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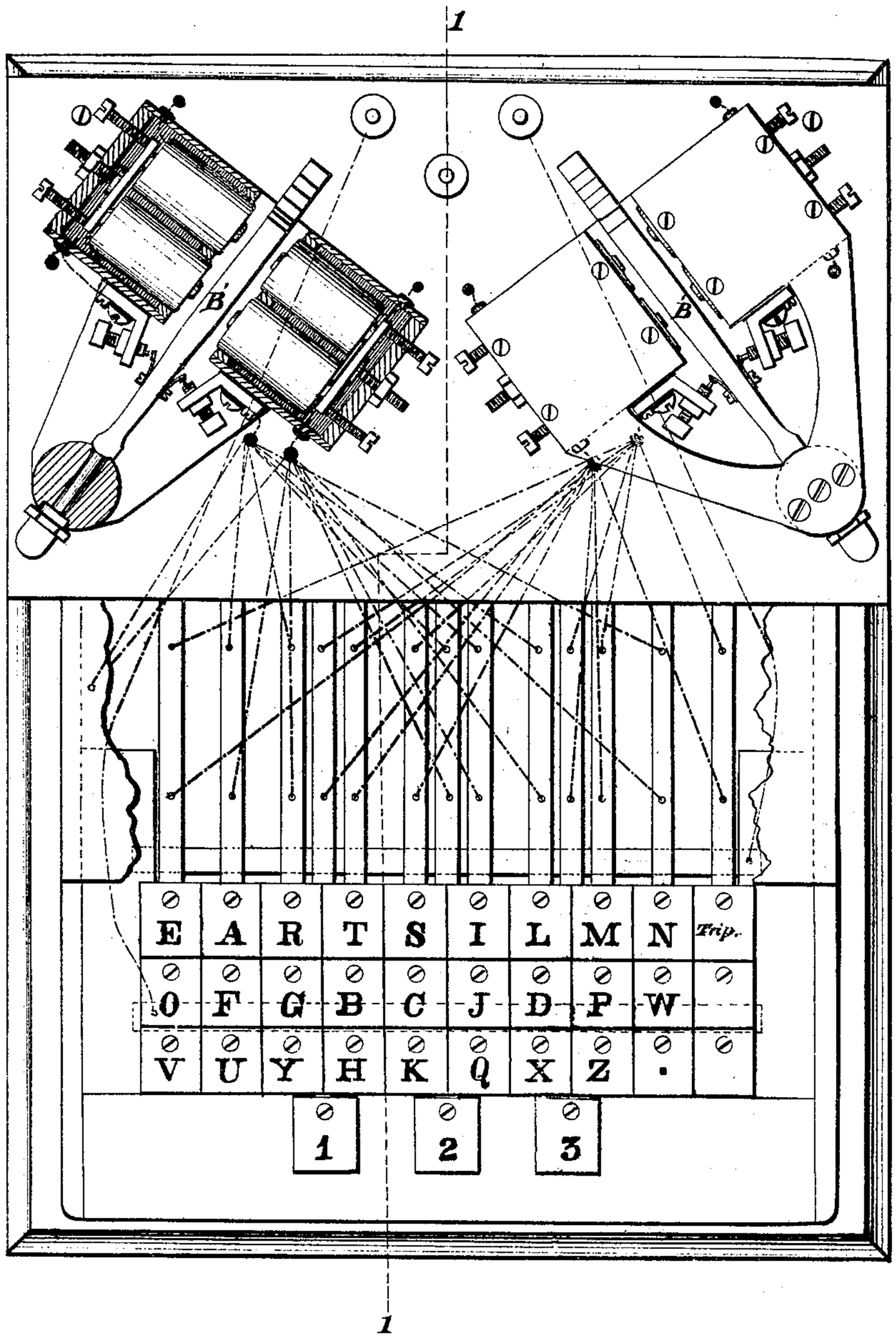
E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 1



WITNESSES

Wm A Skinkle

F. Fish

By his Attorney

INVENTOR

Elisha Gray

Wm D. Baldwin

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E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

