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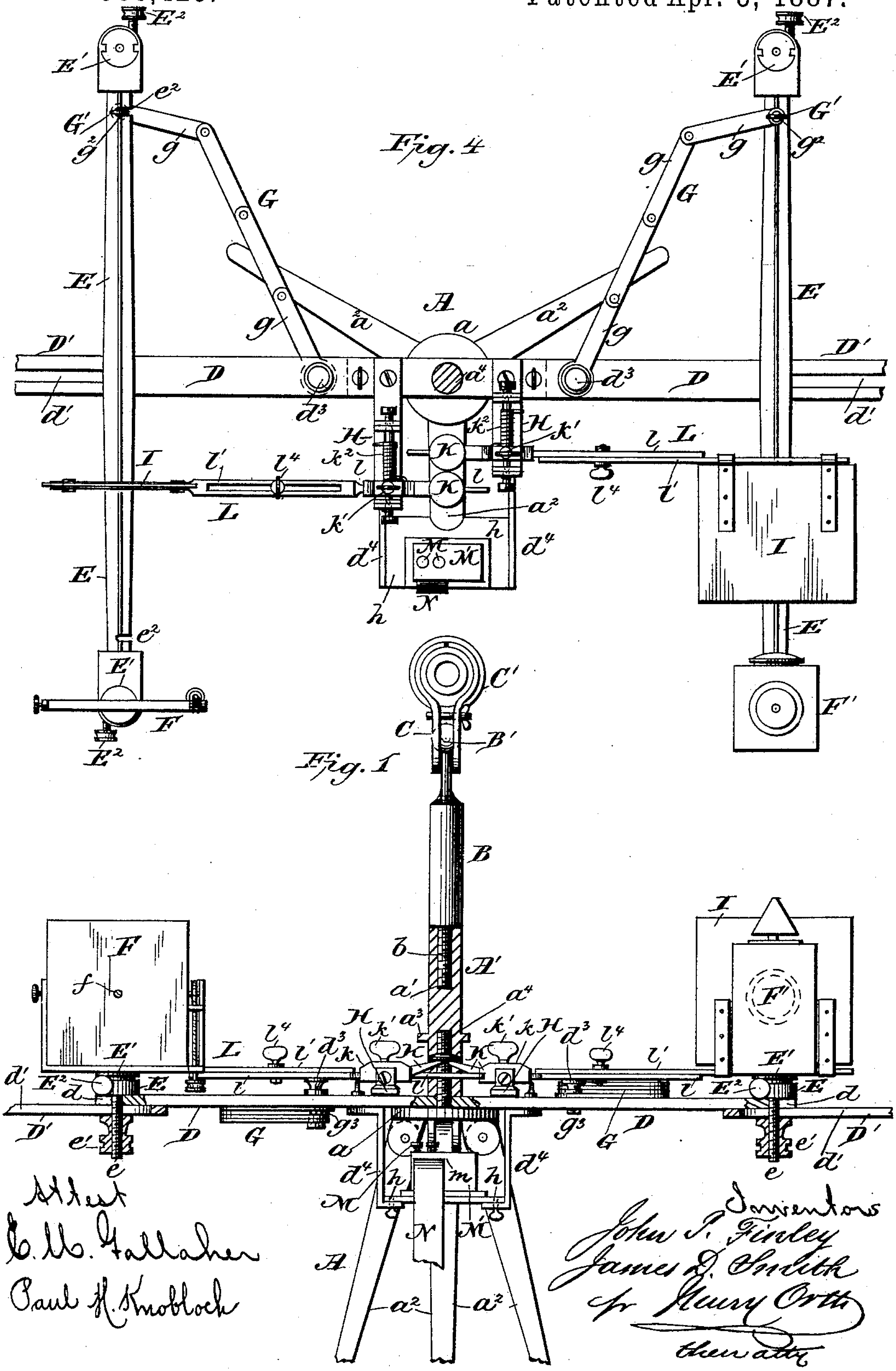
HELIO-TELEGRAPH.

No. 360,425. Patented Apr. 5, 1887.



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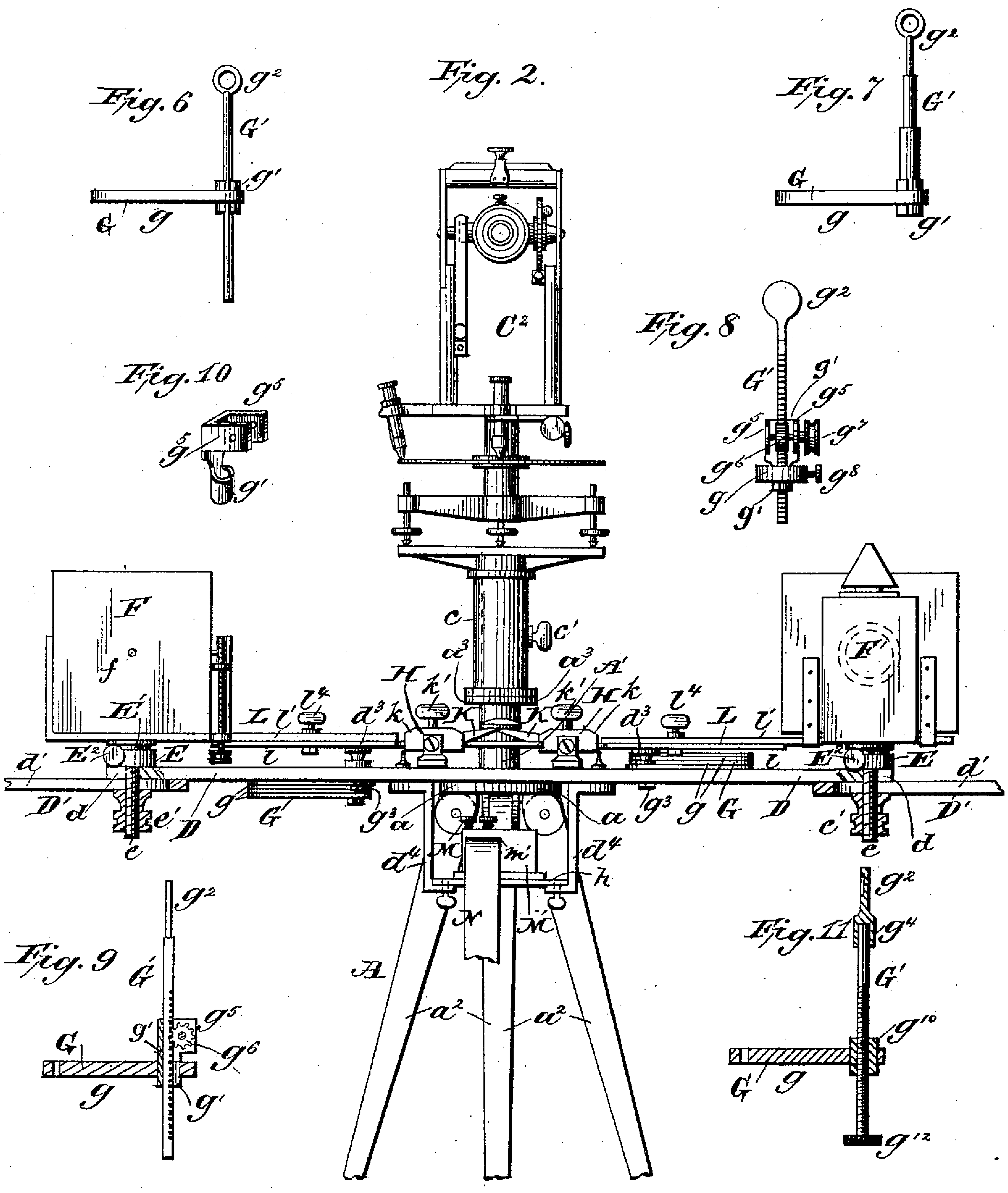

