

R. GREVILLE-WILLIAMS.  
TELEGRAPHY.

No. 568,675.

Patented Sept. 29, 1896.

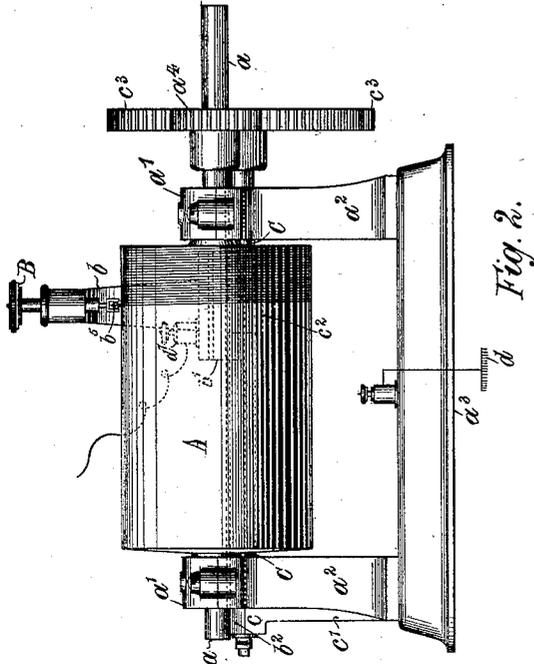


Fig. 2.

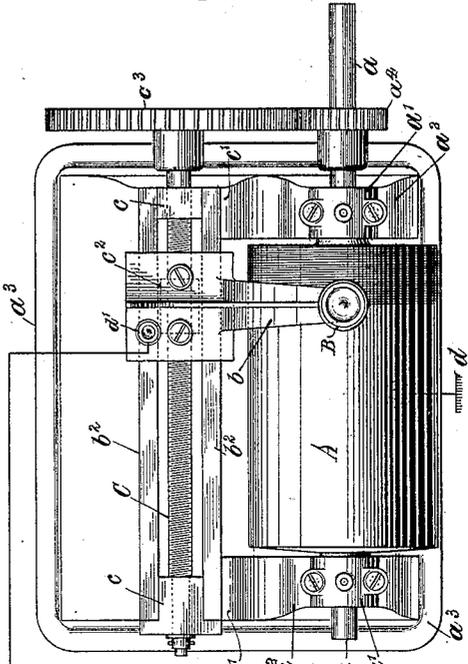


Fig. 3.

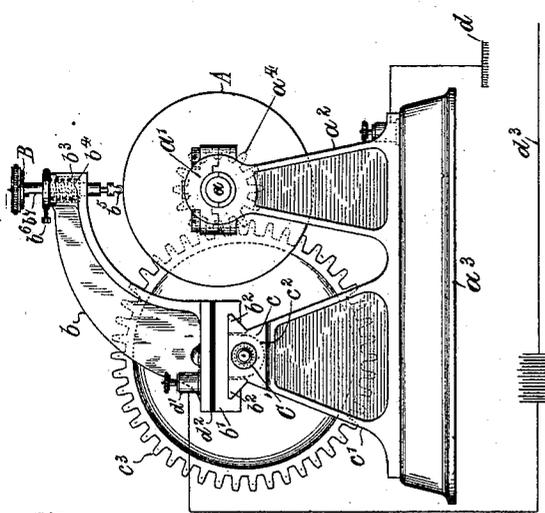


Fig. 1.

Witnesses:  
Robt A Blake  
R. A. Smith.

Inventor:  
Rupert Greville-Williams,  
by Henry H. Keighy Attorney.