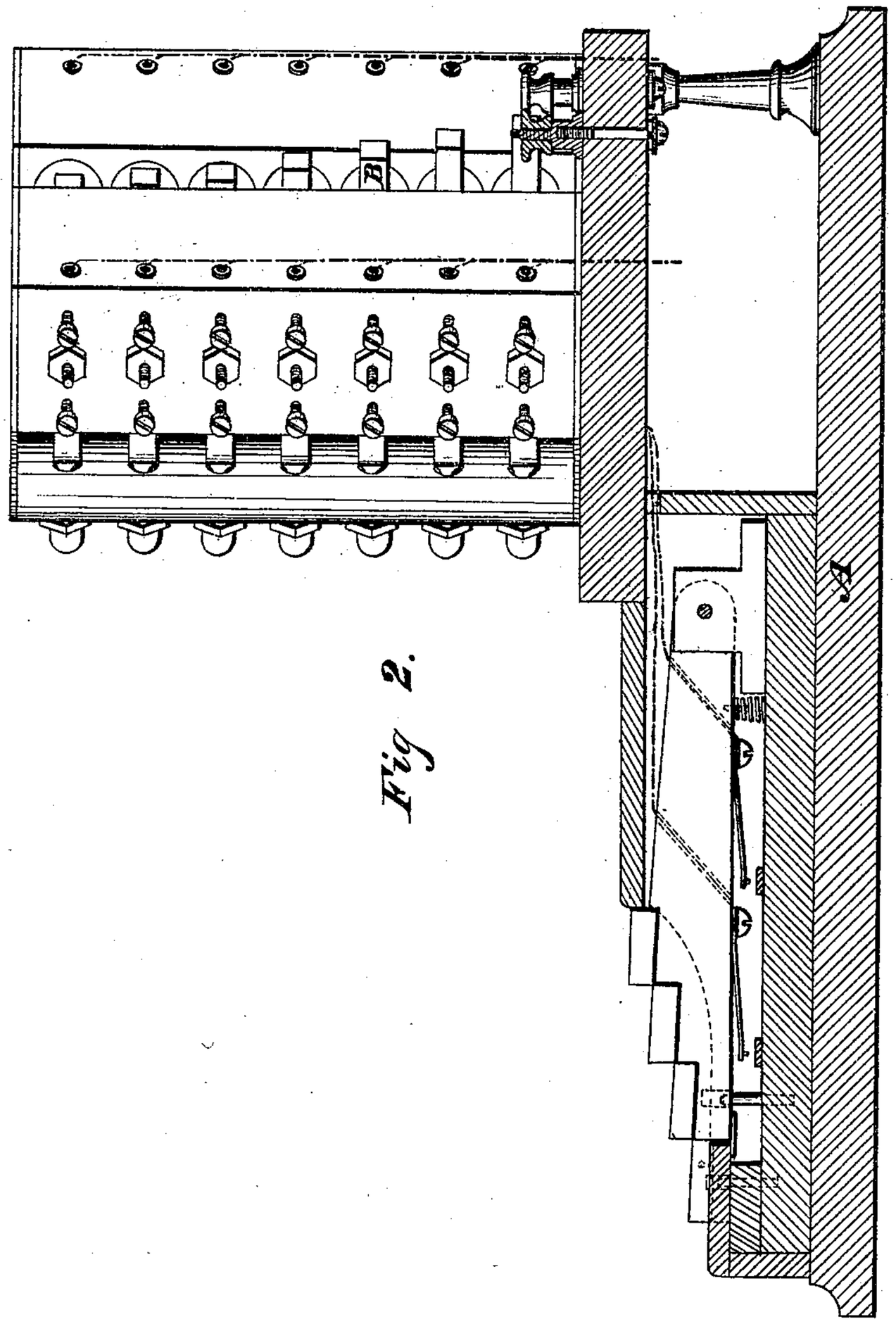


Fig 2.