Fig. 5

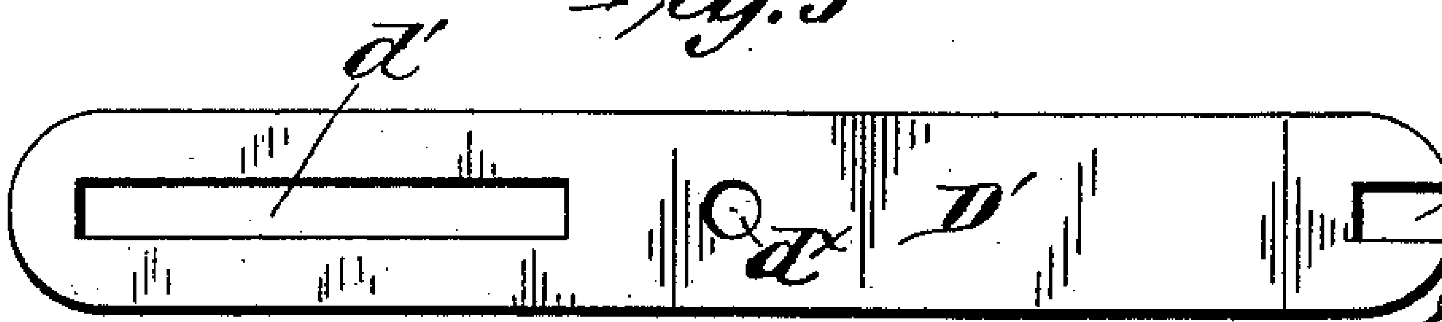

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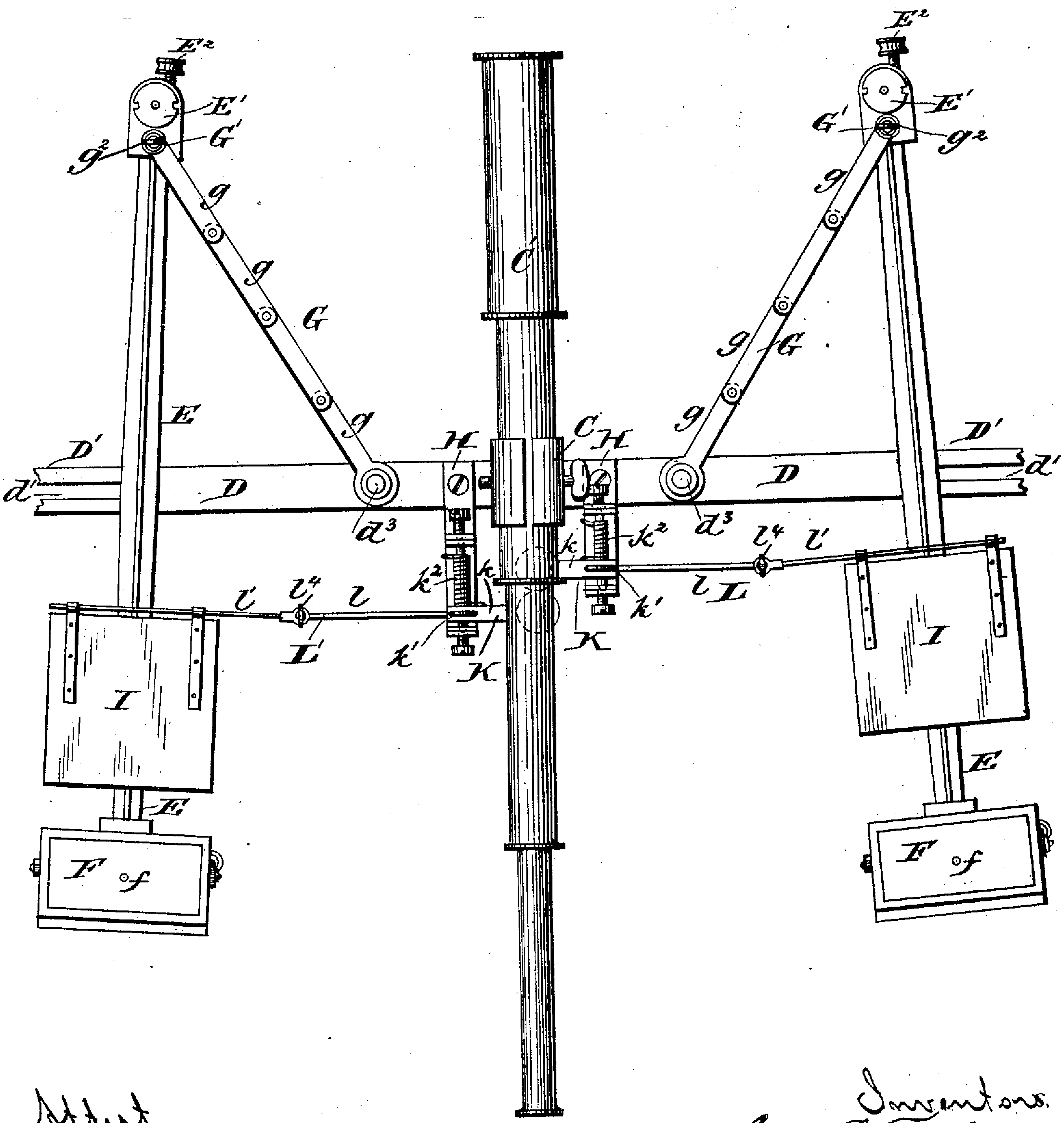
Fig. 3



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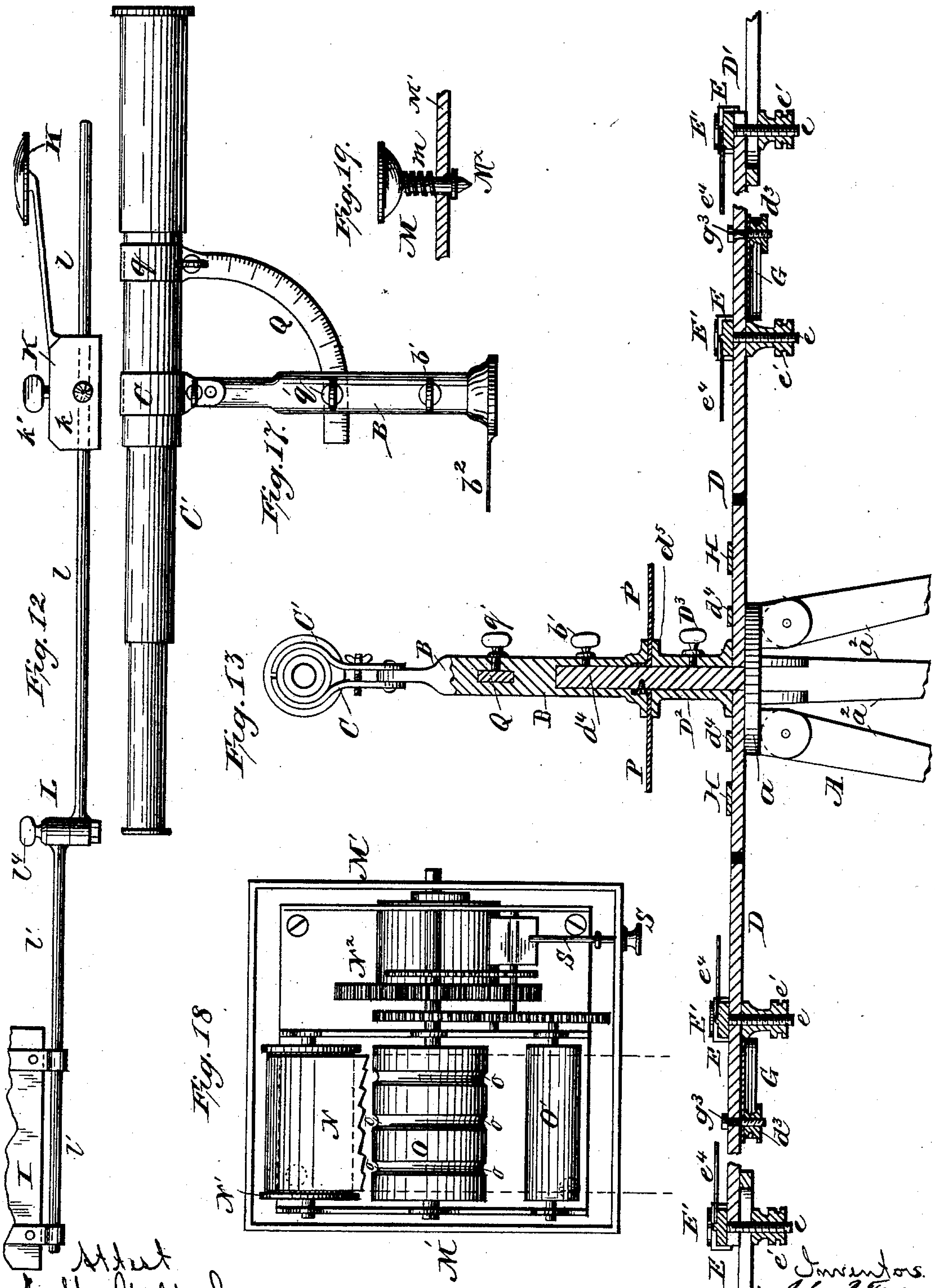

