No. 714,577. Patented Nov. 25, 1902.

E. K. GRUHN.

TELEGRAPHIC OR TELAUTOGRAPHIC APPARATUS.

(Application filed Apr. 16, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

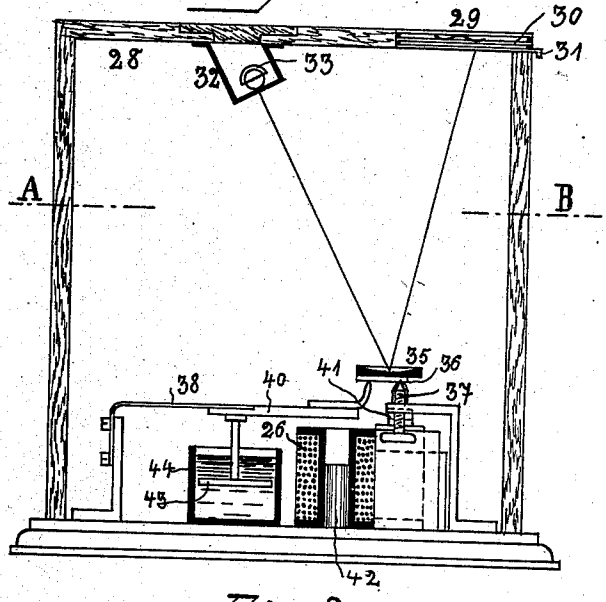
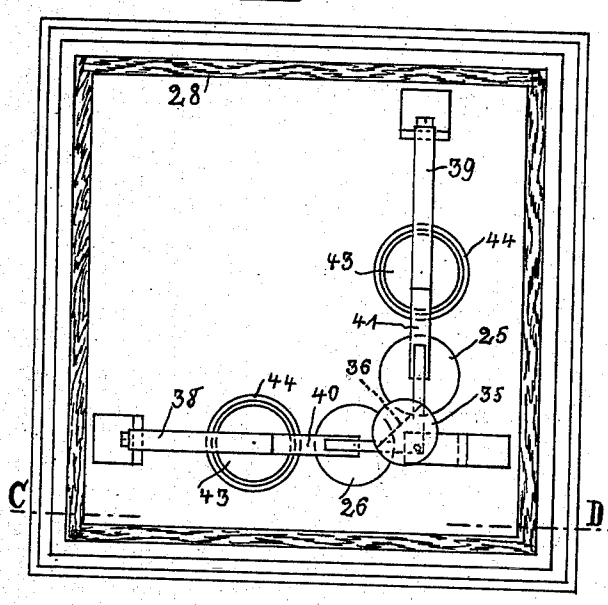


Fig. 2.



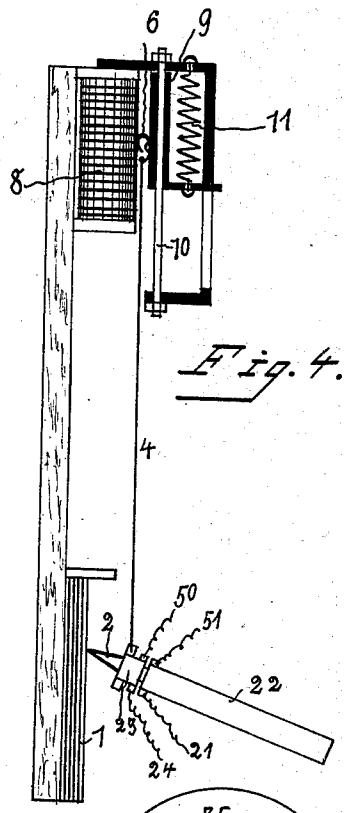


Fig. 4.

Fig. 5.

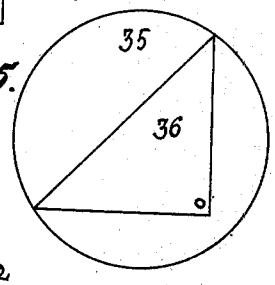
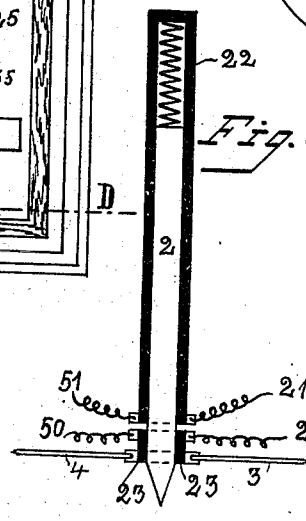


Fig. 6.



Witnesses:
Thomas Durant
J. B. Keyton Jr.