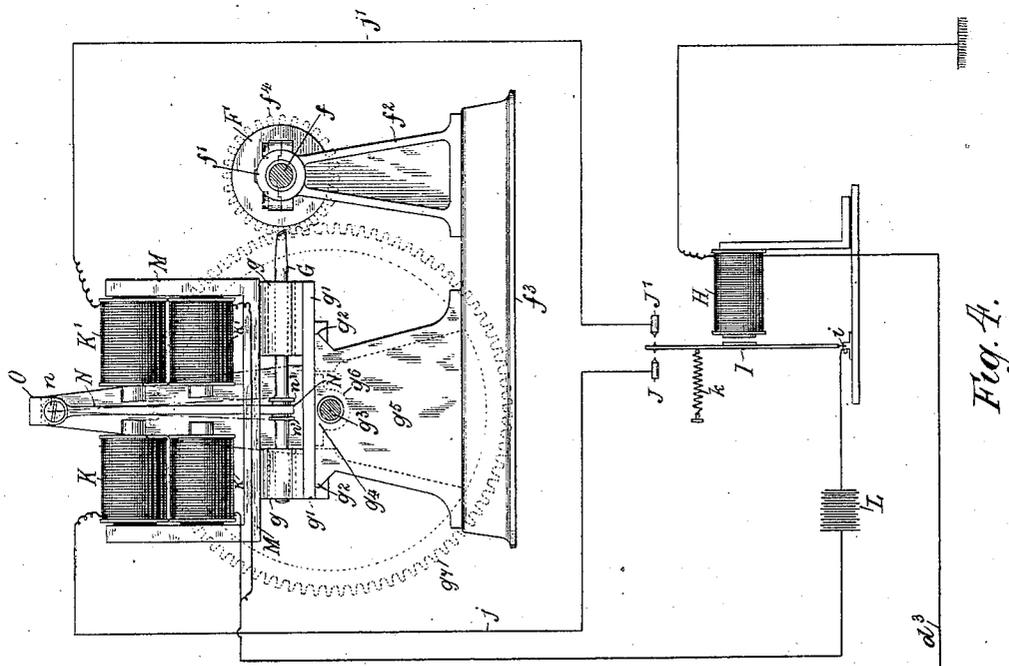
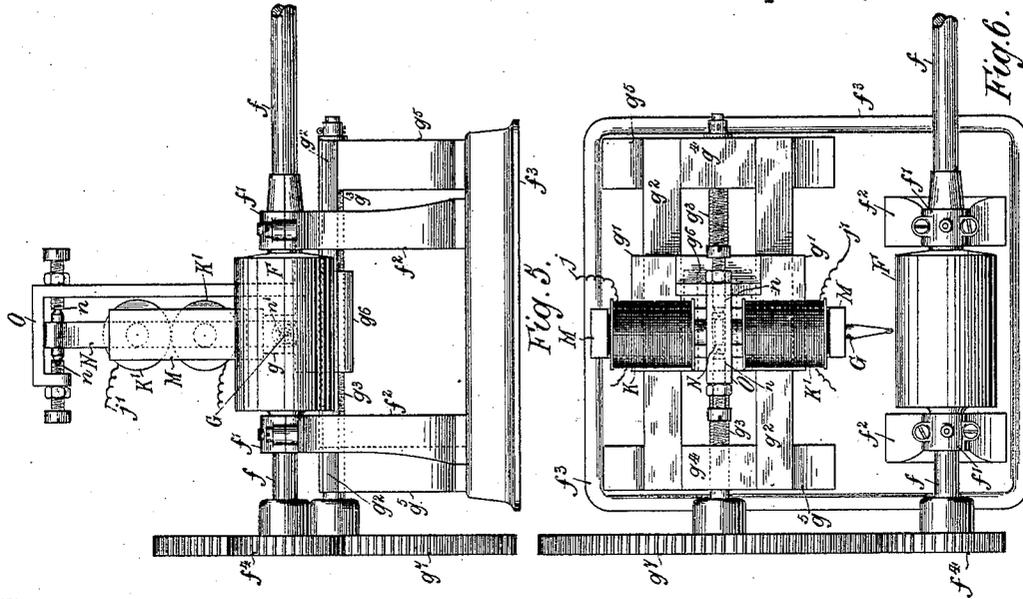
(No Model.)

4 Sheets—Sheet 2.

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Witnessed.

Robt. A. Blake  
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Inventor:

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(No Model.)

4 Sheets—Sheet 3.

R. GREVILLE-WILLIAMS.  
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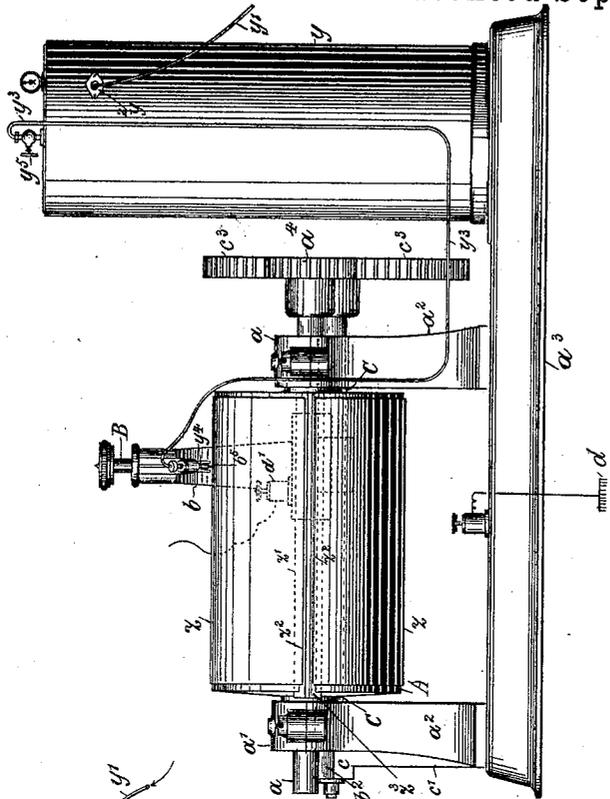


Fig. 8.

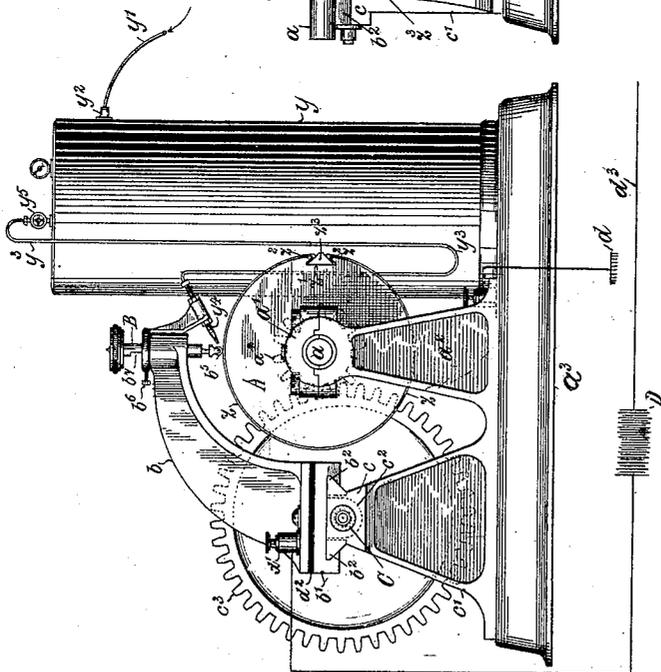


Fig. 4.