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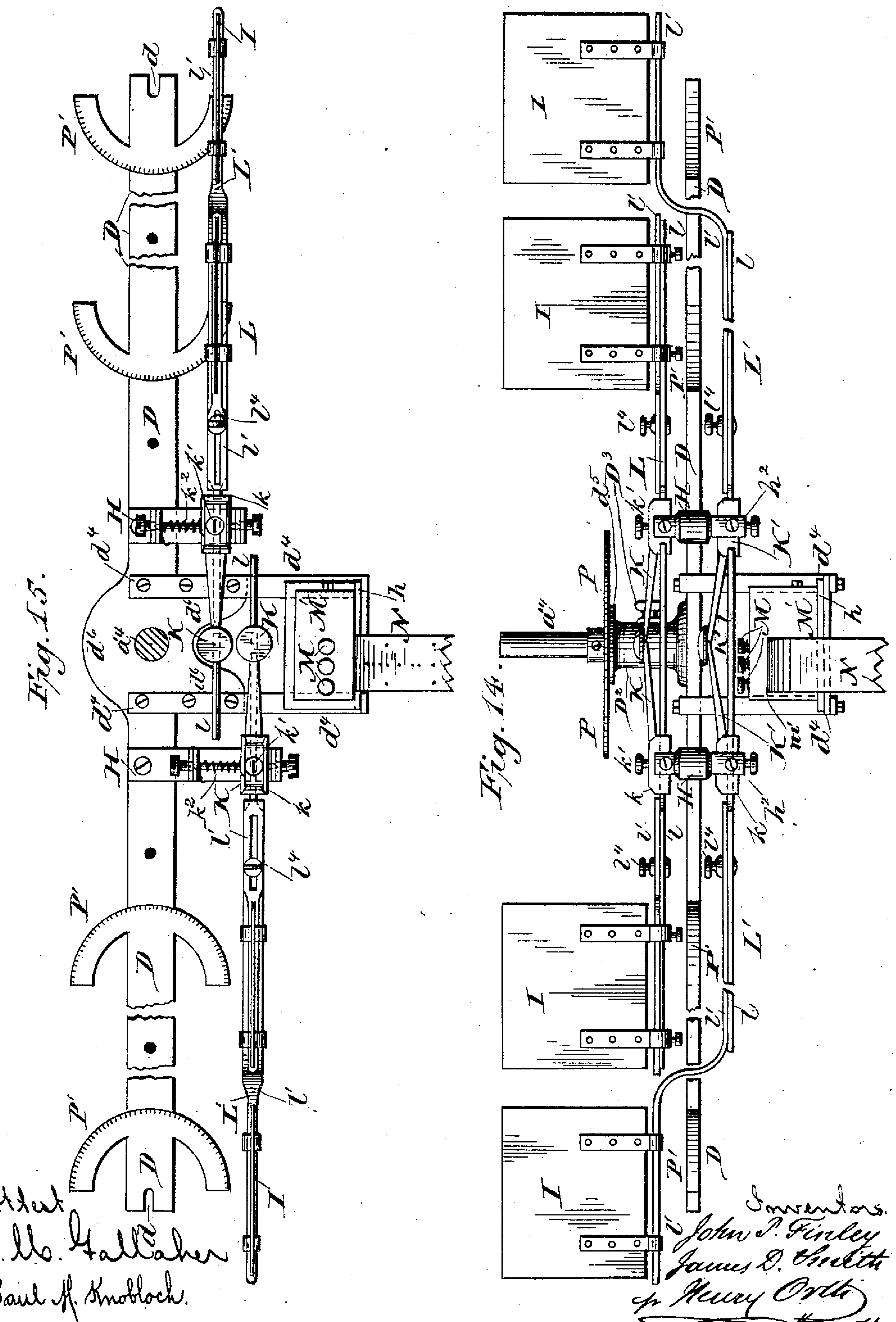

Fig. 15.

Fig. 14.

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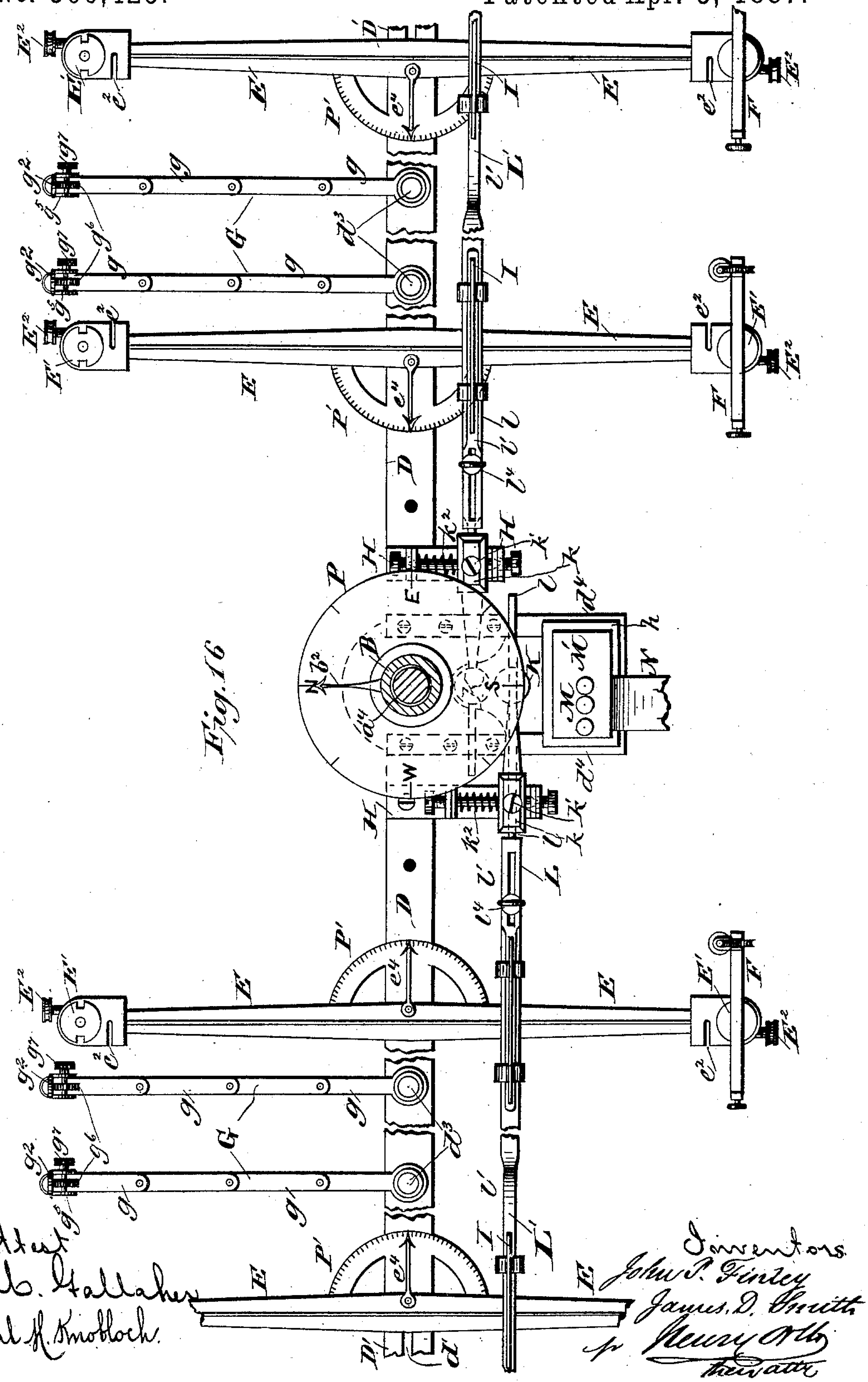

Fig. 16

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UNITED STATES PATENT OFFICE.

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HELIO-TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 360,425, dated April 5, 1887.

Application filed January 13, 1886. Serial No. 188,404. (No model.)

To all whom it may concern:

Be it known that we, JOHN P. FINLEY and JAMES D. SMITH, citizens of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in the Art of Helio-Telegraphing; and we 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, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Our invention relates to the art of transmitting speech or messages through the medium of visible signals operated or positioned to transmit such speech or message by a predetermined code or alphabet.

