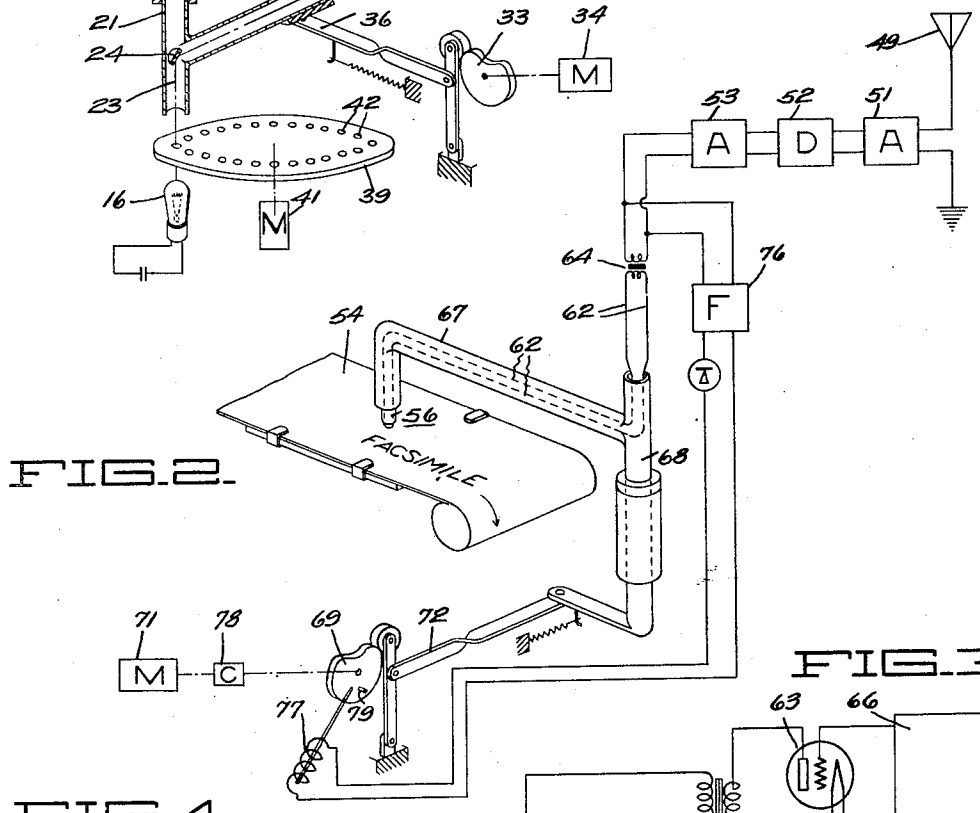


FIG. 2.

FIG. 3.

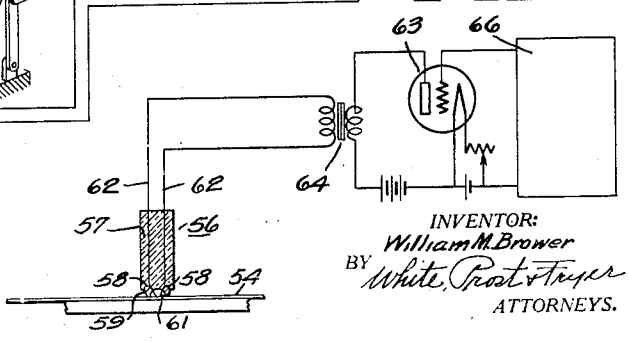
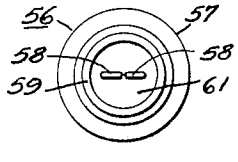


FIG. 4.



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UNITED STATES PATENT OFFICE

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FACSIMILE TRANSMISSION SYSTEM AND METHOD

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This invention relates generally to systems and methods of effecting transmission of facsimile impressions to remote point by means of electrical energy.

It is an object of this invention to devise an improved apparatus and method of effecting scanning of a surface carrying an impression to be transmitted and of a light sensitive surface upon which an impression is to be reproduced.

It is a further object of this invention to device improved means for producing a concentrated spot of light to be utilized in scanning a light sensitive surface.

It is a further object of this invention to devise an improved facsimile transmission system for the continuous and automatic transmission of facsimiles.