Inventor.
Ernst K. Gruhn,
by Church & Church
his Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 714,577. Patented Nov. 25, 1902.

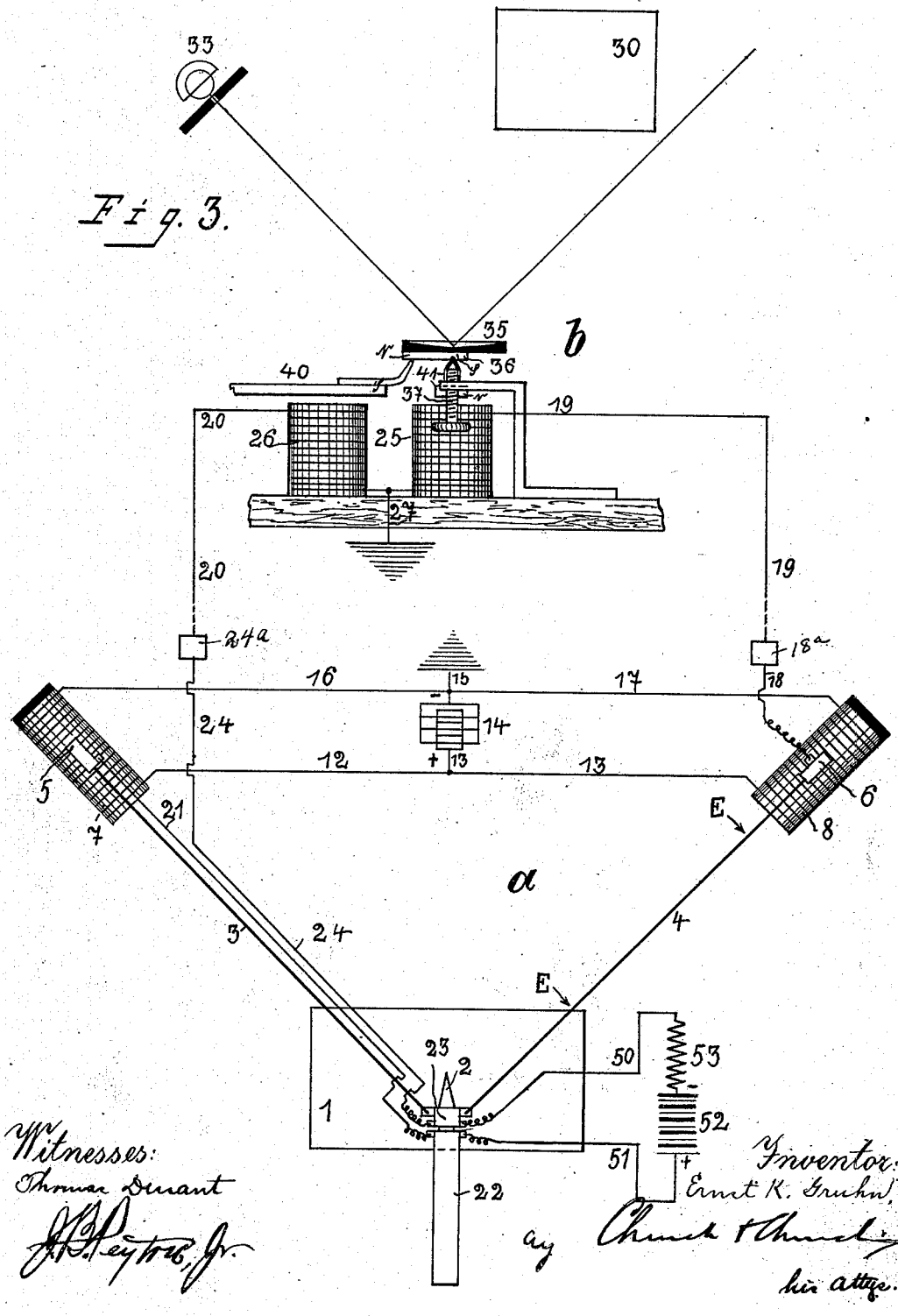
E. K. GRUHN.

TELEGRAPHIC OR TELAUTOGRAPHIC APPARATUS.

(Application filed Apr. 16, 1901.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 3.



Witnesses:
Thomas Durant
H. B. Peyton, Jr.

Inventor:
Ernst K. Gruhn,
by Church & Church
his attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ERNST KARL GRUHN, OF DRESDEN, GERMANY, ASSIGNOR TO KOPIER TELEGRAPH GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, OF DRESDEN, GERMANY.

TELEGRAPHIC OR TELAUTOGRAPHIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 714,577, dated November 25, 1902.

