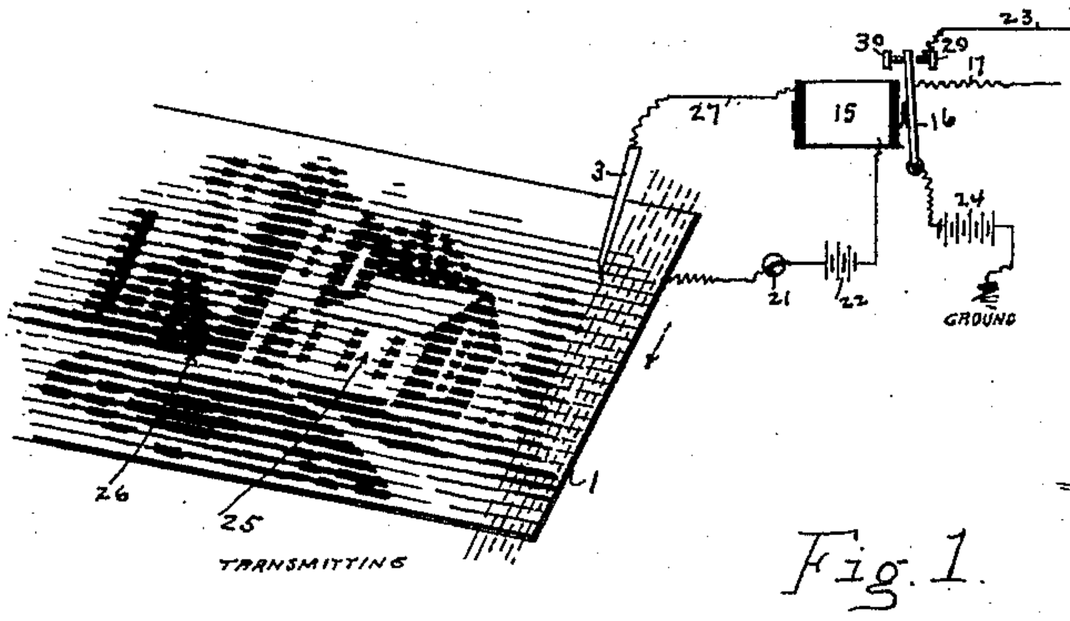
(No Model.)

N. S. AMSTUTZ.

METHOD OF REPRODUCING PHOTOGRAPHS.

No. 577,373. Patented Feb. 16, 1897.



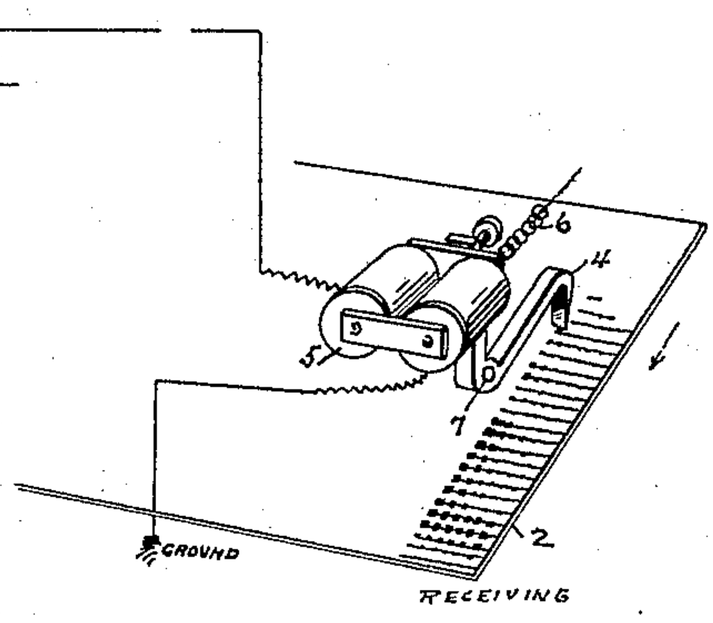


Fig. 1.

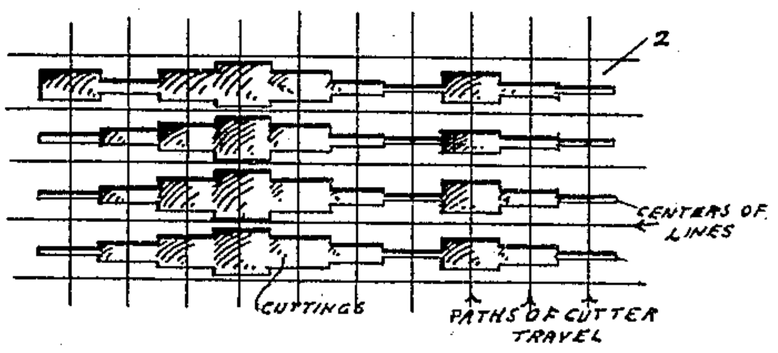


Fig. 2.

