No. 759,987. PATENTED MAY 17, 1904.

E. K. GRUHN.

# FACSIMILE TELEGRAPH APPARATUS.

APPLICATION FILED NOV. 20, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

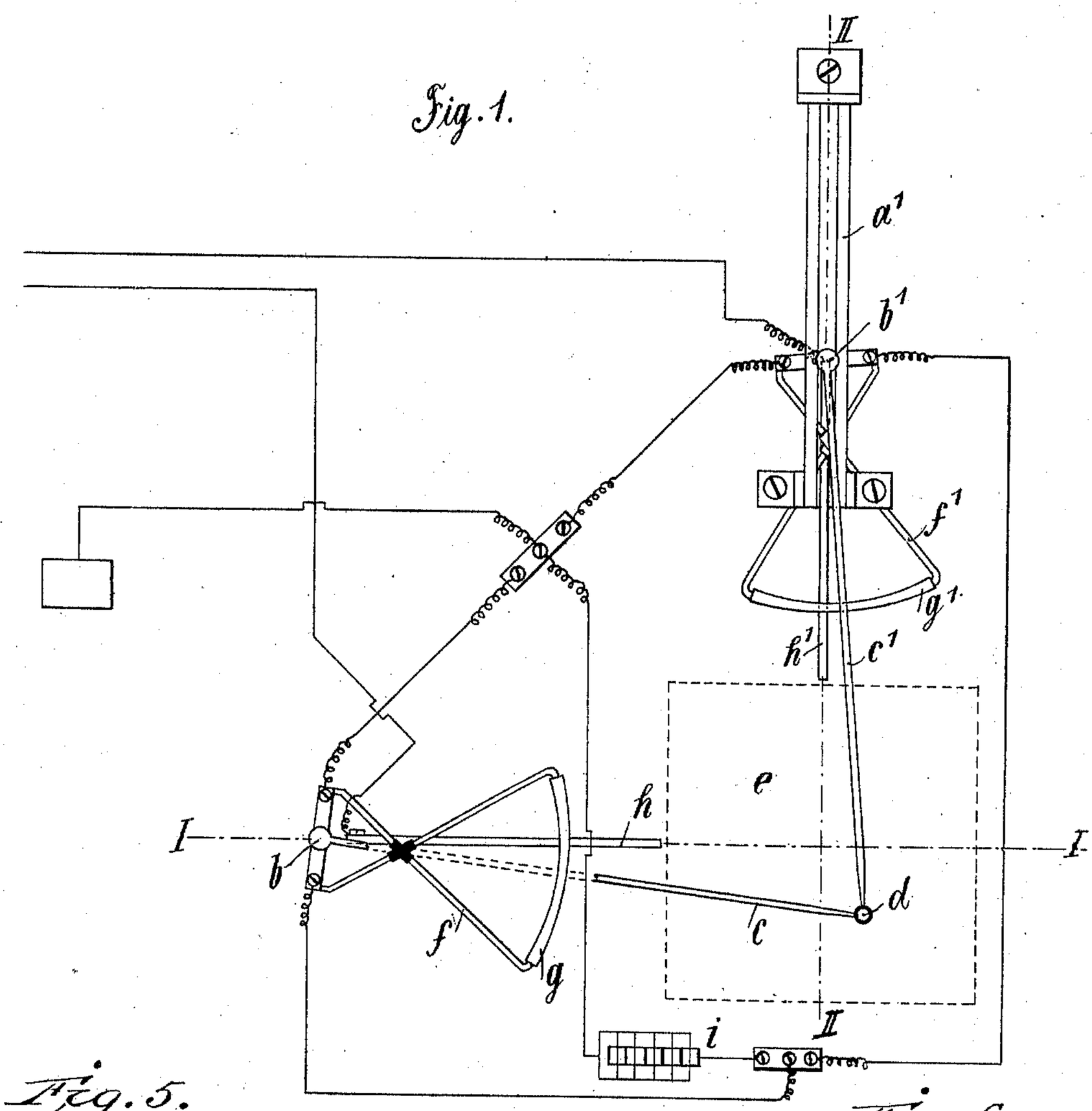



Fig. 5.