Witnesses.

Robt. A. Blake  
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(No Model.)

4 Sheets—Sheet 4.

R. GREVILLE-WILLIAMS.  
TELEGRAPHY.

No. 568,675.

Patented Sept. 29, 1896.

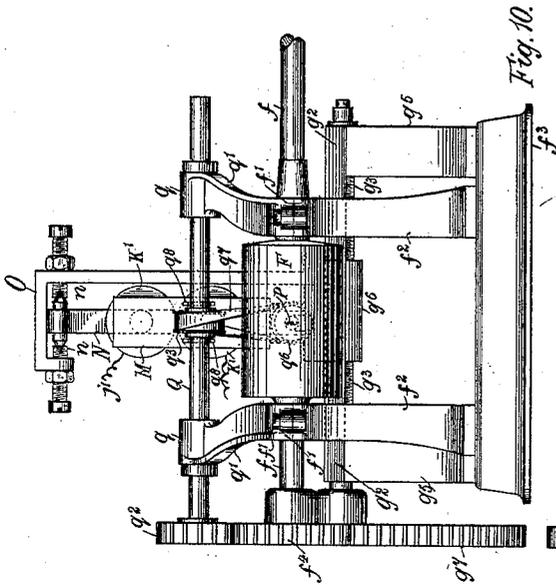


Fig. 10.

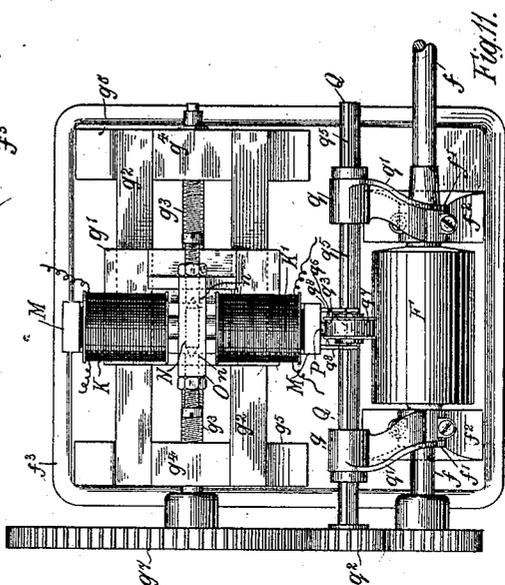


Fig. 11.

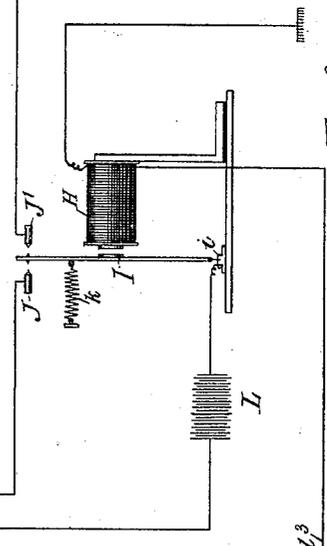
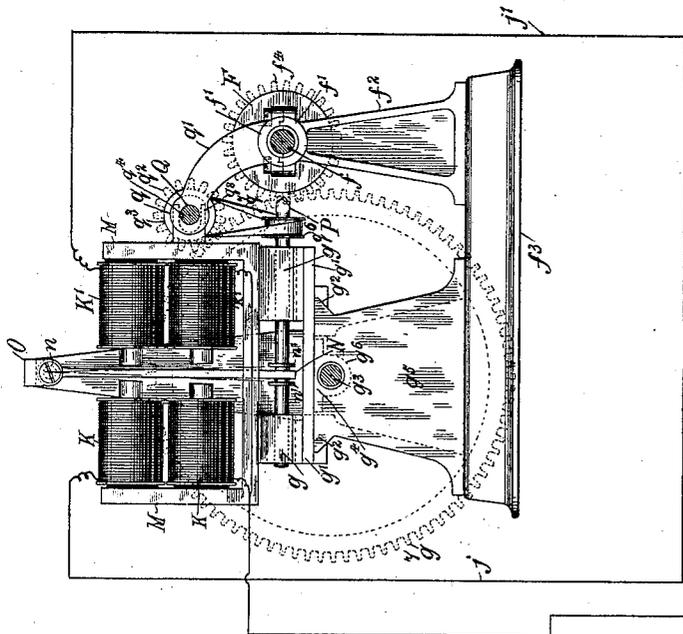


Fig. 9.

Witnesses:  
Rob<sup>t</sup> A Blake  
R. A. Smith.

Inventor:  
Rupert Greville-Williams,  
by Henry H. Neitz,  
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# UNITED STATES PATENT OFFICE.

RUPERT GREVILLE-WILLIAMS, OF HEYWOOD, ENGLAND.

## TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 568,675, dated September 29, 1896.

Application filed October 5, 1895. Serial No. 564,802. (No model.) Patented in England August 1, 1894, No. 14,765, and March 29, 1895, No. 6,509.