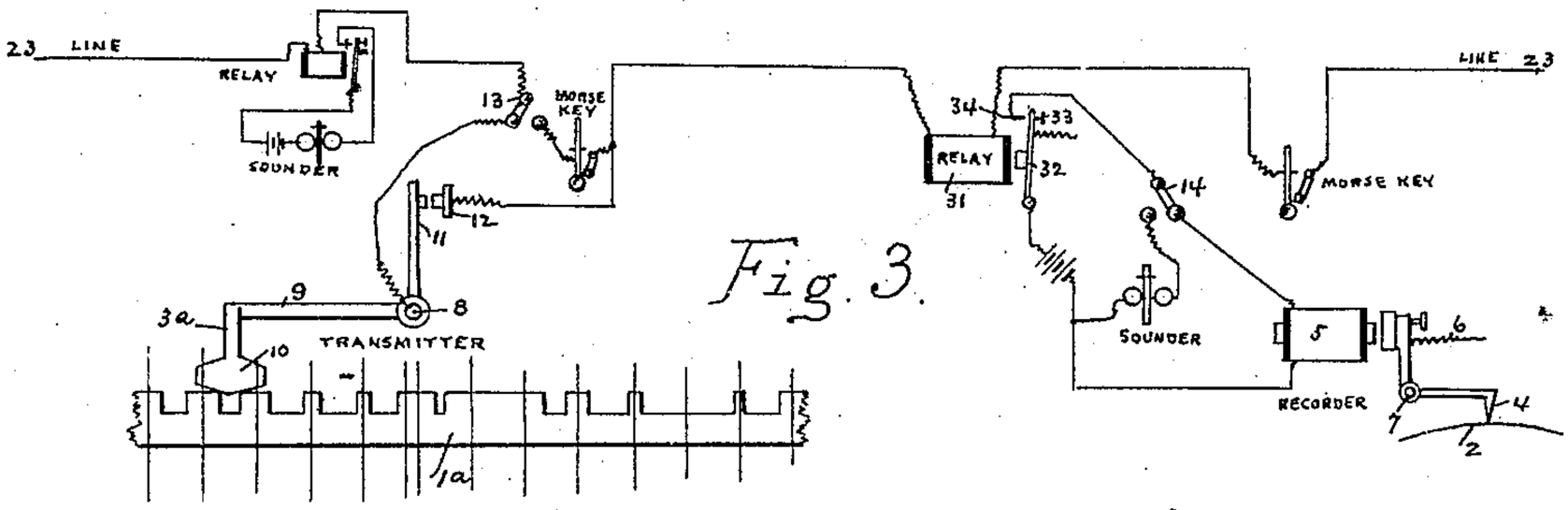


Fig. 3.

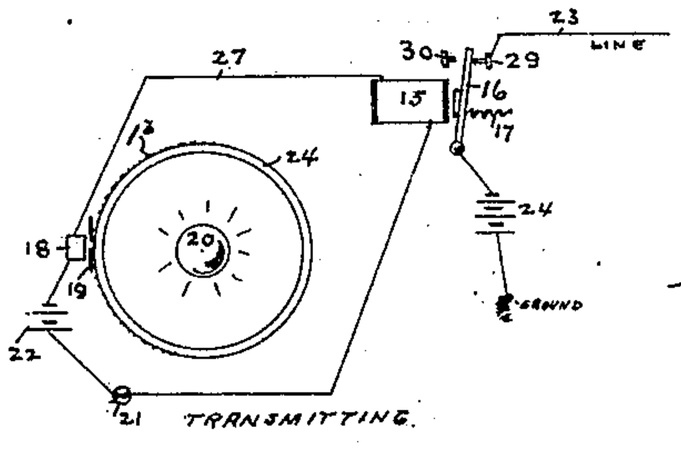


Fig. 4.

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METHOD OF REPRODUCING PHOTOGRAPHS.

SPECIFICATION forming part of Letters Patent No. 577,373, dated February 16, 1897.

Application filed April 9, 1895. Serial No. 545,075. (No specimens.)