In the transmission of speech or messages through the medium of visible signals by the Morse alphabet or code, or any other similar code in which the letters, numbers, or signs are formed by symbols of greater or less magnitude reproduced by the longer or shorter exposition of the visible signal, or by a greater or shorter range of movement of such signal, one great and heretofore insurmountable difficulty has been encountered. This difficulty consists in the inability of the receiver, however skillful the operator may be, to properly distinguish the letters, numbers, or signs formed by the longer or shorter exposition or range of motion of the signal. For instance, in the Morse code, which is the one now generally used in field-signaling for military purposes, it has been found impossible to properly distinguish the longer period of exposition of the signal in forming the "l" dash from the shorter period of exposition of the signal in forming the "t" dash, or to properly distinguish the latter from the dot, or the "m" dashes from the "n" dash and dot.

In order to secure experts in the art of signaling for military purposes, the various governments have been compelled to establish a special signal-corps for transmitting messages or speech by means of signals. Yet, with the present mode and means of effecting this, the most skilled experts fail to readily transmit and receive absolutely correct speech or messages, and where any attempt is made to approximate the speed of transmission attained in telegraphy with the Morse or analogous code the correct reception of the transmitted speech or message has generally resulted in a failure.

The first part of our invention relates more particularly to a mode of transmitting and receiving speech or messages, whereby any one familiar with the code is enabled to transmit and receive speech or messages through the medium of visible signals with absolute correctness.

The second part of our invention relates more particularly to the means for carrying into practical effect our new mode of transmitting speech or messages through the medium of visible signals.

In the transmission of speech or messages in the field through the medium of visible signals the instruments heretofore used are devoid of means for long-distance signaling, the operations being confined to ordinary visual distances, and where the range of transmission is greater than the ordinary visual distance the operators have to rely on their field-glasses or upon telescopes carried and held by them or supported from separate stands or tripods. It is obvious that in such operations the transmitter cannot properly manipulate his instrument while holding his field-glass or a telescope; nor can he rapidly transmit if he is obliged to leave his instrument and go to a telescope to see whether his message is properly received. On the other hand, the receiver cannot properly receive such speech or message if he is compelled to hold his field-glass or telescope to observe the signals by which a message is transmitted to him.

The third part of our invention relates more particularly to the means employed for enabling the operators to transmit speech or messages beyond the range of the ordinary visual distances and enable them to manipulate their instruments rapidly for transmission and observe the signals made at the same time without encumbering them with a field-glass or telescope.

Another serious difficulty in the transmission of speech or messages through the medium of visible signals, irrespective and independent of those already mentioned, is the liability, when such speech or message is of greater than ordinary length, of the inability of the receiver to correctly and fully memorize the speech or message transmitted, especially when such are spelled—that is to say, transmitted letter by letter, and when such letters are formed of one or more symbols of varying magnitude. It has been found that it requires a long practice as well as a very retentive memory to correctly receive messages even of ordinary length. For the reasons stated the transmission of long messages by signals has for military purposes been found impracticable.

The fourth part of our invention relates more particularly to means combined with the instruments whereby speech or messages of any length may be correctly recorded, and with as great a rapidity as that heretofore attained in telegraphy, and whereby a permanent record is obtained for comparison and preservation.

In geodetic and other surveys great difficulties, annoyance, and loss of time have heretofore been occasioned in signaling necessary changes in position of various instruments or in signaling other matter necessary to the proper co-operation of the various instruments or apparatus used, or between different parties. This signaling has heretofore been effected in various ways—as, for example, by means of heliotropes, heliostats, or flags, or by a more primitive mode of signaling, such as by a handkerchief at the end of a pole or by the arms of the signaling party. These modes of signaling are either very complicated and require a comparatively long time in transmitting a message, or, when the Morse or analogous code is employed, are, for reasons hereinbefore stated, generally inaccurate or entirely unintelligible.

The fifth part of our invention relates more particularly to the provision of means combined with a surveying-instrument whereby such signaling may be effected rapidly, intelligibly, and with absolute certainty as to the interpretation of the signals that will enable a surveyor to transmit messages by signals with absolute certainty to any distance within the visual distance of the transmitting parties, or within that distance amplified by the power of a telescope.

In instruments of this class as heretofore constructed no means are provided for a delicate adjustment of the sight-rods. It is well known that in long-distance signaling a very slight variation in the position of the sight-rods will result in a very great divergence in the direction in which the flash is to be thrown, so that the operator at the station signaled to cannot see the same. For short-distance signaling the means heretofore adopted have been found sufficiently accurate, yet for long-distance signaling such means are insufficient. The sight-rods heretofore have been arranged in sleeves fitted to the signal-carrier bar, in which said rods are held by frictional contact, and may be pushed up or down to bring them into the proper plane. In other cases sight-rods jointed together like a fishing-rod, to be planted in the ground, have been used, and other analogous means have been adopted to adjust the sight-rods. By these means it is not possible, except by tedious operations and great loss of time, to accurately adjust the sight-rods in long-distance signaling.

The sixth part of our invention relates more particularly to means whereby a very delicate adjustment of the sight-rods may be attained.

In field-instruments of the class referred to as heretofore constructed no means are provided for transmitting signals to two or more stations without changing the position of the instrument and its support, the signal-carriers being rigidly connected with the tripod; nor are there provisions made for taking the bearings of two or more stations, so that by recording such bearings speech or messages may be transmitted at day or night time to one or more stations successively without first adjusting the instrument, by means of the sight-rod, to throw a flash of light in the proper direction.

The seventh part of our invention relates more particularly to the combination, with a portable helio-telegraph, of appliances for taking the bearings of a station and appliances for adjusting the instrument without having recourse to the sight-rods.

The object of this invention is to provide a novel mode of transmitting speech or messages through the medium of visible signals by any code in which the letters, numbers, and signs are produced or formed by the exposition of a visible signal for a longer or shorter period of time, corresponding to symbols of greater or less magnitude—as, for instance, the longer and shorter dashes and the dot of the Morse alphabet—to enable any one familiar with the code to more or less rapidly transmit the speech or message, or to receive the same with absolute certainty of correctness.

The further object of our invention is to provide means for carrying out this mode of signaling.

The further object of our invention is to provide means for signaling at long distances, enabling the operators to observe each other and at the same time manipulate their instruments.

The further object of our invention is to provide means whereby an operator may receive and simultaneously record transmitted speech or a message and answer the same; and the further object of our invention is to combine a surveying-instrument with a signaling-instrument, to enable the surveyors to transmit any desired message to their assistants or other parties co-operating with them.

The further object of the invention is to provide means whereby the sight-rods may be readily and very accurately adjusted.

The further object of our invention is to combine with a portable helio-telegraph means whereby the bearings of a station may be taken and means for adjusting the instrument by such bearings without having recourse to the sighting-rods, when several stations are to be communicated with successively, after the bearings of such stations are once taken and recorded.

To these ends the invention consists, first, in a novel mode of transmitting speech or messages through the medium of visible signals, by the Morse code or any analogous code, in which each letter is composed of a symbol or a number of symbols of greater or less magnitude, as hereinafter fully described; secondly, in a novel construction of apparatus for carrying out the above method, substantially as hereinafter fully described; thirdly, in combining with the instrument means for amplifying the ordinary visual range to adapt the instrument for long-distance signaling; fourthly, in the combination, with our improved apparatus, of a recording instrument or apparatus for recording the speech or messages received from the transmitter, substantially as hereinafter fully described; fifthly, in the combination, with our improved apparatus, of a surveying instrument or apparatus, substantially as hereinafter fully described; sixthly, in means for readily and accurately adjusting the sight-rod, substantially as hereinafter fully described; seventhly, the invention consists in the combination, with a helio-telegraph, of appliances for taking the bearings of several stations and appliances for adjusting the signal-carriers by such bearings when once noted without having recourse to the sight-rods, and means for changing the position of the signal-carriers without changing the position of their support; lastly, the invention consists in the combination or combinations of co-operative parts of the apparatus and in certain details of construction and arrangement of said parts, substantially as hereinafter fully described.