*To all whom it may concern:*

Be it known that I, RUPERT GREVILLE-WILLIAMS, a subject of the Queen of the United Kingdom of Great Britain and Ireland, residing at Greenfield House, Heywood, in the county of Lancaster, England, have invented certain new and useful Improvements in Apparatus for Electrically Effecting the Reproduction at a Distance of Graphic or Pictorial Matter, (for which I have obtained the following patents: in Great Britain and Ireland, No. 14,765, dated August 1, 1894, and No. 6,509, dated March 29, 1895;) and I do hereby declare that the following is a full, clear, and exact description of the invention, reference being made to the accompanying drawings, which are to be taken as part of this specification and read therewith, and one which will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to improvements in automatic apparatus for the reproduction at a distant receiving-station, by means of regulated electric currents, of facsimiles of manuscripts, sketches, pictures, and other analogous graphic or pictorial matter (hereinafter referred to as the "design") previously in existence at the transmitting-station.

Many attempts have been made to automatically reproduce the design by means of regulated electric currents in a single line-wire. In almost all such attempts paper charged with prussiate of potash was employed and the design was attempted to be reproduced by the passage of the current through it. However, none of these processes or the apparatus in connection with them are of any commercial value because of the numerous defects in one or the other. I have now, however, overcome many of the difficulties which have prevented the previous inventions becoming practical successes. I dispense entirely with chemical processes and yet succeed in reproducing at long distances automatically and through the medium of a single wire shaded "half-tone" photographs, manuscripts, facsimiles of prints, drawings, and the like.

The apparatus which is the subject of the present invention is somewhat similar, as to

some of its features, to those described by Bakewell, Bonelli, and Caselli in their patents necessitating the use of chemically-prepared papers, but it differs very materially from their patents both in general arrangement as well as in specific details.

My invention includes (A) an improved construction of transmitter especially in respect of the contact-finger; (B) improvements in the conducting-surface of the transmitter; (C) improved inks for the imposition of the design upon the conducting-surface; (D) means for facilitating the imposition of the design upon the conducting-surface; (E) mechanism for keeping the conducting-surface of the transmitter clean; (F) improved means for regulating the local currents at the receiving-station by means of the line-current; (G) an improved tool or graver for the receiver; (H) various improved combinations of electrical or mechanical agencies.

Referring to the accompanying drawings, which are to be taken as part of this specification and read therewith, Figure 1 is an end elevation of the transmitter and includes a diagram of a portion of its circuit. Fig. 2 is a front elevation of the transmitter. Fig. 3 is a plan corresponding with Figs. 1 and 2. Fig. 4 is an end elevation of the receiver, including a diagram of the remaining portion of the transmitter-circuit, the relay, and the receiver-circuit. Fig. 5 is a front elevation of the same. Fig. 6 is a plan corresponding with Figs. 4 and 5. Fig. 7 is an end elevation of a transmitter fitted with the improved conducting-surface and mechanism for keeping such surface clean. Fig. 8 is a front elevation corresponding with Fig. 7. Figs. 9, 10, and 11 illustrate a modified type of graver.

*Transmitter.*—The transmitter consists of an electric circuit which includes a conducting-surface, a contact-finger, the line-wire, and the electromagnet of a relay. These members of the apparatus, excepting the last-mentioned magnet, are illustrated in Figs. 1, 2, and 3.

The conducting-surface and the contact-finger stand in such position and mechanical relation to each other that practically the whole of the former shall be moved regularly past the latter or the latter be passed regu-

larly over practically the whole of the former. It is evident that this relationship may be established and maintained in more ways than one. I propose, among others, either of

5 the three following:  
 (a) The conducting-surface may be that of a metal drum rotated at a regular speed about its axis, the contact-finger being traversed over the drum in a line parallel with its axis.  
 10 The finger is traversed by means of a leading-screw engaging in the arm which carries it, the said screw being rotated about its axis, but without linear motion. The width of the finger-tip and the relative speeds of the drum  
 15 and screw are so apportioned that the trace of the finger upon the drum shall be a closed, or nearly closed, spiral, or, in other words, that every point of the conducting-surface shall successively pass the finger-tip afore-  
 20 said once during the traverse of the latter from one end of the axis of the said surface to the other.

(b) The finger may be stationary and the drum receive a linear motion equivalent to its length in addition to the motion of rotation described under (a).

(c) The conducting-surface may be that of a flat table capable of a reciprocating linear motion at right angles to that of the traverse  
 30 of the finger.

Whichever method may be adopted, it is obviously a *sine qua non* that every point of the conducting-surface shall successively pass the finger-tip or the finger-tip pass over  
 35 practically the whole of it during their mutual traverse.

Any suitable motor may be made use of for the purpose of rotating the drum and leading-screw aforesaid or for otherwise effecting the mutual traverse of the conducting-surface and the finger-tip.

The (a) method has been chosen for illustration.

A is a parallel metal drum and its perimeter receives the conducting-surface of the transmitter. This drum is fast upon a shaft  
 45  $a$ , the journals of which are supported in bearings  $a' a'$ , carried by a pair of standards  $a^2 a^2$ , set opposite to each other and at a suitable distance apart upon a firm base  $a^3$ .

B is the contact-finger. It is a round stem or rod capable of a to-and-fro vertical motion through a socket turned in the end of a  
 55 jib  $b$ , the base of which is made fast to a saddle  $b'$ , fitted to embrace a double-V bed  $b^2$ , upon which it can slide to and fro. This bed is alined parallel with the axis and surface of the drum A, and the jib  $b$  overhangs the latter just far enough for the axis of the contact-finger B to be exactly over the axis of  
 60 the drum. The bed  $b^2$  is carried by standards  $c' c'$ , which are set opposite to each other and at a suitable distance apart upon the base  $a^3$  above mentioned.