To all whom it may concern:

Be it known that I, NOAH S. AMSTUTZ, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Methods of Transmitting or Reproducing Photographs; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a new and improved method of transmitting or reproducing photographs, &c., electrically, locally, or at a distance; and it consists, first, in producing a photographic or other image in practically continuous lines upon any suitable material; second, moving a tracer to ride in contact with such surface, so as to successively pass over every portion of the image, thereby causing variable electrical impulses corresponding to the variations in light and shade of the image.

This process comprises the transmission or reproduction of images having half-tones, in contradistinction to ordinary outline images, and in carrying out the features thereof I prepare a picture having its half-tones broken up into practically continuous parallel lines, varying in width and having no arbitrary lines intersecting the same which do not form an inherent portion of the image, in contrast with the arbitrary intersecting lines of the ordinary half-tones.

It is impractical to use an image for telegraphic or other purposes having its half-tones broken up by intersecting lines unless the image is placed upon the machine with one set of lines exactly coincident with the path of travel of the tracer, and the successive paths must also register precisely with the number of lines per inch on the print. This is almost impossible of attainment because it is not feasible to prepare pictorial images under widely-varying conditions which uniformly contain exactly the same number of lines per inch. The devices designed for this art must usually be operated by persons who are not experts in the making of delicate adjustments where the possibility of accumulative errors is so great. In the transmission of such an image when it is not "registered," as set forth, the effect is startling, to say the least, because a large number of recurring dark patches are formed, which entirely destroy the serviceability of the reproduced image. This effect is due to the interference of the paths of travel of the tracer with the diverging line at regular periods when it should exactly coincide with it at every point. My system avoids these features entirely by having continuous lines through the half-tones of the image at an angle to the path of travel of the tracer, the best effects being produced when such lines occur at about right angles thereto.

It is immaterial whether the image is made as a relief-print with practically continuous lines slightly raised and also varying in width or in shape of a print made upon a material having conducting qualities in lines of insulating material varying in width and uninsulated lines between the insulated ones of a maximum width when the insulated lines are a minimum width, and vice versa.

The variation in width of the insulated or the uninsulated lines at any given point, unless modified by any inherent features of the image, are almost uniformly in opposition, so that as one widens the adjoining lines become narrower. This feature holds good whether the prints or sketches are in relief or on conducting material.

When the images which are to be reproduced are "relief-prints," having their half-tones broken up into lines of varying widths, corresponding electrical impulses are produced in the following manner, viz: A suitable tracer rides in contact with the picture. This tracer is secured to a vibrating arm, which at one end thereof is provided with a suitable contact which includes electrical connections with a line-wire. As the tracer moves across the relief-lines at about right angles thereto it rises and falls according to the variations of light and shade of the image. If the circuit is so connected that the impulse is sent to the line during the time that the tracer is in its highest position, then the impulses will vary in length according to the variation in width of the ridges over which the tracer rides, the grooves between the ridges representing the time of inactivity on the line. It should be understood that the

vibrating lever could be connected with equal facility in the opposite manner to that just described, so that the impulses would be sent to the line when the tracer was in a groove or depression, which in its varying widths represents the variation of light and shade of the image just as faithfully as the ridges which occur between the grooves.

The manner of recording the variable electrical impulses is substantially as follows: A suitable surface, such as wax, gelatin, celluloid, &c., is provided and placed upon a carrier which travels in unison with the image to be reproduced. Above this recording-film is placed an engraver, which is regulated in the same manner as the "graver" of watch-case-engraving machines. The operation, in brief, consists in causing the graver to penetrate the surface by an electromagnet when the line is active and withdrawing the same by means of a spring or the like when the line is inactive.

The recording could be effected in just as expeditious and faithful a manner by allowing the spring to move the graver or cutter into the recording-surface and the magnet to move it out of the material.

When the transmitting apparatus is so connected that the impulses are sent to the line while the tracer is upon a ridge or upon an insulated line corresponding to a dark portion of the image, if it is a "positive," then the reproducing apparatus must be so connected that the magnet will draw the cutter out of the material. Of course it is evident that no impulse could be sent to the line when the tracer was upon an insulated line of the image, as just stated, because an "insulated line" implies an uninsulated line to either side of the insulated one, and it is only when the tracer is upon such conducting-surface that an impulse can be sent to the recording device. Under this condition the magnet would be required to draw the cutter into the material and the spring withdraw it.

In carrying out my invention I make use of an apparatus substantially like that shown in the accompanying drawings, in which—

Figure 1 is a diagrammatic view of a subject and the electrical connections from the sending to the receiving station and the simplest form of mechanism which may be employed in carrying out the features of my invention; Fig. 2, an enlarged view of a suppositious engraved record as it is received; Fig. 3, a diagram of the electric connections when the transmitter and receiver are used on an ordinary telegraph-line when a relief-line subject is being sent, as shown, or when the subjects shown in Figs. 1 or 4 are used; and Fig. 4, a diagrammatic view of a transmitter when transmitted light is employed to cause electrical impulses.