Application filed April 16, 1901. Serial No. 56,129. (No model.)

To all whom it may concern:

Be it known that I, ERNST KARL GRUHN, a subject of the King of Prussia, residing at Dresden, in Saxony, Empire of Germany, have invented certain new and useful Improvements in or Relating to Telegraphic or Telautographic Apparatus, (for which application for Letters Patent has been made in France under No. 297,395, dated March 13, 1901; Germany, under K. 20,966 VIII/21 a^2, dated March 14, 1901; Great Britain, No. 6,271, dated March 25, 1901,) of which the following is a specification.

The present invention relates to a telegraphic apparatus for the electric transmission of written designs (telautography or pantelegraphy) of the type in which the motion of the impression-stylus in any direction is divided into two components, through which, however, the resistance or electromotive force in two circuits is varied and which variations produce at the receiving-station corresponding components of movement, from which is obtained a resultant movement equal to the previous motion of the sending-stylus, (although in different proportions.)

The present invention is particularly characterized by the resulting motion at the receiving-station being that of a photographically-recording ray.

The means by which the components of the motion are transformed to the resultant motion of the ray or the means by which the resulting motion of the ray in accordance with the motion previously produced by the stylus is effected may vary. A very convenient device is a small mirror or a prism which is arranged so as to oscillate in two different planes. The oscillations in each of the planes are controlled by the variations of the resistance in both circuits, so that from the simultaneous motions the motion of the light-ray corresponds to the motion of the sending-stylus. This ray is directed onto a layer which is sensitive to light, from which, however, all light has been previously excluded. Thus the ray impresses the characters of a writing or drawing on the sensitive film, which can then be followed by the sending-stylus.

For a satisfactory operation of the receiver the oscillations of the armature of the electromagnet actuating the mirror should be in direct proportion to the amperage of the current. This relation between amplitude and amperage can, for instance, with sufficient exactness be obtained by the use of a permanent magnet as the armature and by providing a large air-space between the magnet-core and the armature.

It is advisable to provide for the inactivity of the recording-ray at each raising of the sending-stylus from the writing-surface until the stylus is again brought into contact with the surface. Since it is possible to determine the intensity of the light source producing the ray and the sensibility of the photographic film within broad limits at will, the choice may be so directed that a very quick motion of the ray over the film has no, or at least only a slight, photographic effect. The inactivity of the recording-ray when the stylus is raised can be effected by interrupting a circuit or both circuits by means of a contact, which is broken when the stylus is lifted. It is sufficient if one or both circuits is interrupted. In each case the ray while the stylus is raised is transferred to a neutral point, preferably beyond the field sensitive to light, but which can also lie within the same. There is no liability of mistakes occurring in the last case, as the indication appears in a known space, which is recognized as a neutral space. The interruption or breaking of the action of the ray on lifting the stylus can be also effected by many other means. It can also be effected by deviation, as in the case specified, if on lifting the stylus an impulse is sent into the circuit in a contrary direction to that of the normal current. The interruption of the branch current while lifting the stylus could also operate a relay through which the circuit of the source is interrupted, supposing of course an electrical source is used.

The main advantage of this invention in comparison with former telautographic devices—as, for instance, Gray's and others—consists in the fact that at the receiving-sta-

tion no masses of a great inertia have to be moved, but only small mechanical resistances are to be overcome, and the construction of the whole apparatus is an extremely simple one.

A practical construction of the invention is shown in the accompanying drawings, in which—

Figure 1 is a vertical section through the receiver on the line C D of Fig. 2. Fig. 2 is a horizontal section on the line A B of Fig. 1. Fig. 3 shows the transmitter in plan and the receiver in elevation and partly in section and at the same time gives a diagrammatic view of the circuit and of the receiving-station. Fig. 4 shows one-half of the transmitter in elevation in the direction of the arrow E, Fig. 3, and a second section through the base-plate, which is omitted in Fig. 3. Fig. 5 is an under-side view of the concave mirror of the receiver, and Fig. 6 shows the writing-stylus in longitudinal section through the contact device forming the sleeves.

In Fig. 3, *a* indicates the transmitting apparatus, and *b* the receiver. The stylus 2, which is to be guided over the paper block 1, Figs. 3, 4, is in any convenient manner, 3 and 4, connected to springs 5 6, which slide upon resistance-coils 7 8. The springs are mounted upon slides 9, which slide upon rods 10 and are drawn by means of springs 11, Fig. 4, toward the outer end of said coils.