65 C is a leading-screw. Its journals are supported in bearings  $c c$ , carried by the standards  $c' c'$ . The leading-screw is parallel with

the axis of the drum A and passes through a screwed nut  $c^2$ , fast to and depending from the under side of the saddle  $b'$ , with which it  
 70 engages for the purpose of traversing the contact-finger B from one end of the drum A to the other during the time that the latter is in motion. The necessary motions of rotation are imparted to the leading-screw C and  
 75 the shaft  $a$  through a pair of gears  $a^4 c^3$ . These are of the proper respective diameters to, in conjunction with the pitch of the screw C, give to the drum A and the said screw C their respectively necessary rates of motion.  
 80 It is a matter of indifference onto which—screw or shaft—the driving impulse is delivered from the prime mover, provided the speed of such impulse is correctly adjusted. The shaft is shown as projecting beyond its  
 85 gear  $a^4$  far enough to receive a driving-pulley.

It will be noticed that the drum A is twice as long as and twice the diameter of the receiving-drum F described farther on. The object of this difference (four to one in respect  
 90 of area) is to provide for the reproduction of the natural size of a half-tone photograph, for instance, which it had been necessary to enlarge to four times its original area on account of the minuteness of its details.

*Contact-finger.*—When the design stands in insulated relief on the conducting-surface, proper provision must be made to allow of the contact-finger rising and falling in the socket above mentioned easily and quickly  
 100 enough to always keep in touch with the surface—conducting or design, as the case may be—immediately under it. A suitable enlargement of the finger-socket is provided to receive a spiral depressing-spring  $b^3$ , the resilience  
 105 of which is exerted between the top of the socket and an annular shoulder  $b^4$  upon the stem. The spring  $b^3$  is sufficiently weak to yield before the resistance offered by the material of the design and strong enough to  
 110 effect the quick depression or return to the conducting-surface of the drum A of the tip of the contact-finger B. With reference to the construction of the tip of the contact-finger it must be pointed out that it is necessary to make special provision against its riving  
 115 up the design material when the two come into contact and pass each other, for if a fragment of such material were rived up by the tip it might maintain non-contact between the  
 120 tip and the conducting-surface for the remainder of the time the transmitter was at work, and would do so until such time as the tip cleared itself. According to the present invention, the contact between the tip and material is always of a rolling nature, inasmuch  
 125 as the tip consists of a small wheel  $b^5$ , (hereinafter called the “contact-roller;”) free to turn upon an axis in the bottom end of the finger. The said axis is parallel with the axis of  
 130 the drum A, and consequently the wheel which constitutes the finger-tip works in a plane at right angles with the last-mentioned axis. Some provision is necessary to prevent the

capacity for vertical motion on the part of the finger B allowing it to turn about its axis, for such turning would change the contact between the tip  $b^5$  and the drum A from a rolling into a more or less scraping one. The one illustrated in the figures consists of a screw-pin  $b^6$ , screwed through the finger-socket in a radial direction and standing with its flat nose close up to, but not touching, the face of a vertical flat surface  $b^7$ , formed upon the adjacent side of the finger B and long enough to allow of the necessary up-and-down motion of the finger-tip  $b^5$ .

*Conducting-surface.*—According to the present invention, the conducting-surface of the transmitter may be of either platinum, silver, or gold. The selected metal may be either solid or deposited. I find that neither of these three metals oxidizes when there is sparking between the roller-wheel of contact-finger and the conducting-surface to the same extent as most other metals. For the same reason the said roller-wheel is made of the same metal (one of the three specified above) as the conducting-surface.

*Inks.*—The insulating-inks which have been proposed up to the present time possess properties which unfit them more or less for use in connection with apparatus of the type forming the subject of the present invention. One reason is that they are generally too brittle to resist the pull of the end of the contact-roller as it passes over the matter, and consequently small pieces of the latter are rived up and remain on the said roller and so maintain it in a more or less insulated condition, or the said pieces are dropped onto the transmitter-surface, where they would be likely to act as part of the imposed design. According to this part of my invention, I make a suitable ink by dissolving india-rubber, gutta-percha, and bitumen in benzin, toluene, or their homologues, or in other suitable solvents. The following proportions and process give a typical ink for the purpose of this part of the present invention: bitumen, (preferably in the form of fine powder, as generally used for half-tone "process" photographic reproductions,) twelve parts, by weight; pure india-rubber, five parts, and gutta-percha, five parts. These three materials are dissolved in seventy-eight parts of benzin. I find it more convenient to make separate solutions of each material, the three solutions being of known strengths, and then mix them together in the requisite proportions. After the mixture has been standing some time it is carefully filtered. It is advisable to exclude the light from the solutions and mixture, as otherwise the bitumen is liable to become insoluble. The proportions above mentioned may be varied in either direction without going outside the present invention.

Another very useful ink for the purpose is made as follows: One hundred and fifty parts of gelatin or glue (fish-glue, preferably) and

one hundred and fifty parts of albumen are dissolved in water (about three hundred parts) and about thirteen parts of bichromate of ammonium, or potassium or sodium dissolved in about one hundred and fifty parts of water are added. This mixture is preferably colored with suitable coloring-matter, such as "pure soluble blue," and should be protected as much as possible from actinic light until imposed.

The inscribed matter is written on the surface of the metallic sheet with an ordinary pen, and the sheet is then heated to a temperature of from  $80^\circ$  to  $130^\circ$ . I find a good result is obtained at a temperature of about  $100^\circ$ . In any case the sheet must not be heated to a higher temperature than  $100^\circ$  before it is dry or the ink will boil and produce blisters.