WITNESSES

Wm A Skinkle
F Stich

By his Attorney

INVENTOR

Elisha Gray

Wm D. Baldwin

10 Sheets—Sheet 3.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 3

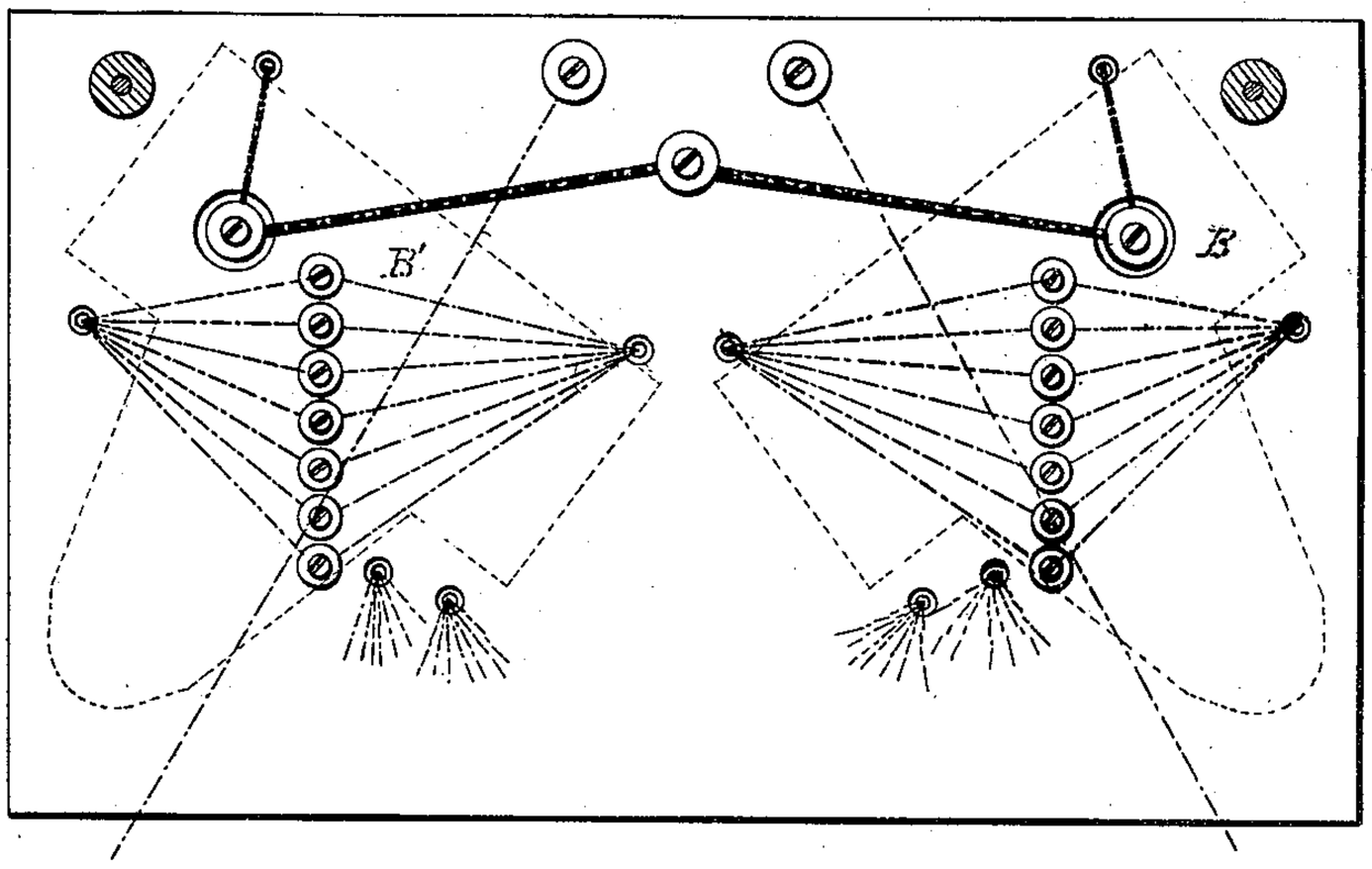


Fig 4.