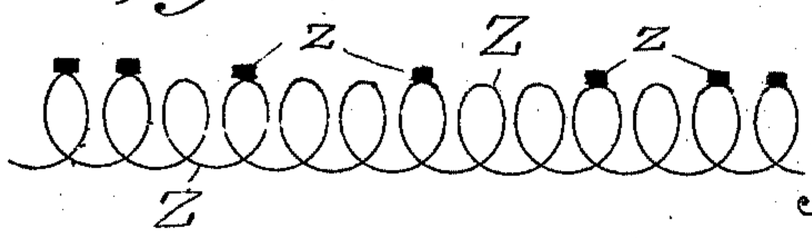
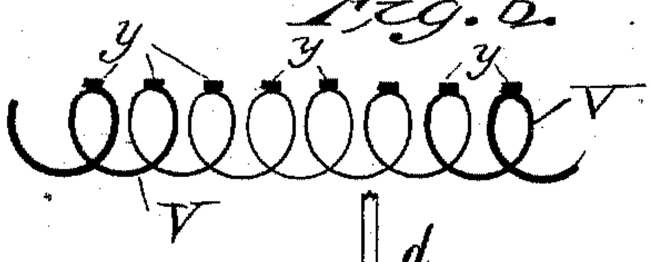
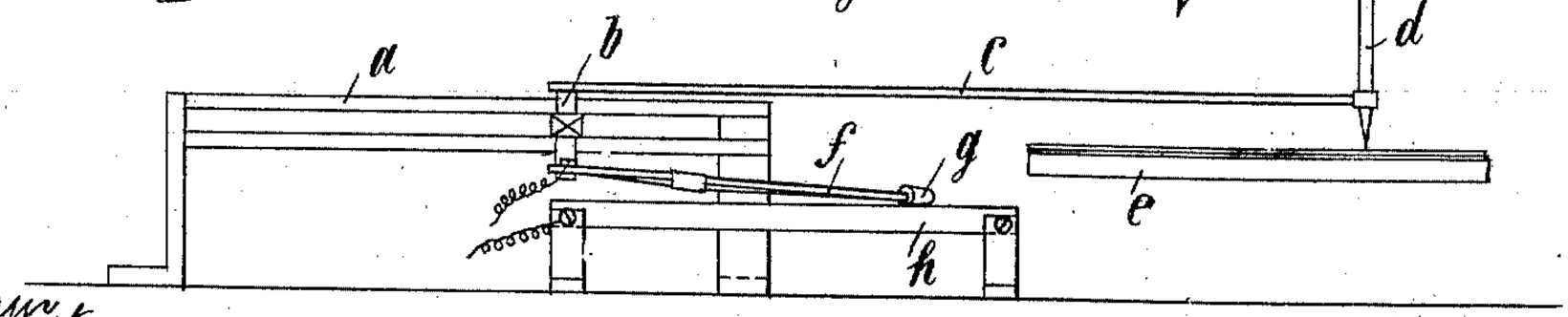



Fig. 2.

Fig. 6.

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his Attys

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FACSIMILE TELEGRAPH APPARATUS.