The bichromate may be left out, but the results are not generally as good as when it is included. These inks can also be used without heating.

*Design.*—The design—that is, the original which is required to be reproduced at the receiving-station—may be written, printed, photographed, or stenciled. My invention imposes no limit upon the nature of the material in which or the process by which it is produced. The design may be of conducting material superficially surrounded by non-conducting material in relief—*e. g.*, a negative photograph upon the drum A—or it may be in conducting material flush with non-conducting surface, produced, *e. g.*, by imposing the design in resist upon the drum A, etching down the bare surface of the latter, cleaning off the design and filling the etching with resist; or it may be in intaglio, produced, *e. g.*, by taking a negative photograph upon the drum A, etching the design, cleaning off the resist, and filling in the etched portions with resist flush with the surface of the drum A. When the design is in relief upon the said surface, proper provision must be made to allow of the contact-finger rising and falling in the socket above mentioned easily and quickly enough to always keep in touch with the surface—conducting or design, as the case may be—immediately under it. A suitable enlargement of the finger-socket is provided to receive a spiral depressing-spring  $b^3$ , the resilience of which is exerted between the top of the socket and an annular shoulder  $b^4$  upon the stem. The spring  $b^3$  is sufficiently weak to yield before the resistance offered by the material of the design and strong enough to effect the quick depression or return to the conducting-surface of the drum A of the tip of the contact-finger B.

*Imposition of the design upon the conducting-surface.*—This part of my invention is illustrated in Figs. 7 and 8. The conducting-surface is frequently (but then only for convenience in working it past the contact-roller  $b^5$ ) cylindrical. A cylindrical surface is a

difficult one to impose the design upon, either by any manual instrument, *e. g.*, pen or pencil, or by means of a photographic negative. According to the present invention the actual conducting-surface is provided by one side of a thin sheet or film of any of the metals before specified or of a combination of them. Such sheet or film  $z$  is held to the drum A by any suitable device. This latter may be a clamp, a wedge, holding-strip, or screws, or of any other convenient and suitable construction so long as it extends longitudinally of the drum A and is capable of holding the sheet or film  $z$  to the surface of the said drum by grasping the two margins of it, which will then be opposite and adjacent to each other. The device illustrated in the figures consists of a double-V or undercut groove  $z'$ , formed in the face of the drum from one end of it to the other and in a direction parallel with the axis of it. The two opposite margins  $z^2 z^2$  of the sheet or film  $z$  are turned down over the respective sides of the groove  $z'$  and held thereto by a wedge  $z^3$  of the same contour as the groove. I also find that the use of corrugated sunk rollers actuated with a nut or lever works satisfactorily. The above apparatus can also be used on the receiving-cylinder to hold the paper, sheet-metal, or other surface to which the image is transmitted.

*Keeping the conducting-surface of the transmitter clean.*—Experience with transmitters and their contact-fingers shows that it is possible, even when the most elastic of the inks heretofore known have been used, for fragments of the design imposed in such ink to be rived up. The mischief which may be done by this accidental riving up has been already explained. The mechanism which I propose to use for removing the fragments above mentioned as well as other foreign matter from either the contact-roller or from the conducting-surface is illustrated in Figs. 7 and 8. It consists of a reservoir  $y$ , adapted to be kept charged with high-pressure air through a pipe  $y'$ , controlled by a valve  $y^2$ , and to discharge an air-blast through a pipe  $y^3$  and nozzle  $y^4$ , controlled by a valve  $y^5$ , directly against the front edge of the contact-roller  $b^5$ .

*Transmitter-circuit.*—D is the battery of the transmitter-circuit. This latter is also the line-circuit. It consists throughout its length of a single conductor. The conducting-surface A is connected to earth  $d$ . One pole of the battery is connected to the contact-finger B, *e. g.*, through a connecting-screw  $d'$  on the jib  $b$ . It is of course a matter of indifference how the current is led to the tip  $b^5$  of the contact-finger B so long as an efficient insulation, as  $d^2$ , is inserted between it and the conducting-surface A. From the other pole of the battery the line-wire  $d^3$  is led away to the receiving-station. As the contact-finger tip  $b^5$  is insulated from the conducting-surface A, it follows that current

can flow through the line-circuit only when it is closed by contact of the tip  $b^5$  with the surface A. During the time that the tip  $b^5$  is rolling over any portion of the design the line-circuit is, of course, opened and kept open by the non-conducting property of the material of such design.

*Receiver and local circuits.*—The receiver consists of a receiving-surface, a local electric circuit containing one or more electromagnets (the latter having a common armature) as well as a circuit-closer or switch adapted to open the receiver-circuit when the line-circuit is closed, and a striker or marker connected to or carried by or under the control of the armature of the said one or more electromagnets. In addition to the above there must be an electromagnet (part of the circuit-closer above mentioned) in the line-circuit, adapted when it is excited to operate the circuit-closer or switch in the local or receiver circuit, the last-mentioned electromagnet and switch constituting a relay. The above-mentioned members of the apparatus are illustrated in Figs. 4, 5, and 6. It is preferable that the relay be fixed at or near to the receiving-station. A current of ordinary strength in the transmitter-circuit or line-wire will meet the requirements of the present invention.

The striker or marker and the receiving-surface are moved in unison with each other or relatively to each other on the same principle and for the same reasons that decide the respective motions of the conducting-surface and the contact-roller of the transmitter. Mechanisms analogous to those specified in connection with the transmitter may be used for producing the said respective motions in the receiver. The one illustrated is substantially the same as the one illustrated in Figs. 1, 2, and 3 and has been selected because for some purposes I regard it as the most convenient one.