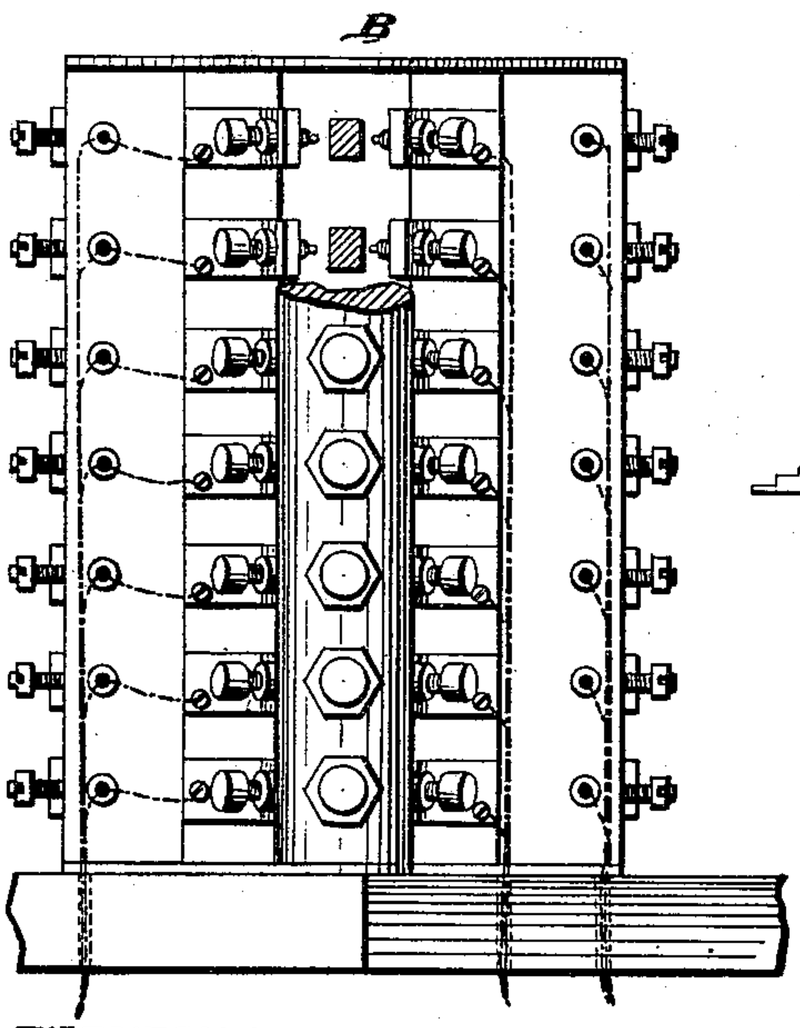
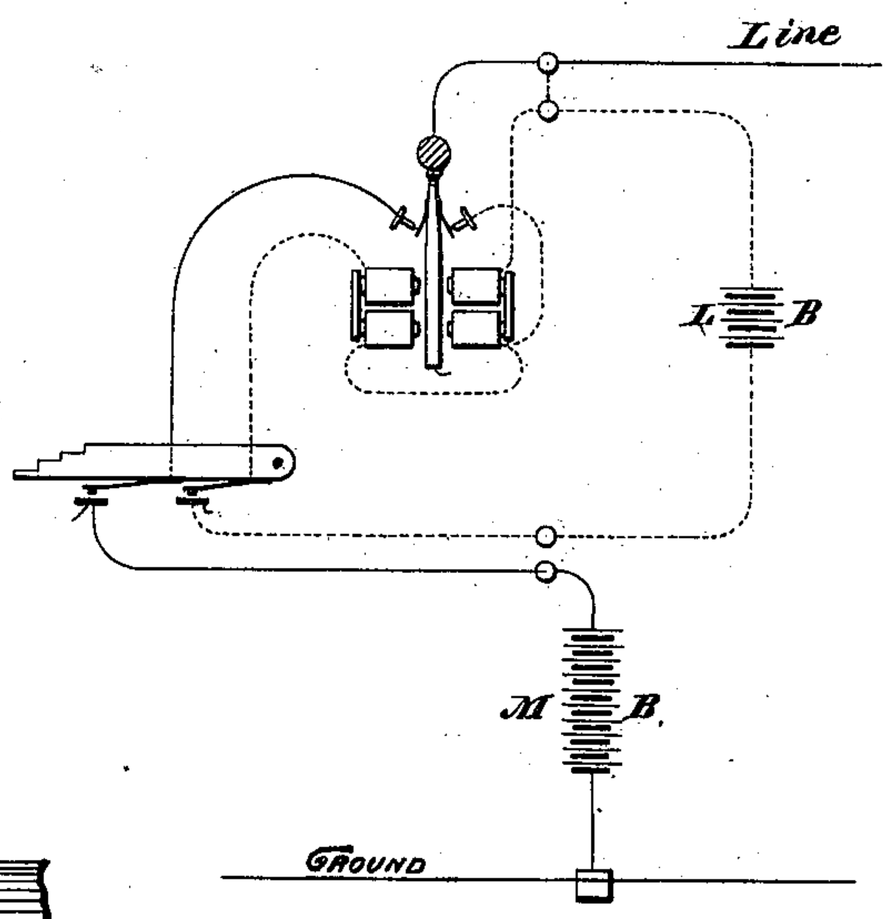