Referring to the several views of the drawings, it will be seen that the subject to be transmitted is made in continuous parallel lines in such portions thereof as neither maximum white or maximum black, as shown. The black lines represent the insulated portion of the subject, while the white lines represent the uninsulated parts. The lines are continuous, as stated, except where they are made discontinuous by reason of the inherent composition of the subject, as shown at 25, Fig. 1, where the black lines are broken because of the "high light," and at 26, Fig. 1, where the white lines are broken because this portion of the subject represents a "dead-black."

The designated high light refers to a maximum white, and dead-black refers to a maximum black.

The subject 1 is formed with a conducting-base which is connected by wire to switch 21, battery 22, relay-magnet 15, and by wire 27 to the stylus or tracer 3. This tracer rides across the subject, or the subject may be moved underneath the tracer, the necessary effect being to cause the tracer to successively engage the insulated lines in a path at about right angles to the lines themselves, whereby electrical impulses are formed at about a uniform rate, the duration of the impulses, however, varying in accordance with the lights and shades of the subject.

The relay 15 serves to repeat the impulses upon the line-wire 23 through the alternate attractions of the armature 16 and the contra movements thereof due to the retractile spring 17, which draws the armature-lever against the stop 29, which closes the line-circuit 23, and on account of a battery 24 being included therein an impulse is sent to the receiving-station, where magnet 5 actuates the recording-armature 4, that is fulcrumed at 7. The magnets 5 attract the armature against the action of the spring 6 and the record is made, preferably, in an engraved manner on the receiving-surface 2.

The object in using the local circuit 27 is to enable me to use a very weak current across the subject 1, in order that the very fine tracing-point which is necessary may not be unduly heated and very little sparking will result. The sparking in itself is not as desirous in systems of this kind as is the heating of the delicate tracing-point, which tends to blunt the point more or less, thus causing it to skip the very narrow or delicate uninsulated lines, because of the point reaching across from one insulated line to another.

As the connections are shown the recording device 4 will make a record each time the tracer 3 is upon an uninsulated portion of the subject. This arrangement of connections, when the recording device 4 is a cutter, will cause it to leave the surface 2 untouched when the tracer 3 is on a black or insulated line, thus leaving the recording material in shape to be printed from by an ordinary printing-press when the reproduction is mounted for printing purposes.

Should the subject be a negative instead of a positive, then the line-wire 23 would be con-

nected to the back contact 30, the armature-lever 16 making contact when the tracer 3 is on a white line, thus attracting the recording device 4 and moving it out of engagement with the recording material 2, whereby a black line is recorded.

Should the reproduction be desired for intaglio plate-printing and the subject 1 is a positive, then line-wire 23 would remain on back stop 30, but should the subject be a negative the line-wire would be placed upon front stop 29.

The line-wire may be provided with a switch similar to switch 21, or these switches might be connected together, so as to be operated simultaneously, so that neither one would be forgotten either in starting or stopping. When the recording device 4 is as broad, or a little more, than the "cross-feed," then the untouched portions of material 2 are in continuous lines varying in width, as shown in the enlarged view of Fig. 2. Should the device 4 be narrower than the width of the cross-feed, an intersection-line of uniform width would be formed. This line would be parallel with the path of travel of the recording-impulses.

When the subject is broken up in varying parallel lines which are raised, it is no longer necessary to use a local circuit, as in Fig. 1, but a tracer 3^a, Fig. 3, is used. This tracer drops into the grooves, as shown, its widened end 10 serving to ride over the ridges of the subject 1^a. The up-and-down movement of the tracer 3^a is imparted to the bell-crank 9, which is pivoted at 8. The other end 11 of this arm carries a platinum contact similar to ordinary telegraph-keys.

The arm 11 connects with contact 12 when tracing-head 10 is on top of the ridges, or, if the contact 12 were placed on the other side, the circuit would be closed while the tracer-head was in a groove.

A switch 13 is used to connect the transmitter with the line-wire 23 of an ordinary Morse circuit, which includes the ordinary relays, of which 31 is shown. This relay actuates the armature 32 against the stops 33 and 34 similar to relay 15 and Fig. 1, the alternative connection of line-wire 23 to stops 33 or 34 being for the same purpose as the connection of line-wire 23 to stops 29 and 30 in Fig. 1, as described.