APPLICATION FILED NOV. 20, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

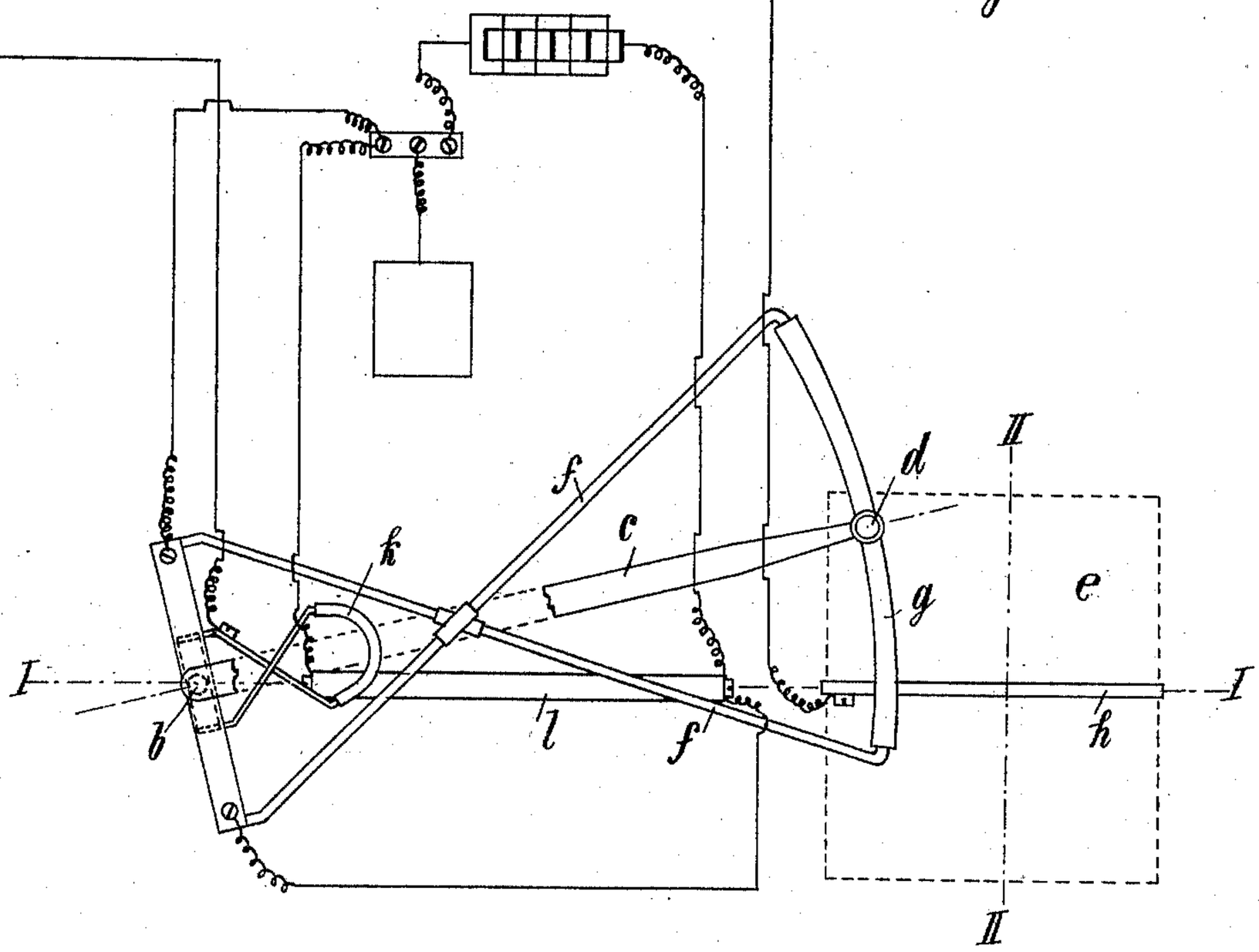
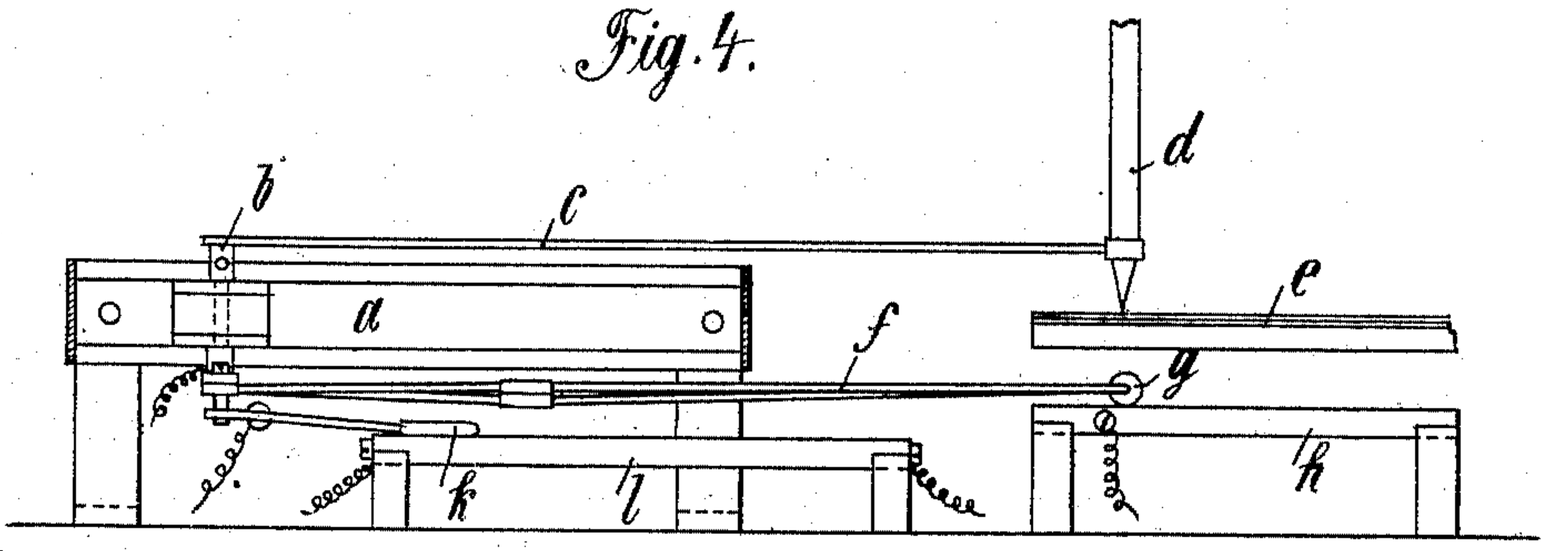