Fig 5



WITNESSES

Wm Askinkle
F. Stich

By Its *Attorney*

INVENTOR

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Wm D. Baldwin

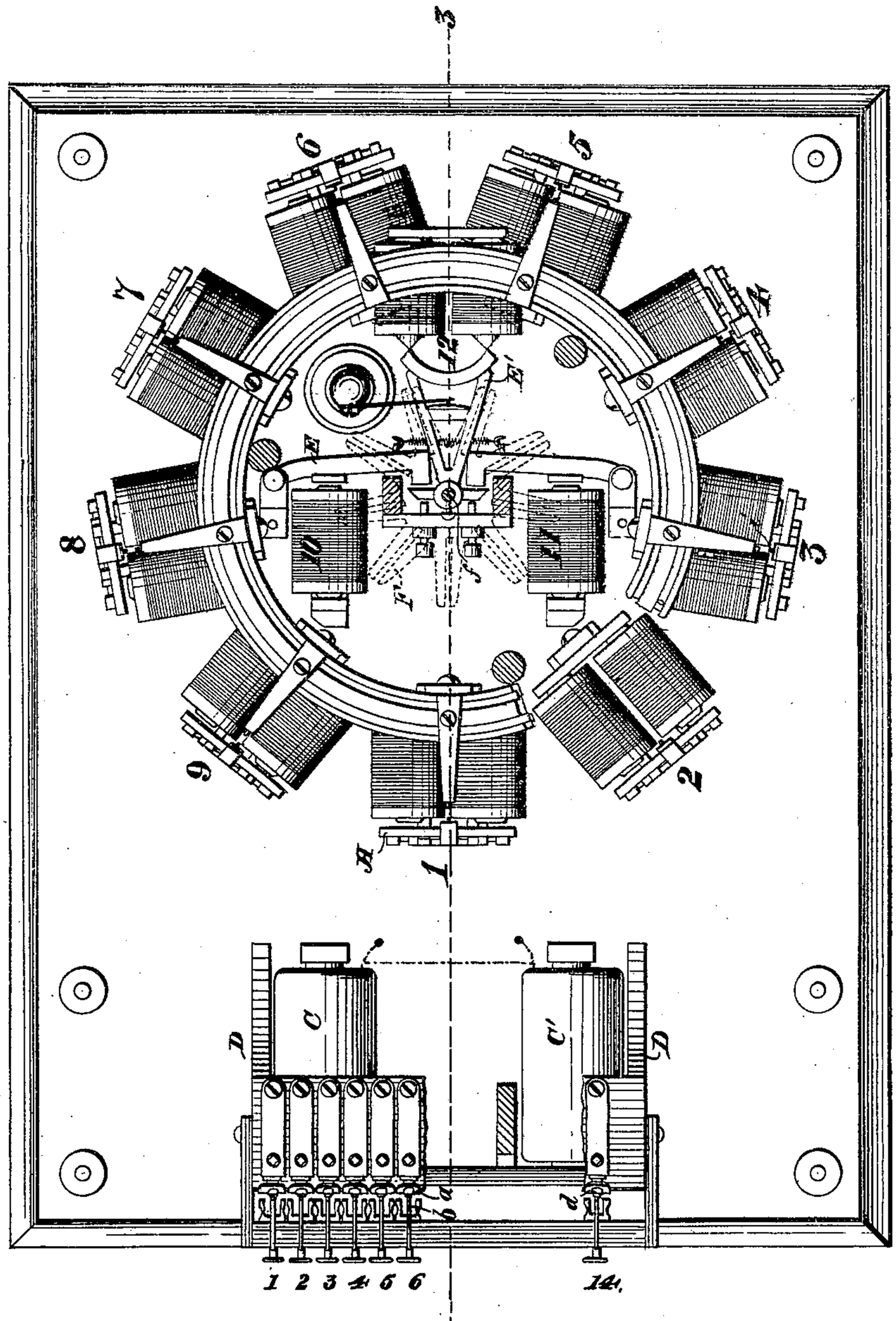
10 Sheets—Sheet 4.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 6.