F is a parallel drum. Its perimeter, or a sheet held thereto, is the receiving-surface upon which the graphic matter on the conducting-surface A of the transmitter is reproduced. This drum is fast upon a shaft  $f$ , the journals of which are supported in bearings  $f' f'$ , carried by a pair of standards  $f^2 f^2$ , set opposite to each other and at a suitable distance apart upon a firm base  $f^3$ .

G is the striker, graver, or marker. Its body is a round rod adapted to move freely to and fro in a direction radial to the drum F in guides  $g g$ , fast upon a saddle  $g'$ . This saddle is carried lathe-wise upon a double-V bed  $g^2$ , upon which it can slide to and fro. This bed is alined parallel with the axis and surface of the drum F and supported upon standards  $g^3 g^3$ , set opposite to each other and at suitable distances apart upon the base  $f^3$ . The traverse of the saddle to and fro upon the bed  $g^2$  is effected by a leading-screw  $g^3$ , the journals of which are adapted to revolve, without imparting any linear motion to the

screw, in bearings  $g^4$ , carried by the standards  $g^5 g^5$ . The leading-screw  $g^3$  is parallel with the axis of the drum F and passes through a screwed nut  $g^6$ , fast to and depending from the under side of the saddle  $g^1$ , with which the said screw engages for the purpose of traversing the striker from one end of the drum F to the other during the time that the transmission of matter upon the conducting-surface of the transmitter is proceeding.

The necessary motions of rotation are imparted to the leading-screw  $g^3$  and the shaft  $f^1$  through a pair of gears  $f^4 g^7$ . These are of the proper respective diameters to, in conjunction with the pitch of the screw  $g^3$ , give to the drum F and the said screw their respectively necessary rates of rotation. It is a matter of indifference onto which—screw or shaft—the driving impulse is delivered from the prime mover, provided that the speed of such impulse is correctly adjusted. The shaft is shown as continued beyond its left-hand bearing and there broken off, thereby indicating a connection (omitted from the figure) to some other mechanism. The type of motor by which, and the mechanism through which the gears  $f^4 g^7$  are driven is outside the scope of the present invention. It is of importance, however, that the rates of the transmitter and of the receiver shall be identical or according to any predetermined ratio, and also, subject to this ratio, synchronous. If the said rates are identical and the surfaces of transmitter and receiver of the same size, the reproduction will be facsimile. If these surfaces differ in diameter, the reproduction will be either larger or smaller, while if the number of the rotations of the transmitting and receiving cylinders differ a corresponding distorted reproduction will be produced. If a reversed image is required on the receiving-surface for the purpose of etching and printing or engraving and printing, this can be produced by reversing the relative linear motions of the receiving or transmitting cylinders. One cylinder can be used as a receiving transmitting cylinder provided that it is fitted with the receiving and transmitting mechanism before described.

With reference to the exact kind or type of the receiving-surface and of its striker, graver, or marker the present invention does not impose any limit. The two are correlated so as to produce the desired result—a reproduction in some superficial form—by means of the actuating mechanism described. Any suitable pen or pencil or style and transfer-paper may be made use of. I find that a very convenient means is to cover the receiving-surface with resist and then take off the transmitted design with the graver, but I unreservedly disclaim the use of chemically-prepared paper with a fixed receiving-style and any combination in which the local or any current passes through the receiving style or marker.

*Improved tool or graver for the receiver.*—

This is illustrated in Figs. 9, 10, and 11. The improvement consists in making the tool to rotate about its axis and to therefore cut after the manner of a drill. P is the improved tool. It is fitted to revolve about its axis in the guides  $g g$  as well as to slide to and fro therein. The necessary rotary motion is communicated to it by any suitable mechanism driven in any convenient way. The present invention does not limit me in respect of either the motor or the intermediate mechanism by and through which the aforesaid rotary motion is communicated to the improved graver. The motor and mechanism illustrated in the figures consist of a shaft Q, carried in bearings  $q q$  in the ends of brackets  $q^1 q^1$ , bolted upon the standards  $f^2 f^2$ , and having a pinion  $q^2$  fast on one end of it and gearing with the wheel  $q^7$ .  $q^3$  is a shrouded pulley adapted by the engagement of a feather  $q^4$  on the pulley in a straight groove  $q^5$  in the shaft Q to travel to and fro upon the said shaft and to be carried round with it. The to-and-fro motion aforesaid is communicated to the said pulley by fingers  $q^8 q^8$ , fast on the frame M and standing on both sides of the boss of the said pulley.  $q^6$  is a shrouded pulley fast on the shank of the tool P, and  $q^7$  is a band passed round both pulleys  $q^3 q^6$ .