The coils should preferably be formed in such a manner that insulated wire is wound in the narrowest possible windings in contact with each other upon a non-conducting core, while the insulation in the path of the springs 5 6 is removed from the surface of the spools, but in such a way that it remains between the single windings of the latter. Each winding, therefore, forms an element of resistance, and by the displacement of the contact-springs 5 6 toward either end such elements are in number either reduced or increased. The inner ends of the coils 7 8, Fig. 3, are connected by wires 12 13 with the source of electricity 14, the other pole of which, by means of a conductor 15, is connected to the earth.

The outer ends of the coils are connected by wires 16 17 with the conductor 15, whereby two local circuits are formed. The contact-springs 5 6 are connected with the distant conductor—*i. e.*, the contact-spring 6—through wire 18, with the distant conductor 19 through terminal connections, as indicated at 18ª, and the contact-spring 5 with the corresponding distant conductor 20 through a contact device on the stylus, as later on described. The currents sent into the distant circuit 19 20 pass through the coils of the electromagnets 25 26 and are conducted through the earth-conductor 27 to the earth. In the construction shown in the drawings the earth represents a common circuit for both branch currents; but a common metallic return-circuit or even separate return-circuits can be provided.

In the arrangement shown in the drawings the distant conductors form a shunt on the local circuit of the battery 14. Through this parallel arrangement of distant circuits besides relatively intense local currents the further advantage is obtained that the current variations in the distant circuits, even in case of a greath length of the latter, are always in exact proportion with the movements of the transmitting-stylus. Of course the conductors 16 17 could be dispensed with, in which case the whole current influenced by the resistance of the coils 7 8 would pass through the distant circuits. In this case, however, the resistance of the coils would necessarily have to be very great in comparison with the resistance of the conductors, and the proportionality referred to would be more difficult to obtain. Therefore such an alteration is not advisable.

The following means are recommended for deviating the photographically-recording ray at the receiving-station: Upon the stylus 2 is mounted a sleeve 22, under the influence of a spring, adjacent to which a second sleeve 23 is arranged, The sleeve 22 is connected through a wire 21 with the spring 5, while the sleeve 23 is in connection with the distant circuit 20 by means of a wire 24 through terminal connections, as indicated at 24ª. The stylus is held by means of the socket 22 and guided over the paper. If placed in position to write, the point of the stylus 2 touches the paper first, whereupon the sleeve 22 moves downward and makes contact with the sleeve 23, whereby an electrical connection between the wires 21 and 24 is effected. In lifting the stylus this contact is broken, and the ray immediately oscillates in the direction influenced by the corresponding branch distant circuit to the extreme extent, so that the point of light leaves the sensitive surface. The deviation of the point of light, however, is effected still quicker if the branch distant circuit is not interrupted, but if a relatively strong current in the contrary direction (of course with regard to the current direction of battery 14) is sent through. To this end it is, as shown in Fig. 3, only necessary to join the wires 50 and 51 of a second battery 52 to the sleeves 22 and 23 and to insert for the battery in this second circuit a resistance 53. The direction of the current in this circuit is contrary to the direction of the current coming from the battery 14. When writing, the contact between 22 23 is closed, and the battery 52 does not come into action. The current of this battery passes through the stylus-contact and the resistance back to the battery. The current in the distant circuit remains uninfluenced and acts as if the battery 52 and the circuit were not present at all. When, however, the stylus is lifted, the contact is broken, and the battery 52 is placed

in the circuit of the distant circuit. Its greater pressure overcomes the weaker branch current of the battery 14, and thereby repels the armature of the corresponding electromagnet 26.

In a light-tight box 28, Fig. 1, a holder 29, containing the light-sensitive material 30, (glass plate, film, or negative-paper,) is arranged, which can be uncovered toward the interior by pulling out a slide 31. A roll-film might also be used, in which case it would be rolled from one spool onto another, being kept taut at the impression-point between the spools. In a casing 32 is placed an electric glow-lamp 33, throwing its light through a blind upon a concave mirror 35, which reflects the ray or bundle of rays to the sensitive surface 30. The mirror is attached, preferably by means of cement, to a small iron plate 36 in the form of a right-angled isosceles triangle, Figs. 1, 3, and 5. One corner of the latter rests upon a set-screw 37, upon which point the mirror can oscillate in any direction. Beneath each of the other corners extends an armature 40 41, carried by flat springs 38 39. These armatures produce the oscillations corresponding to the component movements of the transmitter, from the coöperation of which the previous motion of the transmitting-stylus is obtained. The positive upward oscillations of the mirror are insured through the positive movement of the armatures 40 41 of the electromagnet. In order to secure also a positive downward oscillation of the mirror by lowering the armature, links would have to be placed between the armature and the plate 36, which links, however, owing to the friction and other causes, are not free from drawbacks. These drawbacks are therefore overcome by simply employing permanent or steel magnets 40 41 for the armature of the electromagnets, the iron plate 36 being attracted by the iron horns mounted upon the armatures 40 41. These horns are magnetized by contact with the magnets 40 41 and hold the iron plate sufficiently firmly. If the armature 40 acts at N with a south pole and the armature 41 at S with a north pole, a connection, positive in every sense and free from all friction and forming a universal joint, is thereby obtained.