WITNESSES

Wm A Skinkle
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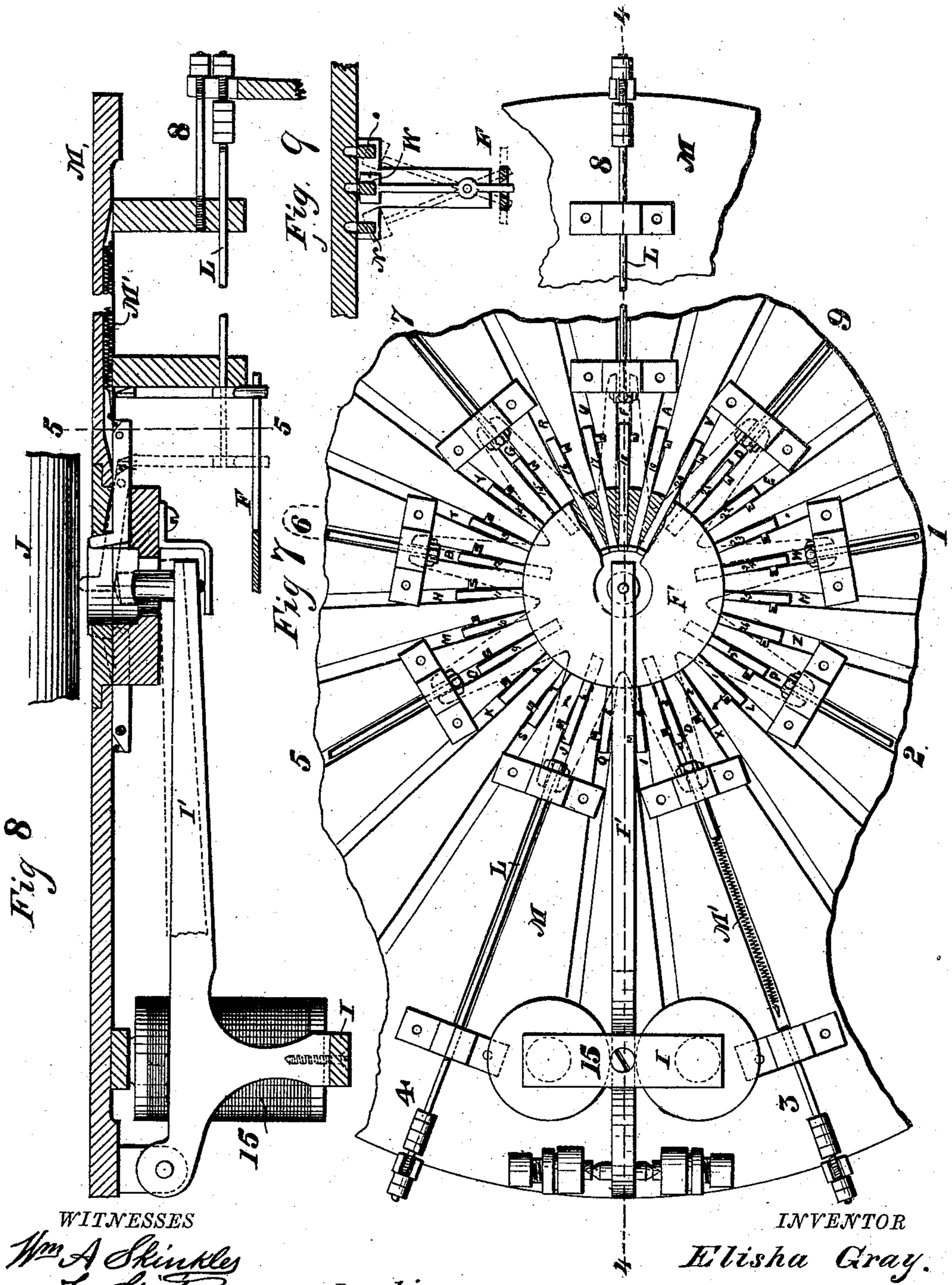