*Receiver or local circuit.*—H is the electromagnet of the relay above mentioned. As already explained, it is included within the line-circuit, which is connected with one of the terminals, the other terminal being connected to earth. I is its armature. The latter is pivoted at  $i$  in order that it can swing freely between two contacts J J', according as to whether it is under the attraction of its magnet H or under the pull of the spiral spring  $k$ . K K' are a pair of electromagnets. Both are in the local circuit as far as wiring is concerned, but only one can be excited at a time by the current in that circuit. The magnet K and the contact J are connected together, and the magnet K' is connected with the contact J', as indicated by the course of the conductors  $j j'$ . L is the local battery. One pole of it is wired to the armature I and the other to the remaining terminals of the magnets K K'. The said magnets K K' are held in a frame M with the axis of their coils respectively alined with each other and their pole-pieces opposite each other at a sufficient distance to allow of an armature N to oscillate between them, according to which of them is excited. The frame M is carried upon the top of the guides  $g g$ , to which it is made fast. The armature N hangs from pivots  $n n$ , supported above the magnets by a gallows O, which is erected upon the top of the saddle  $g^1$ . The bottom of the armature is connected to the body of the striker G in such a way that its motion of oscillation may put the striker into work or withdraw it. It is shown as bifur-

ated and embracing the body of the striker or marker G between two collars *n' n'*, fast on the striker and close enough to be always in touch with the armature bifurcations, yet far enough apart to prevent their interfering with the free oscillation of the armature between the magnets K K'.

I claim—

1. The combination of a platinum contact-roller; a drum or support, a removable conducting-surface; a line-circuit which includes the said roller and surface; a relay at the receiver end of the line-wire; a local battery and circuit which includes the armature of the relay; and a local or receiver circuit comprising two shunt-circuits and two electromagnets.

2. The combination with a platinum contact-roller; a drum or support, a removable conducting-surface thereon; a line-circuit which includes the said roller and surface and a circuit-breaker on the conducting-surface consisting of a design in ink compounded of gelatin or glue, albumen and a bichromate of an alkaline metal.

3. In an electric transmitter in which the conducting-surfaces and roller-contact are both metallic, a circuit-breaker consisting of a design imposed upon the conducting-surface in ink compounded of gelatin or glue, albumen and a bichromate of an alkaline metal.

4. The combination of a platinum contact-roller; a removable conducting-surface; a line-circuit which includes the said roller and surface; a relay at the receiver end of the line-wire; a local battery and circuit which latter includes the armature of the relay; two shunt-circuits from the local circuit; their respective electromagnets; an armature common to them both; and a graver or marker fast to the said armature.

5. The combination of an electric transmitter; a line-circuit which includes the said roller and surface; a relay at the receiver end of the line-wire; a local battery and circuit which latter includes the armature of the relay; two shunt-circuits from the local circuit; their respective electromagnets; an armature common to them both; and a graver or marker fast to the said armature.

6. The combination of an electric transmitter; a line-circuit which includes the contact-roller and the transmitter-surface; a relay at the receiver end of the line-wire; a local battery and circuit which latter includes the armature of the relay; two shunt-circuits from the local circuit; their respective electromagnets; an armature common to them both; a graver or marker fast to the said armature; and mechanism for rotating the said graver.

7. The combination of a platinum contact-roller; a removable conducting-surface; a line-circuit which includes the said roller and surface; a relay at the receiver end of the line-wire; a local battery and circuit which

latter includes the armature of the relay; two shunt-circuits; their respective electromagnets; an armature common to them both; a graver or marker fast to the said armature; and mechanism for rotating the said graver.

8. The combination of an electric transmitter; a line-circuit which includes the contact-roller and transmitting-surface thereof; a relay at the receiver end of the line-wire; a local battery and circuit which latter includes the armature of the relay; two shunt-circuits from the local circuit; their respective electromagnets; an armature common to them both; a graver or marker fast to the said armature; mechanism for rotating the said graver; and a metallic receiving-surface.

9. The combination of an electric transmitter; a line-circuit which includes the contact-roller and the transmitting-surface thereof; a relay at the receiver end of the line-wire; a local battery and circuit which latter includes the armature of the relay; two shunt-circuits from the local circuit; their respective electromagnets; an armature common to them both; a graver or marker fast to the said armature; mechanism for rotating the said graver; and a resist-covered metallic receiving-surface.

10. The combination of a platinum contact-roller; a removable conducting-surface; a line-circuit which includes the said roller and surface; a relay at the receiver end of the line-wire; a local battery and circuit which latter includes the armature of the relay; two shunt-circuits from the local circuit; their respective electromagnets; an armature common to them both; a graver or marker fast to the said armature; mechanism for rotating the said graver; and a metallic receiving-surface.

11. The combination of a platinum contact-roller; a removable conducting-surface; a line-circuit which includes the said roller and surface; a relay at the receiver end of the line-wire; a local battery and circuit which latter includes the armature of the relay; two shunt-circuits from the local circuit; their respective electromagnets; an armature common to them both; a graver or marker fast to the said armature; mechanism for rotating the said graver; and a resist-covered metallic receiving-surface.

12. The combination of a local battery and circuit; two shunt-circuits from the said local circuit; their respective electromagnets; an armature common to both the latter; a graver or marker fast to the said armature and mechanism for keeping the said graver or marker in constant rotation during its motion both to and from the said receiving-surface.

13. The combination of local battery and circuit; two shunt-circuits from the said local circuit; their respective electromagnets; an armature common to both the latter; a graver or marker fast to the said armature; a metallic receiving-surface; and mechanism for keeping the said graver or marker in con-

stant rotation during its motion to and from the said receiving-surface.

14. The combination of local battery and circuit; two shunt-circuits from the said local  
5 circuit; their respective electromagnets; an armature common to both the latter; a graver or marker fast to the said armature; a resist-covered metallic receiving-surface; and mechanism for keeping the said graver or marker

in constant rotation during its motion to and from the said receiving-surface. 10

In witness whereof I have hereunto affixed my signature, in presence of two witnesses, this 18th day of July, 1895.

RUPERT GREVILLE-WILLIAMS.

Witnesses:

THOS. FEARNHEAD,  
THOMAS NORTH.