In order to compensate the faults due to the remanence and permeability of the armatures, or, in other words, to obtain an amplitude of the armature of the electromagnet in proportion to the amperage, said armatures are, as already mentioned, constructed as permanent magnets, and, as can be seen in Fig. 1, the cores 42 are made short and project into the hollow space of the coils only to such an extent as to form a large air-space between core and armature. Thus fine shades or variations of resistances can be safely reproduced in the sender during the operation of the electromagnets of the receiver. Finally in order to lessen the oscillations of the armatures, which take place on closing and breaking the current through the stylus or in going over the insulated spaces between each pair of resistances, the armatures are connected with plungers 43, Figs. 1 and 2, which extend into oil-filled cylinders 44. The plungers are of a slightly-smaller diameter than the cylinders, or they are perforated, so that during the movement of the armature the oil passes through the space between the plunger and the cylinder or through the perforation from one side of the plunger to the other. By this arrangement of liquid brakes the self oscillation or vibration of the armatures is prevented or lessened. The same result is also effected by allowing the plungers to act on air in the cylinder.

The more strongly one of the magnet-cores is submitted to induction by the currents sent into the distant circuits the stronger is the attraction of the armature 40 or 41 and the tension of the corresponding springs 38 and 39 and the greater the amplitude of the mirror in the corresponding direction. From the simultaneous movement in both directions the resultant movement is obtained. Thus the action of the ray upon the sensitive layer is effected so as to form a photographic reproduction of the characters or design and only requires development and fixing.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a telegraphic or telautographic apparatus embodying circuits, a stylus and means for varying the current through said circuits in accordance with the component movements of the stylus, the combination with a device for deflecting a ray of light, of means for oscillating said deflecting device in different planes controlled by the variation of current in the circuits whereby the movements of the stylus in any direction are made manifest by the rays of deflected light; substantially as described.

2. In a telegraphic or telautographic apparatus the combination with a transmitter embodying means for varying the current in accordance with the component movements of a stylus, of a receiver embodying electromagnetic devices actuated by the variations in the current and having two independent deflector-controlling points, a fixed deflector-controlling point and a light-deflector controlled by said three points whereby the angle of said deflector may be varied in any direction; substantially as described.

3. In a telegraphic or telautographic receiver the combination with a light-deflector, spring-supported supports on which it may pivot and electromagnetic controlling devices for said supports, of means for checking false vibration of said supports embodying dash-pots and pistons; substantially as described.

4. In a telautographic receiver the combination with a light-deflector three pivotal supports therefor, angularly disposed with relation to each other, springs carrying two of said supports, independent electromagnetic de-

vices controlling the movement of said supports against the tension of their springs, dash-pots and pistons working therein and connected with the movable supports to check false vibration; substantially as described.

5. In a telautographic apparatus the combination with a receiving instrument operated by current variations to produce component motions corresponding to similar motions of the transmitter and a transmitter embodying variable resistance mediums controlled by a stylus whereby said resistance mediums are varied in direct ratio, of a switch controlled by the stylus and reverse battery connections controlled thereby rendered operative by the withdrawal of the stylus from operative position to send a reverse current to the receiver; substantially as described.

6. In a telautographic apparatus, the combination with a receiver embodying an indicator universally movable to indicate in a given field and having an abnormal movement to carry the indication out of said field, of a transmitting instrument embodying current-varying mediums for controlling the indicator for indicating the movements of the transmitting instrument and a reverse-current switch for reversing the normal current to move the indicator to an abnormal position when the transmitting instrument is out of operative position; substantially as described.

7. In a telautographic apparatus, the combination with a transmitting instrument embodying independent variable resistance mediums, a stylus connected with and controlling the same by its component motions and a switch on the stylus for establishing a working circuit by the pressure on the stylus in transmitting, of a receiver embodying a light-deflector, electromagnetic controlling devices therefor actuated by the variation of the resistances of the transmitting instrument in accordance with the movement of the stylus and a sensitive receiving-surface on which the path of the reflected light is recorded; substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERNST KARL GRUHN.

Witnesses:

KARL GREIERT,

CH. HUGO DUMMER.