Fig. 4.

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# UNITED STATES PATENT OFFICE.

ERNST KARL GRUHN, OF DRESDEN, GERMANY, ASSIGNOR TO TELAUTOGRAPH, GESELLSCHAFT MIT BESCHRAENKTER HAFTUNG, OF DRESDEN, GERMANY.

## FACSIMILE-TELEGRAPH APPARATUS.

SPECIFICATION forming part of Letters Patent No. 759,987, dated May 17, 1904.

Application filed November 20, 1902. Serial No. 132,108. (No model.)

*To all whom it may concern:*

Be it known that I, ERNST KARL GRUHN, a subject of the King of Prussia, Emperor of Germany, residing at Dresden, Saxony, Empire of Germany, have invented certain new and useful Improvements in or Relating to Facsimile-Telegraph Apparatus, of which the following is a specification.

The present invention relates to a sending or transmitting apparatus for those facsimile telegraphic apparatus in which the movements of the writing-stylus in any direction are decomposed by levers connected with the stylus in components and the component motions being used for varying the resistances in long-distance branch conductors, so that the variations of the resistances reconverted in the receiver into component motions reproduce the original writing characters or the like.

The invention is characterized by the manner in which one component motion (or both component motions) is expressed in the form of variations of the resistance (or of resistances) by the oscillating motion of a lever (or of two levers) movable with its fulcrum, and consequently of invariable length. It must be noted that the resistance to be varied is arranged on the lever as an arc curved concentrically to the lever-fulcrum, so that it glides upon a contact-bar parallel to the direction of displacement of the lever-fulcrum, and consequently is influenced by the oscillations of the lever connected with the stylus, while the oscillations of the lever remain inoperative. This mode of utilizing the oscillations of a lever of invariable length for the purpose of decomposing the motion of the writing-stylus into orthogonal coördinates distinguishes the present invention particularly from a prior invention (German Patent No. 84,922) in which also an oscillating motion of a lever is used which, however, is movable relatively to a stationary fulcrum, and thus is of variable length and with which instead of orthogonal coördinates polar coördinates are described. This difference remains even if, as in the older invention, both component motions are effected by one lever owing to the use of the displacement besides that of the oscillation.

In the drawings two constructions of apparatus according to this invention are shown, in one of which a special lever is used for each component motion, while one lever only is used for both component motions in the other construction, as above indicated.