WITNESSES

Wm A Skinkle

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E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 22.

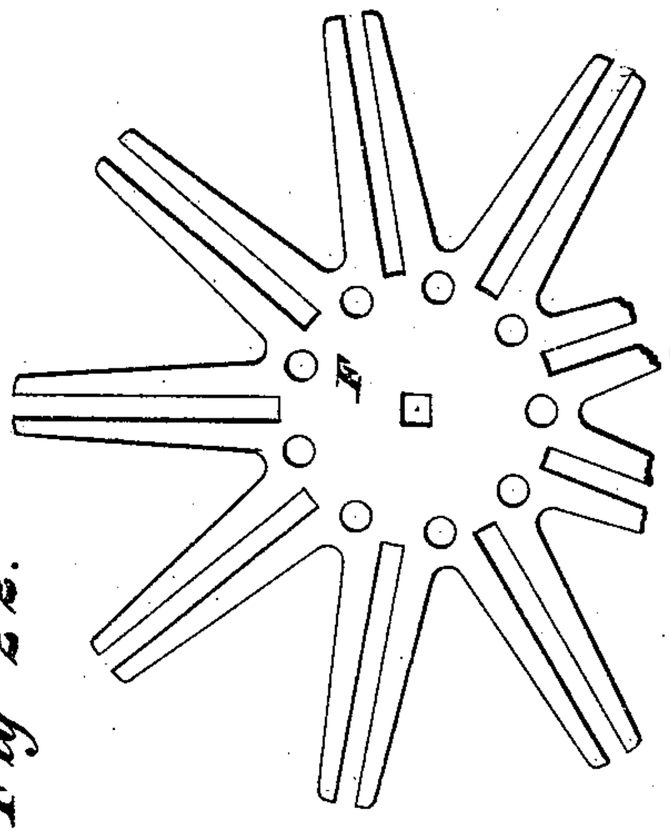

Fig 10.

WITNESSES

Wm A Skinkle

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Wm D. Baldwin

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E. GRAY.