In carrying out the first part of our invention—namely, the mode of transmitting speech or messages through the means of visible signals of whatever nature by a code the letters whereof are formed by symbols of varying magnitude instead of exposing the signal to view for a longer or shorter period of time—we propose to expose one or more signals, according to the magnitude of the symbol or symbols corresponding to a given letter to be transmitted. Taking the Morse code or alphabet as an illustration, we form, for example, the long dash of the "l" by two or, if necessary, by three signals exposed to view simultaneously, and the shorter "t" dash by two such signals, while for the dot but one signal is exposed to view. For general purposes two signals will be found sufficient, since the only mistake that can arise from this mode is the mistaking of the "l" for the "t," an error which, when, the word is completed, can generally be detected. Yet it will be obvious that by varying the number of signals according to the magnitude of the symbol or symbols that represent a given letter all liability to error will be avoided, and any one acquainted with the code will be able to transmit and receive speech or messages with absolute accuracy. This novel mode will be readily comprehended from the following explanation:

We propose to form the longer dash of the Morse code by the simultaneous exposition of at least two, and, if necessary, three, signals—the shorter dash by two signals and the dot by one signal. Thus the letter "m" will be formed by the simultaneous exposition to view of two signals repeated at a short interval, said letter being formed by two short dashes. The letter "a," being formed by a short and a long dash, will be produced by a single signal followed by two signals simultaneously exposed to view. The letter "n," being formed by a long and a short dash, will be produced by the simultaneous exposition of two signals followed by that of one signal. The letter "o," being formed by three long dashes, will be produced by the simultaneous exposition of two signals repeated at short intervals three times, and the letter "p," being formed by a short dash, two long dashes, and a short dash, will be produced by the exposition first of one signal followed by the simultaneous exposition of two signals repeated, and then one signal, &c., throughout the code.

It will be seen that, whatever the nature of the signal, if a set of such is so arranged that they can be manipulated as described no difficulty will be encountered in transmitting speech or messages with absolute certainty.

The mode of signaling may be carried out on board ship in day-time by a set of flags arranged to be exposed to view at a certain point of a mast or yard in the manner described, and at night by a corresponding set of lights or signals of any other nature capable of being manipulated as described may be employed. On land the signaling may be carried on in day-time within visual distance by the arms, or the latter and another signal—such as a flag, for instance—or by any other desired means, and messages transmitted correctly and intelligibly. We have, however, invented an instrument or heliotrope for signaling on land or at sea, by means of which our improved mode may be carried into practical effect and a speed of transmission attained equal to that attained in telegraphy with the Morse code, and this apparatus and its various uses we will now describe, referring to the accompanying drawings, which form a part of this specification, and in which like letters indicate like parts wherever such may occur.

Figure 1 shows by an elevation, partly in section, our improved heliotrope or helio-telegraph arranged to carry two signaling devices. Fig. 2 is a like view, the telescope being removed and a surveying-instrument substituted therefor. Fig. 3 is a top plan view of the instrument shown in Fig. 1, the tripod being omitted. Fig. 4 is a similar view, partly in section. Fig. 5 is a plan view of one of the extension-bars. Figs. 6 and 7 are side elevations of the outer link or end of one of the sight-rod carriers, showing an ordinary and a telescopic sighting-rod, respectively. Fig. 8 is a face view of the outer link or end of one of the sight-rod carriers, showing means for adjusting the sighting-rods. Fig. 9 is a longitudinal vertical section of the outer link or end of one of the sight rod carriers and the means for adjusting the sighting-rod shown in Fig. 8. Fig. 10 is an isometric view of the bearing-sleeve for the sighting-rod shown in Figs. 8 and 9. Fig. 11 is a view similar to Fig. 9, showing a modified construction of sighting-rod. Fig. 12 is an elevation, on a larger scale, of one construction of screen-carrier. Fig. 13 is a vertical sectional elevation of our improved heliotrope arranged to carry four signaling devices. Fig. 14 is an elevation of the instrument shown in Fig. 13, the signal and sight-rod carriers, the telescope, and the tripod being removed. Fig. 15 is a top plan view of the main cross-bar of the instrument shown in Figs. 13 and 14, the standards from which the telescope is supported being shown in section. Fig. 16 is a top plan view of the instrument shown in Figs. 13 and 14 without the tripod, a portion of one of the outer signal-carrier bars being broken away and the standard for supporting the telescope shown in section. Fig. 17 is a side elevation of the telescope-standard and telescope for the instrument shown in Figs. 13, 14, and 16. Fig. 18 is a top plan view of the recording-instrument, the top or lid of the inclosing box or case being removed to show the operating mechanism; and Fig. 19 is a detail view, on a larger scale, of one of the keys of the recording-instrument.

When the apparatus is employed at a fixed signaling-station, its support will necessarily be a fixed support and the apparatus provided with the well-known mechanism for use as a heliostat, while for field purposes the instrument is supported, as usual, from a tripod.

The apparatus in its construction may be variously modified to render the same more or less complete, and correspondingly enlarge the scope of its utility. These modifications, however, are not essential departures from the nature of our invention, the principle of which is based upon means whereby the magnitude of a symbol or symbols representing a letter, number, or sign may be represented or formed by one or more visible signals adapted to be seen at ordinary visual distances, or at such distances amplified by artificial means.

In order that our invention may be better understood, we will first describe the instrument in its simplest form, referring more particularly to Figs. 1 to 12, inclusive.

A indicates a tripod of any suitable or preferred construction, and a is the disk, to which the legs a^2 are hinged. From the disk a projects an axial screw-rod, a^4, to which is screwed a standard, A′, in whose upper end is formed a screw-threaded socket, a', and said standard is provided with an annular seat-flange, a^3. By means of this standard a telescope may be connected with the apparatus, or, instead of said telescope, a suitable surveying-instrument, such as a theodolite or other desired instrument used in geodetic or other surveys.

When a telescope is connected with the instrument, as shown in Figs. 1 and 3, we employ a supporting-rod, B, provided at one end with a screw-threaded extension, b, that is adapted to be screwed into the socket a' of standard A′. At its other end the rod B terminates in a ball, B′, that, with the clamp C, forms a ball-and-socket or universal joint of well-known construction, which need not be described in detail. Any other construction of universal joint combined with a clamping device for supporting a telescope, C′, may, however, be used, and for obvious purposes. When, on the other hand, the instrument is to be used as a combined surveying and signaling instrument, as shown in Fig. 2, the telescope C′ is removed, and a surveying-instrument, C^2, (theodolite or other,) is secured to the standard A′.

The surveying-instrument, being mounted on a tubular support, c, that fits on the standard A′, is seated on flange a^3, and is secured in position by a set-screw, c'.

It is obvious that, instead of supporting the telescope C′ from a rod adapted to be screwed on standard A′, said telescope may be supported from a tubular support, c, adapted to fit on standard A′, having its seat upon the flange a^3 thereof, and secured in position by means of a set-screw in the manner shown and described with regard to the surveying-instrument.

Between the standard A′ and the disk a of the tripod is secured a cross-bar, D, the outer ends of which are provided with a longitudinal slot, d, as shown in Fig. 1. To adapt the cross-bar D to rotate freely on the disk a, it is loosely mounted on standard a^4 and secured in the desired position by screwing the standard a' down onto it, as will be readily understood, so that said cross-bar and the devices carried thereby, and presently to be described, may be positioned without changing the position of the support or tripod A. This cross-bar serves to support the signaling devices, mirrors, or lanterns, or any other suitable signaling device adapted to be alternately exposed to and screened from view of the party signaled to. This support for the signaling devices consists of bars E, each provided at their longitudinal center with a screw, e, by means of which and a nut, e', said bars are detachably connected to the slotted ends of the cross-bars D.

At each end of the bars E is formed a bearing, in which is secured a mirror, F, when the signals consist of flashes of light obtained by the focused rays of the sun, or a lantern, F′, for night signaling, as shown in Figs. 1, 2, and 4, on the left and right, respectively. The bearing E′ is one well known, and is rotated by the usual tangent-screw, E^2.

Inasmuch as we employ two or more signals to indicate the magnitude of the symbol or symbols representing a given letter, number, or sign, and it being well known that two or more objects within a given distance of one another can be separately seen or distinguished at a given distance only, it is necessary, whenever the distance is greater than that at which such objects can be separately seen, to increase the distance between the objects or signals in order to increase the visual range at which they may be separately seen, whether this visual range is the ordinary visual range or that amplified by a telescope. To effect this we employ extension-bars D′ D′, that are secured to the ends of the cross-bar D, said extension-bars serving to support the bars E E at their outer ends whenever the visual range is to be amplified. One of said extension-bars is shown in detail in Fig. 5, and also in Figs. 1, 2, 3, and 4, where a portion of said extension-bars is shown. These bars are provided with a longitudinal slot, d', at one end, through which passes the screw e, and by means of which said extensions may be adjusted to more or less increase the distance between the signal-supporting bars E. At the opposite end said bars are further provided with a slot, d^2, for the passage of the screw e on the signal-supporting bars E, and with a pivot-hole, $d^{\times}$, for the reception of the pivot g^3 of the sight-rod carrier.