Figure 1 shows the first construction in top plan view, wherein for the sake of clearness the straight guide for one of the lever-fulcra is omitted. Fig. 2 is a lateral view which for the same reason only shows one system of levers. Fig. 3 is a top plan view of a second construction. Fig. 4 is a side elevation of the same. Figs. 5 and 6 are diagrammatic views illustrating modified constructions of resistance-coils.

The straight guides $a$ $a'$ are situated in the orthogonal axis I I II II, in which are movably arranged the pivots $b$ $b'$, as indicated in Figs. 1 and 2. These pivots are connected, respectively, by levers $c$ $c'$ with the writing-stylus $d$, which is guided over the paper-surface at will. Mounted upon the pivots $b$ $b'$ are cross-bars $f$ $f'$, which carry the resistance bodies $g$ $g'$, curved concentrically to $b$ $b'$. Parallel to the straight guides are contact-bars $h$ $h'$, upon which glide the resistances $g$ $g'$. These resistances are, as shown in Fig. 1, insulated from each other at the crossing-point of their arms $f$ $f'$ and are switched into the circuit of a local battery $i$, while the contact-bars $h$ $h'$ are connected with the long-distance branch conductors.

When, for example, the writing-stylus $d$ is moved parallel to the axis I I, this motion with regard to the lever system situated in the axis I I causes a displacement of the fulcrum $b$, and owing to the angle of the lever relatively to the bar $h$ being not varied the effect of the resistance $g$ remains constant.

With regard to the lever system situated in the axis II II, however, the imaginary motion of the stylus has the effect of an oscillation of the lever $c'$ as well as of a displacement of the fulcrum $b'$. The latter motion also is inoperative with regard to the quantity of

the resistance; but the quantity of the resistance varies according to the angular motion of the lever $c'$. This lever, therefore, converts the component motions of the stylus effected parallel to the axis I I into variations of the resistance $g'$ in the same manner as the lever $c$ converts the motion parallel to the axis II II into variations of the resistance $g$. In this manner the motions of the stylus decomposed into orthogonal coördinates are transmitted as variations of the electric phase of the long-distance branch conductors to the receiver.

In the second construction (shown in top plan view in Fig. 3 and in side elevation in Fig. 4) only one lever system $b$ $c$ $f$ is arranged with the arc-shaped resistance $g$, which system gives the component motions parallel to the axis II II corresponding to the above description. In order, however, to effect the other component motions, the displacement of the lever-fulcrum $b$ is used in a known manner. To this end the lever $c$ is connected with a contact-arc $k$, which glides upon the resistance $l$, arranged parallel to the straight guide $a$. The shape of the contact-arc $k$ is selected in the manner described in another application for patent filed by me on the 21st day of November, 1902, Serial No. 132,298, and for the purpose of suppressing the deviations resulting from the oscillations the arc is so constructed that the variation of the resistance $l$ is as much as possible proportionate to the component motion in each position of the lever system. This equalization does not, however, form the object of the present invention. An equalization, however, which refers to the function of the arc-shaped resistance body forms part of the object of the present invention. From the fact that the movement of the writing-stylus in the direction of one or other of the components is straight while the motion of the resistance over the contact-bar is circular it results that the variation of the resistance is not always precisely proportional to the movement of the point of the writing-stylus. The deviations which increase with the amplitude of movement of the lever amount with an amplitude of seventeen degrees to about 1.5 per cent. As the lever without the risk of inconvenient measurements can be made so long that the imaginary angle of the amplitude is not exceeded, the slight error in practice is hardly worth consideration. Yet there are cases where great exactness and precision or a large writing-surface with a relatively short length of lever is of importance, and in these cases an equalization is desirable. This can be attained by irregularly shaping the arc-shaped resistance body in such a manner that the resistance per unit of length gradually decreases from the center toward the ends. Then the large motion with a large amplitude is equalized by the slight increase of the resistance per unit of length of the resistant body. This can be attained in various manners. If, for instance, the resistance body consists of homogeneous substance—say carbon—it can from the center toward the ends gradually increase in thickness, as indicated in the construction shown in the accompanying drawings. However, if the resistance consisted of a coil the number of windings would have to be decreased toward the ends, or, in other words, the length of the wire would have to decrease per unit of length, as shown diagrammatically in Fig. 5, wherein Z indicates the coil and $z$ the contacts, or the thickness of the resistance-coil could gradually increase toward the ends, as shown diagrammatically in Fig. 6, wherein V is the coil and $y$ the contacts.