Further objects of the invention will appear from the following description in which I have set forth the preferred embodiment of my invention. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Figure 1 is a diagrammatic illustration showing certain features of my invention incorporated in an apparatus for translating impressions into electrical variations.

Fig. 2 is a diagrammatic illustration showing apparatus for receiving and translating electrical current variations produced by apparatus such as shown in Fig. 1.

Fig. 3 is a diagrammatic view illustrating my apparatus for producing a concentrated source of light at the receiving end of my system.

Fig. 4 is an end view of the device which I utilize for producing a concentrated source of light.

Referring to the drawings for a complete description of one embodiment of my invention, the apparatus which I employ at my transmission station preferably includes a photoelectric cell or some other suitable light sensitive device 11 associated with a suitable transmission means, as for example a radio transmitter 12. The impression to be transmitted is carried upon a suitable surface such as upon a sheet of paper 13, and may consist for example of a printed image or lettering 14, this lettering being preferably of such a character that it will change the light transmitting properties of the paper 13. As a source of light I have shown conventionally a small electric lamp 16, and both lamp 16 and photoelectric cell 11 are preferably mounted relatively stationary.

As is usual in facsimile systems, light from lamp 16 is directed upon the paper 13 so as to be modified by the impression thereon, and modified light is caused to affect the photoelectric cell 11. In order to permit the use of a stationary lamp 16 and photoelectric cell 11, I preferably utilize apparatus somewhat as shown which includes a pair of hollow arms 18 and 19 extending laterally from a hollow shaft 21. Shaft 21 is journaled as by means of bearing member 22, so that the arms 18 and 19 may be oscillated about a fixed axis 23. Shaft 21 is arranged with respect to the lamp 16 so that a ray of light from the lamp can be directed thru the hollow arm 19, concentrated upon the paper 13, the light as modified by the impression received and directed back thru the arm 18, and applied to photoelectric cell 11. To accomplish this result I have shown a prism or mirror 24 adapted to reflect a ray of light received from lamp 16 along the arm 19, and another prism or mirror 26 for reflecting the ray toward the paper 13. The outer end of this arm is provided with a lens 27 for focusing the light upon a relatively small spot of the paper 13.

In the particular apparatus shown the light from lamp 16 is directed thru the paper 13 or other surface carrying the impression, in which event it is obvious that paper 13 must be transparent or translucent. Therefore arms 18 and 19 are shown upon opposite sides of the paper 13, and arm 18 is shown as provided with a lens 28 for receiving light transmitted thru paper 13. Light transmitted thru lens 28 is reflected by a prism or mirror 29 and directed back thru the hollow arm 18, and reflected by another prism or mirror 31 upon the photoelectric cell 11. It is noted that mirrors 24 and 31 respectively are arranged so as to receive the light from lamp 16 and so

as to direct the light toward photoelectric cell 11, along directions which are substantially coincident with the axis 23. Therefore arms 18 and 19 may be oscillated without directly affecting the light received by the photoelectric cell.

Suitable mechanism is provided for oscillating the arms 18 and 19 at a definite rate, such mechanism being represented by means of a cam 33 driven at a definite rate by means of a motor 34. Suitable motion transmitting mechanism 36 serves to interconnect cam 33 and arms 18 and 19, whereby the arms are recurrently moved back and forth relative to the paper 13 thus causing the paper to be scanned by the light focused by the lens 27. In order to cover an area of paper 13, this paper is moved in one direction lateral to the scanning movement of arms 18 and 19. Movement of the paper may be continuous but I prefer to employ intermittent movement. In practice at the completion of each complete cycle of movement of arms 18 and 19, paper 13 is advanced a small distance to present another portion of the paper surface. To support the paper as it passes between the opposed ends of arms 18 and 19, I have shown a plate 38 of transparent material such as glass.

I prefer to utilize my apparatus with a transmitting system making use of carrier waves modulated by an audible frequency of say 1000 cycles. This modulation is preferably effected by means of a tone wheel which chops or interrupts the light supplied to the photoelectric cell 11. Such a wheel is indicated at 39 and is driven at a definite speed by means of a motor 41. It is interposed at some point between lamp 16 and the photoelectric cell, as for example between lamp 16 and the mirror 24, and is provided with a plurality of apertures 42 which intermittently permit light to pass at a tone frequency of say 1000 cycles. The carrier wave transmitting apparatus associated with the mechanism described above, has been diagrammatically shown as comprising an amplifier 43, as of the vacuum tube type, having its input connected to the photoelectric cell 11 and its output to a suitable modulating device 44. Modulator 44 is associated with a master carrier frequency oscillator 46, and the modulated output is passed thru a suitable amplifier 47 to a transmission circuit, which in this instance comprises a radio antenna 48.