When signaling by means of the reflected rays of the sun and when the latter is in rear of the operator, two mirrors are employed, one at each end of the bars E, as is well understood.

G G are extensible carriers, composed of a series of short rods or links, g, pivoted together and to the cross-bar D, and capable of being moved to opposite sides of the cross-bar D into proper position or to be moved out of the way when not required, or to be folded one upon the other. These expansible carriers serve to support the sighting-rods G′, and to this end are provided at their outer ends with the usual split spring bearing or sleeve, g', into which a telescopic or other sighting-rod is fitted. As shown on the left of Fig. 4, the bar E has a transverse slot, e^2, of such depth that when the extensible carrier G is moved to bring the sighting-rod G′ into the slot the center of its disk g^2 will lie in the plane of the axial sight-aperture f usually formed in the mirrors, the vertical adjustment of the rod being effected by moving it up or down in its split bearing in the carrier G, Fig. 6, to bring the sighting-disk into the horizontal plane of the mirror. In this arrangement the outer link of the carrier G moves under the bar E; but it may be arranged to move over said bar E, in which case a telescopic sighting-rod, G′, Fig. 7, is employed, as shown in Fig. 3 and on the right of Fig. 4.

The extensible rods or carriers G may be pivoted on top of the cross-bar D, as shown in Fig. 3 and on the right of Figs. 1, 2, and 4; or they may be pivoted on the under side of said cross-bar D. When pivoted underneath, as shown on the left of Figs. 1, 2, and 4, the links of the rod or bar G are pivoted so as to fold one under another, and when pivoted on top of the cross-bar the said links are pivoted to fold on top of each other. In either case the pivot consists of a screw, g^3, that passes through the cross-bar and one end of the inner link of the carrier G, which is secured in position by a binding-nut, d^3, as shown.

In instruments of this class it is well known that the slightest deviation from the true position of the sighting-rod in adjusting the instrument to throw a flash of light to a given point will result in such deviation of the direction of the flash that the party signaled to will fail to perceive the signal. This is especially the case when signaling at long distances, and in the instruments as heretofore constructed no means have been provided for a delicate adjustment, except such as require a great deal of time and labor.

We have invented means whereby a delicate adjustment of the sight-rods may be readily and very conveniently effected, and this construction is shown in Figs. 8, 9, 10, and 11. In the latter figure the sight-rod G′ is screw-threaded, and instead of the split bearing-sleeve g' we employ an interiorly-threaded sleeve, g^{10}, in which the rod G′ works, said rod having a head, g^{12}, for rotating the same. In this construction it is necessary to provide means for adjusting the sighting-disk g^2, as it is obvious that when adjusting the sight-rod the disk may not be in proper position. To this end we form a socket, g^4, in the shank of the disk g^2, adapted to fit snugly and capable of being rotated on the sight-rod G′. This construction, however, necessitates a separate manipulation of the disk g^2, and to avoid this we prefer to use the construction shown in Figs. 8, 9, and 10. In this construction the disk g^2 forms an integral part of the sight-rod G′, as is usual, and said rod is provided with fine teeth, thus forming a rack-bar, the split sleeve or bearing g' being in this case provided with lugs or ears g^5, in which are formed bearings for a toothed wheel, g^6, that meshes with the teeth of the rod G′, the arbor of said wheel carrying a milled head, g^7. The sleeve g' fits in a suitable opening in the outer link of the carrier G, and is held in position by a set-screw, g^8.

It is obvious that either of the described sleeve-bearings for the sighting-rod G′, instead of being secured to a separate carrier G, may be applied, as usual, to the signal-carrier bar E itself. It will also be seen that in either of the constructions of sighting-rods shown in Figs. 6 to 11 they may be readily detached from their carrier for convenience of packing.

Upon the cross-bar D, on opposite sides of the standard A′, are secured brackets H, that are provided with bearings for the pivots of two keys, K, the shanks k of which are perforated for the reception of one end of the cylindrical shank l of the longitudinally-adjustable screen-carrier L.

For ordinary purposes of short-range signaling, when but two signal mirrors or lanterns are used, the screen-carriers L may be constructed as more clearly shown in Fig. 12, in which case they consist of two rods, l and l', pivoted together and secured in position at their pivotal connection by means of a set-screw or binding-screw, 14. In this construction the sections of the screen-carriers L are sufficiently long to permit the use of an extension-bar, D', if necessary, and bring the screens in proper position thereon; but when more than two screens are employed, in order to bring the keys within proper reach of the operator, this construction will necessarily be modified. We may employ this construction of screen-carrier for the inner screens when more than two are employed, or we may employ a carrier of modified construction for the inner and outer screens, which latter also has a greater range of adjustability. This modified screen-carrier, as shown in Figs. 12, 13, and 16, instead of being composed of cylindrical rods, is composed of two flat bars, l l', slotted longitudinally and adjustable or extensible one upon the other, by means of a thumb-screw, l^4, which also serves as a pivot for the bars. The flat bar l has a cylindrical shank that passes through the perforated shank k of its key K, and is secured by means of a binding-screw, k', and the flat bar l' terminates in a like cylindrical shank, to which is secured a screen, I. When the instrument is in position and adjusted for signaling, the screens I are in a vertical position to cover the mirrors or lanterns, and said screens, by depressing the key-levers, with which they are rigidly connected through the binding-screws k', are elevated sufficiently to uncover the mirrors or lanterns, thus exposing to view the reflected rays of the sun, or the light of the lanterns, and producing the signal-flashes.

When it is desired to adjust the instrument to throw the flashes in a given direction—that is to say, when it is necessary to adjust the instrument by means of the sight-rods—the screens are moved out of the way, and this may be readily effected by loosening the binding-screws k', which enables the screen-carriers L, under the weight of the screens, to tilt over, said screens lying flat on their bars E, as shown in Fig. 3 and on the right of Fig. 4. This removal of the screens may also be effected by turning the rods or the bars on their pivotal screw l^4 and moving the screens away from the bar E. It is obvious, however, that by means of the binding-screw k' the removal of the screens from in front of the signals may be effected more rapidly.

We form the screen-carriers of two sections adjustable longitudinally one upon the other, so that when the extension-bars D' are used, and the distance between the bars E is increased, the said screen-carriers may be correspondingly adjusted for co-operation with the signaling devices, as will be readily understood.

It will of course also be understood that the extensions D' of the cross-bars D may be of any desired length, and that a multiplicity of such extension-bars may be used. It is also obvious that by means of these extension-bars a multiplicity of signals may be employed to indicate letter, sign, or number symbols of varying magnitude, as hereinafter explained.

Coiled springs k^2 are arranged around the pivots of the keys K, to lessen the shock of the screens on the signal-carriers E when the keys are released to allow the screens to fall down into position to cover the signals, one end of said springs being connected with the bracket H and the other with the key K. In this heliotrope or helio-telegraph the two signals, simultaneously exposed, will indicate a symbol of greatest magnitude—as, for instance, the "l" and "t" symbols—the dots being indicated by a single signal. Thus, for instance, if it is desired to signal the words "Move in," both keys K are depressed twice in succession to form the symbols or dashes of the letter "M," producing at each depression two flashes simultaneously. They are then depressed three times in succession to form the three symbols of the letter "o." One of the keys is next depressed successively to produce three successive single flashes, and both keys are again depressed to produce the double flash for the letter "v." One key is now depressed to produce a single flash corresponding to the dot of the letter "e." The two keys are then depressed successively to produce the two successive flashes or the symbols of the letter "i," and for the symbol of the letter "n" both keys are simultaneously depressed for the symbols of greater magnitude, and then one key is depressed for the symbol of less magnitude that forms the letter "n," and so on for every letter in the message.

To adjust the instrument for signaling, the screen-carriers are first moved out of the way, as described, and the sighting-rods are brought into position and properly adjusted. The operator then adjusts the signal-carriers and signals to throw the rays of light in the proper direction, when the sighting-rods are removed and the screens are placed in front of the signals, the instrument being ready for use, the adjustment and sighting being effected in the same manner as in instruments of this class heretofore used, whether the extensions D' of the cross-bar D are employed or not.