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

1. A transmitting mechanism for facsimile-telegraphs embodying the following instrumentalities, whereby the movement of the stylus is decomposed into orthogonal coördinates to effect a variation in the resistance of the line conductors, to wit; a stylus, a lever connected therewith and mounted to have a bodily as well as an oscillatory movement, a resistance body whose resistance is varied by the oscillatory movements of the lever only and circuit connections; substantially as described.

2. A transmitting mechanism for facsimile-telegraphs embodying the following instrumentalities, whereby the movement of the stylus is decomposed into orthogonal coördinates to effect a variation in the resistance of the line conductors, to wit; a stylus, a lever connected therewith and mounted to have a bodily as well as an oscillatory movement, a resistance body movable in unison with the bodily movements of the lever without variation in its resistance and whose resistance is varied by the oscillatory movements of the lever, and circuit connections; substantially as described.

3. A transmitting mechanism for facsimile-telegraphs embodying the following instrumentalities, whereby the movement of the stylus is decomposed into orthogonal coördinates to effect a variation in the resistance of the line conductors, to wit; a stylus, a lever connected therewith and having a bodily movement in a right line and an oscillatory movement, a resistance body movable in unison with the lever, a contact extending in the direction of bodily movement of the lever and with which the resistance body coöperates to vary the resistance during the oscillations of the lever and circuit connections; substantially as described.

4. In a transmitting mechanism for facsimile-telegraphs embodying the following instrumentalities, whereby the movement of the stylus is decomposed into orthogonal coördinates to effect a variation in the resistance of the line conductors, to wit; a stylus, a lever

connected therewith and mounted on a fulcrum movable in a right line, an arc-shaped resistance body movable in unison with the lever, a contact extending in the direction of bodily movement of the lever and with which the arc-shaped resistance body coöperates to vary the resistance by an angular displacement of the lever and resistance-body with the fulcrum in any position of adjustment; substantially as described.

5. In a transmitting mechanism for facsimile-telegraphs embodying the following instrumentalities, whereby the movement of the stylus is decomposed into orthogonal coördinates to effect a variation in the resistance of the line conductor, to wit; a stylus, a lever connected therewith and mounted to have a bodily as well as an oscillatory movement, a resistance body whose resistance is varied by the oscillatory movements of the lever only, said resistance body being so formed that the ohm resistance per unit of length decreases from the center toward the ends, and circuit connections; substantially as described.

6. In a transmitting mechanism for facsimile-telegraphs embodying the following instrumentalities, whereby the movement of the stylus is decomposed into orthogonal coördinates to effect a variation in the resistance of the line conductor, to wit; a stylus, a lever mounted on a fulcrum movable in a right line, an arc-shaped resistance body movable in unison with the lever and so formed that the ohm resistance per unit of length decreases from the center toward the ends, a contact extending in the direction of bodily movement of the lever and with which the arc-shaped resistance body coöperates to vary the resistance when displaced angularly in unison with the angular displacement of the lever.

7. In a transmitting mechanism for facsimile-telegraphs embodying the following instrumentalities, whereby the movement of the stylus is decomposed into orthogonal coördinates to effect a variation in the resistance of the line conductor, to wit, a stylus, a lever connected therewith and having a bodily movement in a right line and an oscillatory movement, an arc-shaped resistance body movable in unison with the lever, an arc-shaped contact also movable in unison with the lever, a fixed contact extending in the line of bodily movement of the lever and with which the arc-shaped resistance coöperates, and a fixed resistance extending in the direc- tiod of bodily movement of the lever and with which the arc-shaped contact coöperates and line connections; 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:
CARL GREIERT,
OTTO WOLFF.