A switch 14 serves to connect receiver-magnets 5 in circuit with the line-wire 23 instead of the ordinary Morse sounder.

When the subject is formed on a transparent medium 1^b, as shown in Fig. 4, the impulses are formed as follows, viz: The transparent drum 24 supports the subject 1^b. A lamp 20 is placed within it and a perforated diaphragm 19 at one side, so that the light-rays of lamp 20 pass through the drum 24 and the aperture of diaphragm 19 upon a selenium cell 18, which is connected with a battery 21, switch 22, and wire 27 to relay-magnet 15, the same as in Fig. 1.

The current in wire 27, Fig. 4, is constantly flowing so long as switch 21 is closed; but it varies in strength in accordance with the variation of the intensity of the light projected upon it from lamp 20. As the current is weakened the relay 15, Fig. 4, loses a part of its magnetism and the spring 17 draws the armature 32 away; but just as soon as the current again increases to a predetermined point the magnet overcomes the spring 17 and again attracts the armature.

The connections to line-wire may be the same whether the subject is in one form or another, the only requisite being that the subject shall be made with the half-tones broken up in parallel lines varying in width, so as to automatically produce electrical impulses which vary in duration in accordance with the variations in light and shade of the subject, so long as such impulses occur substantially at a uniform rate in the half-tone portions of the subject.

I am aware that it is not new to use alternate conducting and insulated surfaces to produce electrical impulses, since this has been accomplished in a number of autographic systems, among which may be mentioned Casselli, Blakewell, Myers, and Sawyer. Neither is it new to use a surface having alternate ridges and grooves for actuating a transmitting device, as is evidenced in Edison's "embossed" autographic system.

What I do believe is new, and what I set forth as my invention is, making an image, as a photograph or sketch, with its portions occurring between a maximum black and a maximum white of parallel continuous lines, varying in width as these portions of the image vary, and cause electrical variations in an electric circuit to correspond to the varying lines of the image which is to be reproduced and record such variations on another surface automatically.

I do not limit myself to the use of the raised lines or to those formed on a conducting material, because I can equally well use a transparent image having its half-tones similarly broken up.

When a transparent image is used, the same is supported upon a suitable transparent surface, such as a glass cylinder, in the front of which is a diaphragm with a small aperture through which the image is successively projected upon a selenium cell which makes electrical impulses in the circuit to which it is connected, which vary with the lines of the image. The receiving or recording with the selenium-cell transmission is the same as in the instances already recited.

With my improved system I am enabled to transmit all the varying lights and shades of the image faithfully, with no greater complexity of electrical features than are found in ordinary telegraph offices.

Transmitting devices embodying the features of my improved method are connected to an ordinary telegraph-line through a suit-

able relay, the receiving devices being connected beyond ordinary relays in the same manner as ordinary sounders are connected.

With my system the "image-message" is subject to the same limitations as an ordinary telegram, and it can be duplexed or quadruplexed in the same manner, by this method cable transmission being very much reduced from the speed attainable on land lines.

My reproductions when made on celluloid can be electrotyped in the ordinary manner, and stereotypes can also be made directly from the reproduction.

What I claim is—

1. The herein-described method of electrically reproducing photographs, &c., consisting, first, in forming a pictorial image with continuous parallel lines in the half-tone portions thereof; second, in moving in contact therewith, at about right angles to said lines, a suitable tracer whereby electrical impulses of varying duration are formed, and third, recording such impulses in an engraved manner on another surface, substantially as set forth.

2. The herein-described method, consisting in forming continuous parallel lines, varying in width, throughout the half-tone portions of an image, except where the inherent composition of the image makes them discontinuous, then moving a tracer in contact with the lines of the image in such a direction as to cause successive electrical impulses of variable duration and recording such impulses upon another surface, substantially as set forth.

3. The method of reproducing images other than "outlines," which consists in forming an image with continuous parallel lines of varying widths, except where they are discontinuous through the inherent composition of the subject and causing variable electrical impulses to be formed through the medium of such lines and a suitable transmitter and then recording such impulses upon another surface, substantially as set forth.

4. The method of reproducing photographic or other images locally or at a distance, the same consisting of forming electrical impulses of variable duration according to the varying lights and shades of the image, by forming a pictorial image with continuous parallel lines and in moving in contact therewith at right angles thereto a tracer, whereby the electrical impulses may be graphically recorded by a suitable instrument, substantially as specified.

In testimony whereof I affix my signature in the presence of two witnesses.

NOAH S. AMSTUTZ.

Witnesses:
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J. R. NOTTINGHAM.