Of course when the extensions D' are used the sight-rods are shifted and connected thereto by means of their thumb or set screws g^3, as mentioned hereinbefore.

Any other convenient or well-known mode of connecting the extensions D' to and adjusting the same on the cross-bar D may be adopted in lieu of that described.

We have hereinbefore stated that in instruments of this class long messages cannot conveniently be transmitted, by reason of the inability of the receiver to correctly memorize the same. To avoid this we employ a recording-instrument constructed on the principle of the Morse recorder, only instead of one key we employ two or more, according to the number of signals simultaneously to be exposed to view to form a symbol of given magnitude.

In the instrument above described, the magnitude of a symbol being expressed by the exposition to view of one signal, or by the simultaneous exposition to view of two signals, two keys will be sufficient, though more can be used, as will hereinafter appear. This recording-instrument is supported from bracket-arms d^4, secured to the cross-bar D on opposite sides of the standard A′, the table or shelf h, on which the instrument stands or to which it is secured, being suitably recessed to fit over one of the legs of the tripod, as shown in Fig. 4. The recording-instrument itself consists, essentially, and as more plainly shown in Figs. 18 and 19, of a box or inclosing-case, M′, containg a spool, N′, upon which is wound a fillet or strip of paper, N, a cylinder, O, that has as many peripheral grooves o as there are keys, over which cylinder the fillet of paper N is caused to move, of feeding-rolls O′, between which the fillet of paper passes and by which it is fed through a slit, m', in the front wall of the inclosing-case M′, and by which feed-rolls it is unwound from the spool N′, and a train of clock-work, N^2, for rotating the grooved cylinder and feed-rolls, or one of the latter. The keys M are arranged on top of the box and project through the same on a line with the grooves in the cylinder O, and they terminate in points $M^{\times}$, that register with said grooves, as more plainly shown in Fig. 19. When an operator receives a message, he depresses one or both keys, according to the symbols transmitted to him. Thus, if he is to record the words "Move in" of a sentence, he twice depresses the two keys simultaneously, a coiled spring, m, around the key-stem returning the keys into their normal position. This operation will produce four perforations, two on a line, in the strip of paper, that will indicate the two symbols or dashes of the letter "M." The same operation repeated three times will produce three rows of double perforations or punctures to indicate the three symbols or dashes of the letter "o." He next depresses one key three times in succession and then both keys simultaneously, to produce three successive single and one double perforation to indicate the symbols or three dots and a dash of the letter "v;" and, finally, he depresses one key to produce the symbol or dot of the letter "e," and so on for the word "in" and the remaining words of the message, as will be readily understood.

Instead of providing the keys with a perforator they may be provided with a pencil or other device for making a mark on instead of making it in the paper fillet.

S is a stop-pin adapted to engage the fly of the train of clock-gearing to arrest the movement thereof when the instrument is not in use. An operator is thus enabled to receive messages of any length and obtain a permanent record thereof for transcription, comparison, and preservation, and it will be readily seen that even with the instrument in its simplest form messages may be transmitted and received with almost absolute correctness.

The range of usefulness of this instrument may, however, be increased considerably, so that it may be employed for transmitting signals to different stations successively, whether by day or by night, a preconcerted signal being given to the station last communicated with that the operator is about to communicate with another station.

By means of this instrument messages may be transmitted and received without possibility of error, the symbols that form the letters of the code being formed by a varying number of signals exposed to view simultaneously. For instance, in the Morse code there are symbols of three different magnitudes—the long dash of the "l," the shorter dash of the "t" and other letters, and the dot. These symbols we propose to indicate by the simultaneous exposition to view of three signals for the longer dash, two for the shorter dash, and one for the dot, so that there cannot be a possibility of an error in transmitting or receiving, a fourth signal being used for any desired purpose, such as signaling changes of position or when it is desired to signal with another station, or for any other purpose. In this construction of instrument a recording-instrument having three, and, if desired, four, keys will be employed. This construction we will now describe, referring more particularly to Figs. 13, 14, 15, 16, and 17; but in order to adapt the instrument for convenient signaling to different stations it is necessary that the parts supported from the tripod A should be capable of rotation thereon. This we effect as follows, and as more plainly shown in Figs. 13 and 15: The cross-bar D has a central enlargement, d^6, to which are secured the bracket-arms d^4, that support the recording-instrument, so as to adapt it to rotate around the tripod A, which, instead of being provided with a screw-threaded rod, a^4, as hereinbefore stated, is provided with a rod or standard, a^{14}, on which is fitted a bearing-sleeve, D^2, secured against rotation thereon by means of a set-screw, D^3. If desired, the bearing D^2 may form an integral part of the cross-bar D. At its upper end the bearing D^2 has a seat-flange, d^5, upon which is seated a compass-card, P, rigidly secured to standard a^{14}, and on the compass-card is seated the standard or rod B that supports the telescope C′, Figs. 13, 16, and 17, said standard being likewise secured in position on the standard a^{14} by means of a thumb-screw, b'. The telescope C′ in this construction is pivotally connected with its supporting-rod B through the medium of the clamping device, and said rod, instead of having a screw-threaded extension, h, has a socket, so as to fit on the standard a^{14}, on which it is revoluble for the purpose of positioning the telescope in taking the bearings of a station, and when positioned said support is locked against rotation on the standard by means of a set-screw, b'.

The rod B is slotted for the passage of a quadrant, Q, that is connected with the telescope in any usual manner. As shown, the connection is made by a clamp, q, and when the telescope is adjusted in measuring angles it is secured in position by means of a set or binding screw, q', impinging upon the quadrant, as shown in Fig. 13. From the foot of the rod B, that supports the telescope, projects a pointer, b^2, that extends over the compass card P, for obvious purposes.

By means of the construction, arrangement, and connection of the several parts just described and shown in reference to Figs. 13 to 17 the entire system, except the compass-card P, is capable of rotation on its support A, and may therefore be turned in any direction when it is desired to communicate with several stations. By taking the bearings of such several stations in the day-time and noting them down the instrument may be readily adjusted for transmitting messages to any one of such stations by day or night, and this is a very important improvement in our apparatus.

The length of the cross-bar D in this instrument is proportionately increased, so as to carry four signal-supporting bars E instead of two, whereby three or four signals may be exposed to view simultaneously, as hereinbefore mentioned, extension-bars D′ being used for increasing the visual range at which such signals may be separately distinguished, as hereinbefore described.

The sighting-rods are pivoted between the two bars E, on opposite sides of the instrument, and said rods may be used at either end of the bars E for sighting purposes, and telescopic or other sighting-rods may be employed, as hereinbefore described. Such rods as described in reference to Figs. 8, 9, 10, and 11 are preferably used.

The cross-bar D, at the point where the bars E are supported, is provided with a half-circle, P′, graduated to one hundred and eighty degrees, the chord of which lies in the plane of the axis of the bars E, and each of the latter bars carries a pointer, e^4, by means of which devices, when the bearings of one or more stations have been taken and noted down, the signaling devices may be adjusted without having recourse to the sighting-rods for communicating signals to any one of such stations.

As the greatest magnitude of the symbols of the code in this instrument is represented by at least three signals, three keys are necessary to operate the screens thereof, though we prefer four, for purposes previously stated. These keys are arranged as shown more plainly in Fig. 14, the second pair of keys, K′, lying immediately below the first pair, K, the brackets H having a second set of pendent bearings, h^2.

As the screen-carriers L′ of the lower set of keys, K′, lie immediately below the screen-carries L of the upper set of keys, and to adapt them to operate their respective screens properly, they extend under the inner signal-carriers E, their cylindrical shank to which the screen is attached being bent at right angles, or approximately so, to the body of the screen-carrier, and then horizontally, so that the horizontal portion that carries the screen will rest on the outer signal-carrier bar E, as shown in Fig. 12. Extensions D′ for the cross-bar D are here also employed for purposes already stated.

It is obvious that in the construction described the telescope C′ may be readily removed and a surveying-instrument applied instead.