The receiving apparatus shown in Fig. 2 is somewhat similar to the transmitting apparatus of Fig. 1, in that arcuate scanning movements are effected. For receiving the modulated carrier wave energy I have shown conventional apparatus consisting of a radio antenna 49 coupled to an amplifier 51 and detector 52. The output of detector 52 is preferably passed thru one or more stages of an audio frequency amplifier 53, as of the vacuum tube type. As the carrier waves are integrated in detector 52, the output of amplifier 53 is modulated by an audible tone frequency, which in this one specific example is 1000 cycles, and at the same time is modulated according to the character of the impression being transmitted. I have found that such a modulated output may be caused to jump a small electric gap and that an arc so formed is a convenient source of concentrated light for scanning purposes. Accordingly I form a small arc gap immediately adjacent the light sensitive surface of a strip of photographic paper or other material 54, by means of a device which I have indicated generally at 56. This device is illustrated in detail in Figs. 3 and 4 and in the specific instance shown consists of a body 57 of insulating material within which is placed a pair of electrodes 58. One end of the insulating body 57 is preferably in contact with the surface of light sensitive sheet 54, and for making such contact I have shown one end of body 57 formed with an annular ridge 59, defining an inner pocket 61. Electrodes 58 are extended into pocket 61, and terminate in close proximity to the surface of paper 54. The use of an annular ridge 59 prevents accidental puncturing of the paper by the electrodes. Connected to the electrodes 58 are the usual terminal wires 62.

In order to illustrate the general application of the device 56, in Fig. 3 I have shown the same as being supplied with current from the output of the vacuum tube amplifier 63, the output of this amplifier being coupled to the terminals 62 thru a suitable step-up transformer 64. A source of modulated energy is indicated diagrammatically at 66 and is connected to the input of amplifier 63.

When incorporating the device 56 in a receiving apparatus for receiving modulated current variations from an apparatus shown in Fig. 1, I prefer to scan the light sensitive paper 54 by moving device 56 back and forth along an arcuate path similar to the movements of the scanning apparatus shown in Fig. 1. Therefore in Fig. 2 I have shown device 56 as being carried upon the end of an arm 67, and this arm is secured to a rotatable shaft 68. Terminal wires 62 are preferably carried thru the arm 67 and shaft 68 and are connected to the output of amplifier 53 thru step-up transformer 64. Arm 67 is oscillated by suitable means such as a cam 69 driven by a motor 71. Interposed between cam 69 and shaft 68 I have shown a suitable motion transmitting means 72. Paper 54 is moved along intermittently substantially identical to the movement of the paper 13 at the transmitting station, and the direction of movement is of course lateral to the arcuate movements of the device 56. Paper 54 is preferably supported in such a way that

its surface will always be substantially in contact with the end of device 56.

Any convenient means may be employed for synchronizing movements of the arms 18 and 19 at the transmitting station with the arm 67 at the receiving station. As an example of such synchronizing means, I preferably operate the cam 69 at the receiving station at a slightly greater speed than the cam 33 at the transmitting station. Associated with the scanning mechanism of the transmitting station, means is provided for transmitting a synchronizing signal for a definite position of the synchronizing mechanism. For example I have shown a switch 74 adapted to be closed when arm 18 reaches one limit of its movement, and closing of this switch impresses a modulating frequency differing from the tone frequency of wheel 39, upon the modulator 44. At the receiving station this synchronizing signal is selected out from the output of amplifier 53 as by means of filter 76, and is caused to actuate a tripping solenoid 77. Interposed between motor 71 and cam 69 I have indicated an overrunning clutch 78, whereby movement of cam 69 can be arrested. Normally solenoid 77 is arranged to engage a member 79 carried by cam 69, so that upon completion of each back and forth movement of arm 67, the arm will be momentarily arrested by solenoid 77. When arm 18 at the transmitting station completes its movement which will be immediately following arresting of movement of arm 67, a synchronizing impulse is sent out which releases solenoid 77 and permits the receiving apparatus to start out in exact synchronism with the transmitting apparatus.