The recording-instrument in this case has three or four keys, a fillet of paper of corresponding width, and a cylinder having a corresponding number of grooves being employed, as will be readily understood, and as shown in Fig. 18. This recording-instrument is supported from a bracket secured to the enlargement d^6, so as to adapt it to rotate with the cross-bar D, and be maintained in proper position relatively to the keys K K′, so that the operator may, if necessary, transmit and receive simultaneously. This he can readily do by manipulating the keys K K′ with one hand and those of the recording-instrument with the other. For this reason we have arranged the keys in pairs, one above the other, and the two keys of each pair as close together as possible, so that but two fingers will be required to operate the four keys simultaneously or independently, each finger lying on a pair of keys. By depressing the two pairs of keys four signals will be simultaneously exposed to view, and by moving the finger backward and forward on the keys, one or more, or all of them, may be depressed.

By means of our improved instruments a rapidity of transmission and reception of speech or messages may be attained equal to that attained in telegraphy, and with as great if not greater accuracy.

From the description of the construction of the apparatus it will be seen that all its parts are detachably connected together for convenience of packing the same for transportation.

Having now particularly described our invention and in what manner the same is operated, what we claim is—

1. A helio-telegraph comprising a tripod or other support, a cross-bar mounted thereon, and a plurality of signal-carrying bars connected at their longitudinal center to and adjustable on said cross-bar, for the purpose of producing a plurality of signals simultaneously, substantially as and for the purposes specified.

2. A helio-telegraph comprising a tripod or other support, a standard projecting vertically therefrom, a cross-bar revoluble on the support around said standard, a plurality of signal-

carrying bars connected with and adjustable on the cross-bar, an optical instrument mounted and revoluble on the standard, and locking devices to lock the said parts against revolution, for the purpose of locating the receiving-station and positioning the signal-carrying bars in long-distance signaling, substantially as described.

3. In a helio-telegraph, the combination of a support with an extensible cross-bar and a plurality of signal-carrying bars connected with and adjustable on the cross-bar, substantially as and for the purpose specified.

4. In a helio-telegraph, the combination of a suitable support and an extensible cross-bar rotatably connected therewith with two or more signal-carrying bars adjustably connected with and rotatable on said cross-bar, substantially as and for the purpose specified.

5. In a helio-telegraph, the combination of a supporting-standard and a compass-card rigidly secured thereto with an extensible cross-bar, two or more signal-carrying bars adjustably connected with said cross-bar, and a telescope or geodetic instrument rotatably mounted on said standard, substantially as and for the purpose specified.

6. In a helio-telegraph, the combination, with the support, a cross-bar connected therewith, and signal-carrying bars connected with and adjustable on the cross-bar, of a sight-rod carrier pivoted to the cross-bar and adjustable relatively to the signal-carrying bar, substantially as described, for the purpose specified.

7. In a helio-telegraph, the combination of the support, a cross-bar connected therewith, and a signal-carrying bar pivoted to the cross-bar and adjustable as to length and relatively to the signal-carrying bar, substantially as and for the purpose specified.

8. In a helio-telegraph, two signal-carriers constructed to carry a signaling device at either end, and a support for said carriers, and a sight-rod carrier pivoted to the said support intermediate of the signal-carriers and adapted to be swung to either end thereof, substantially as and for the purpose specified.

9. A helio-telegraph comprising a support, a cross-bar connected therewith, a signal-carrying bar connected with and adjustable on the cross-bar, and a sighting-rod-carrying bar connected with and adjustable on the cross-bar relatively to the signal-carrying bar, whereby said sighting-rod carrier may be adjusted to bring the sight-rod to either end of the signal-carrying bar, substantially as described.

10. In a helio-telegraph, the combination, with a plurality of revoluble signal-carrying bars constructed to carry a signal at either end, of a sighting-rod carrier for each two signal-carrying bars, adjustable relatively to the opposite ends of the bars for the purpose of using the sighting-rod at either end of said bars, substantially as and for the purpose specified.

11. A helio-telegraph comprising a support, a cross-bar connected therewith, a signal-carrying bar connected with and adjustable on the cross-bar, a sighting-rod carrier connected with the cross-bar, and a sighting-rod adjustable vertically in the end of the carrier, said carrier being connected with the cross-bar and adjustable relatively to the signal-carrying bars to bring the sighting to either end thereof, substantially as and for the purpose specified.

12. In a helio-telegraph, the combination, with the sighting-rod carrier, of a sleeve, g', fitted in a suitable bearing in said carrier, a revoluble toothed pinion mounted on said sleeve, and a sighting-rod extending through the sleeve and having teeth meshing with the teeth of the pinion, substantially as and for the purpose specified.

13. A helio-telegraph comprising a support, a signal-carrier adjustably connected therewith and provided at either end with a transverse slot, a sighting-rod carrier adjustable independently of and relatively to the signal-carrier, and a sighting-rod adjustable vertically in a bearing in the sighting-rod carrier and in the transverse slot of the signal-carrier, substantially as and for the purpose specified.

14. In a helio-telegraph, the combination, with a tripod or other support, a signal-carrier connected therewith, and the signaling device connected with the carrier, of a screen-carrier consisting of an articulated rod, to one end of which the screen is secured, and terminating at the other end in a finger-key pivotally connected with the support.

15. In a helio-telegraph, the combination, with a tripod or other support, a signal-carrier connected therewith, and the signaling device connected with the carrier, of a screen and a screen-carrier comprising an articulated extensible rod, to one end of which the screen is secured, and terminating at the other end in a finger-key pivotally connected with the support, substantially as and for the purpose specified.

16. In a helio-telegraph, the combination, with a tripod or other support, a signal-carrier connected therewith, and a signaling device connected with the carrier, of a screen, a screen-carrier comprising an articulated extensible rod, to one end of which the screen is secured, and a finger-key pivoted on the support to which the other end of said rod is adjustably and detachably connected, substantially as and for the purpose specified.

17. In a helio-telegraph, the combination, with the signaling devices, the signal-carrier, and the support therefor, of a screen, a screen-carrier, a bearing in which said carrier is revoluble, a locking device to lock the screen-carrier against rotation, said bearing being pivotally connected with the helio-telegraph support, substantially as and for the purpose specified.

18. In a helio-telegraph, the combination, substantially as herein described, with a suitable support, a cross-bar connected therewith, and two or more signal-carrying bars supported from said cross-bar, of two or more

screens and key-levers for operating the said screens, substantially as and for the purpose specified.

19. In a helio-telegraph, the combination, with a suitable support, an extensible cross-bar connected therewith, and two or more signal-carrying bars supported from and adjustable on said extensible cross-bar, of extensible screen-carriers, substantially as and for the purpose specified.

20. In a helio-telegraph, the combination of a suitable support with an extensible cross-bar rotatably mounted thereon, two or more signal-carrying bars supported from and adjustable on said cross-bar, two or more extensible screen-carriers, and key-levers supported from the cross-bar for operating the screen-carriers, substantially as and for the purpose specified.

21. A helio-telegraph comprising a support, a signal-carrier mounted thereon, signaling devices connected with and adjustable on the carrier, and a recording-instrument connected with and adjustable on the support relatively to the signal-carrier, substantially as and for the purpose specified.

22. A helio-telegraph comprising a tripod or other support, a signal-carrier connected with and revoluble on the support, signaling devices connected with the carrier, a screen for said signaling devices, and a recording-instrument for recording messages connected and revoluble with the carrier on the support, substantially as and for the purpose specified.

23. The herein-described improved helio-telegraph, consisting of a suitable support, a cross-bar arranged to rotate thereon, two or more signal-carrier bars, two or more screen-carriers, and two or more sight-rods adjustably connected with said cross-bar, a recording-instrument connected and arranged to rotate with the cross-bar, a compass-card rigidly connected with the support for the cross-bar, and a telescope or a geodetic instrument mounted and arranged to rotate on said support independently of the cross-bar, substantially as and for the purpose specified.

24. A helio-telegraph comprising a signal-carrier, a signaling device mounted with and adjustable thereon, a screen to screen the signaling device from or expose the same to view, geodetic instruments or appliances for taking the bearings, and a common support on which all said devices are revoluble, substantially as and for the purposes specified.

25. In a helio-telegraph, the combination, with a cross-bar rotatably mounted thereon and provided with the graduated scales P′, two or more signal-carrying bars, two or more sight-rods, and two or more screen-carriers supported from said cross-bar, of a stationary compass-card, a rotatable telescope, and a support common to all said devices, substantially as and for the purpose specified.

In testimony whereof we affix our signatures in presence of two witnesses.

JNO. P. FINLEY.
JAS. D. SMITH.

Witnesses:
GEO. M. FINCKEL,
HENRY ORTH.