To briefly review operation of the complete system, light from the lamp 16 is interrupted by wheel 39 at a tone frequency and is directed outwardly thru hollow arm 19 and focused upon the sheet 13 carrying the image or impression to be transmitted. Light transmitted thru sheet 13 is directed back thru arm 18 and reflected upon the photoelectric cell 11. Variations of the resistance of the photoelectric cell caused by modulation of the light, modulates the radio transmitter 12 and corresponding modulated variations are picked up by the receiving apparatus. The received modulated energy is integrated, amplified, and impressed upon the device 56 to form a small electric spark or arc immediately adjacent the light sensitive surface of the paper 54. Generally the apparatus is adjusted so that when transmitting a black ink impression on a white paper surface, no spark will be formed by device 56 for the ink surfaces but a spark of considerable intensity will be formed for the white or blank surfaces.

It is to be understood that by transmission of facsimile impressions, I have reference to transmission of optical images of any kind such as printed or written messages, pictures, sketches and the like. The novel construction of my scanning apparatus makes it possible to introduce sheets of paper of various sizes bearing messages or pictures to be transmitted. Such operation is not practical with prior apparatus which transmit an impression from a cylindrical surface.

I claim:

1. The method of modulating light by scanning a plane surface with a beam of light which comprises projecting said beam of light in a direction perpendicular to said surface, bending said beam so that it impinges on said surface, rotating the beam through an arc about an axis coincident with its first straight portion, and bending the modulated light received from said plane surface so that it is projected along said axis.

2. The method of scanning a plane surface with light which comprises directing a beam of light along a path perpendicular to the plane of said surface, bending said beam whereby it impinges on said surface at a point spaced from said first path, focusing said beam on an elementary area of said surface whereby it is illuminated, intercepting light from said illuminated elementary area, focusing said intercepted light into a parallel beam, bending said beam to direct it along a path in a line with said first path, and rotating said beams about an axis coincident with said first path.

3. In a facsimile transmission system comprising a plane surface to be scanned and a stationary source of light and a stationary photo-electric cell lying in a line perpendicular to said plane, scanning means for reflecting a beam of light from said source to a point on said surface laterally spaced from said perpendicular line, focusing means on the opposite side of said surface for intercepting light from said point on said surface, means for reflecting said intercepted light along a path coincident with said perpendicular line whereby it impinges on said photoelectric cell, and means for rotating said entire scanning device through an arc about said perpendicular line as an axis.

4. The method of modulating light during transmission of said light from a stationary source to a stationary photoelectric cell, which comprises bending a beam of light from the direct path between the light source and the cell, focusing said beam on a plane surface, rotating said beam about an axis coincident with said direct path, collecting the modulated light from said plane surface to form a modulated beam of light, rotating said modulated beam about said axis through equal angles and synchronously with said first mentioned beam, and directing said modulated beam along said axis to the photoelectric cell.

5. Apparatus for scanning a plane surface, comprising a shaft having hollow end sections, means for rotating said shaft about its longitudinal axis, a pair of arms carried by said shaft and angularly disposed to said axis, means for projecting light through one end section of said shaft, means carried by one of said arms for focusing light from said shaft to the plane surface, means carried by the other of said arms for transmitting light received from said plane surface through the opposite end section of said shaft, and a light sensitive element adjacent the last mentioned end section.

6. Apparatus for scanning a plane surface, comprising a shaft having hollow end sections, said shaft being disposed with its longitudinal axis substantially perpendicular to the plane of said surface but removed therefrom, means for rotating said shaft about said axis, means for projecting light through one end section of said shaft, means carried by said shaft for focusing said light upon an elemental area of the plane surface, means carried by said shaft for transmitting light received from said elemental area through the opposite end section of said shaft, and a light sensitive element adjacent the last mentioned end section.

7. Apparatus for scanning a plane surface, comprising a shaft having hollow end sections, means for rotating said shaft about its longitudinal axis, a pair of parallel hollow arms carried by said shaft and disposed at substantially right angles to said axis, means for projecting light through one end section of said shaft and one of said hollow arms and focusing said light upon an elemental area of the plane surface, means for transmitting light received from said elemental area through the other of said hollow arms and the opposite end section of said shaft, and a light sensitive element adjacent the last mentioned end section.

In testimony whereof, I have hereunto set my hand.

WILLIAM M. BROWER.