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Fig 11

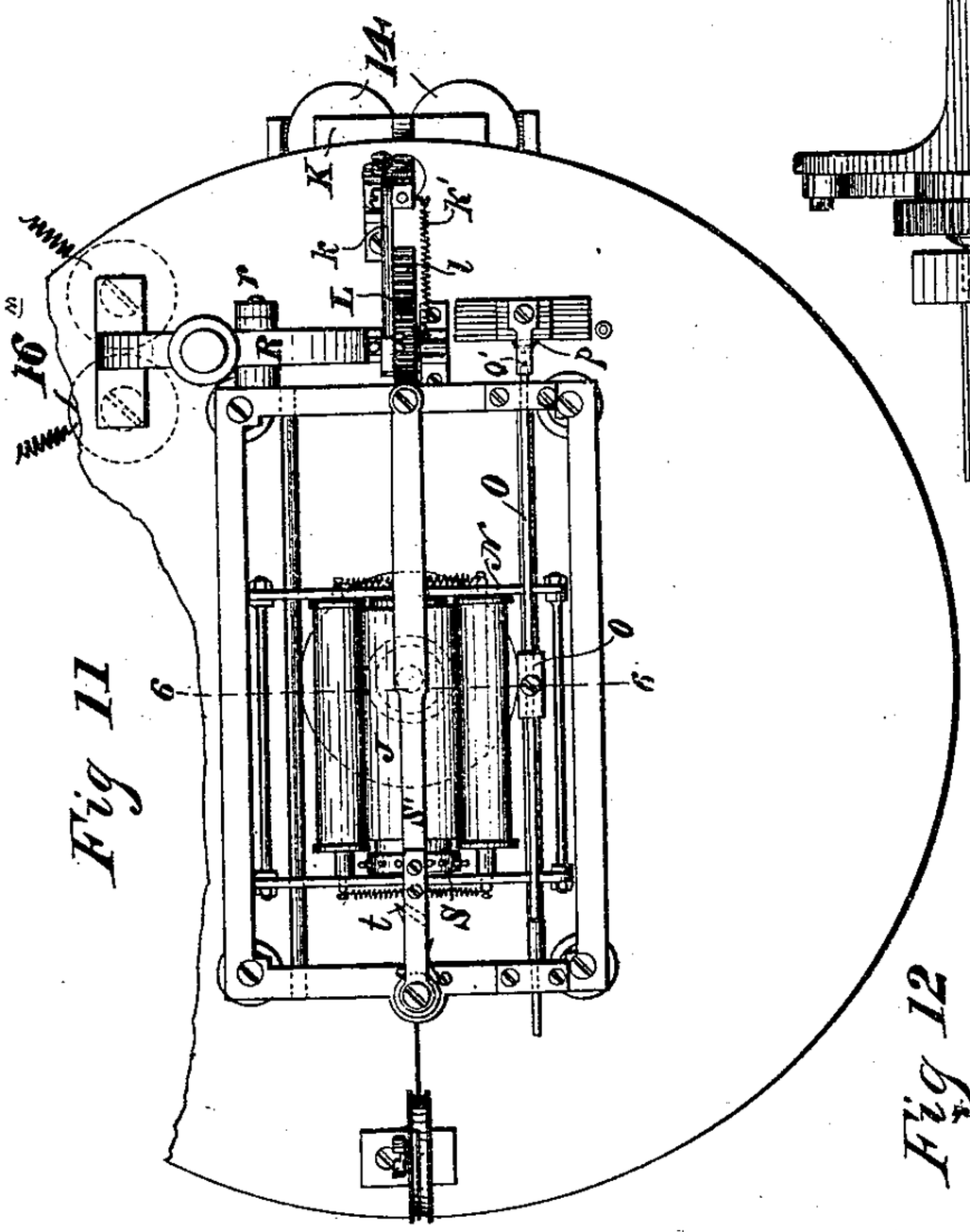

Fig 11ª

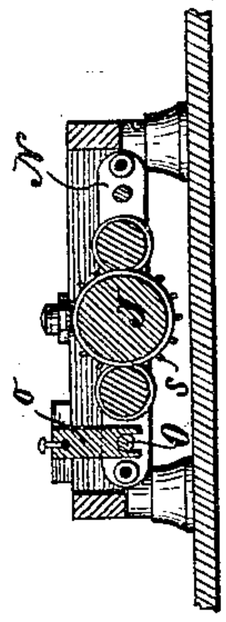

Fig 12

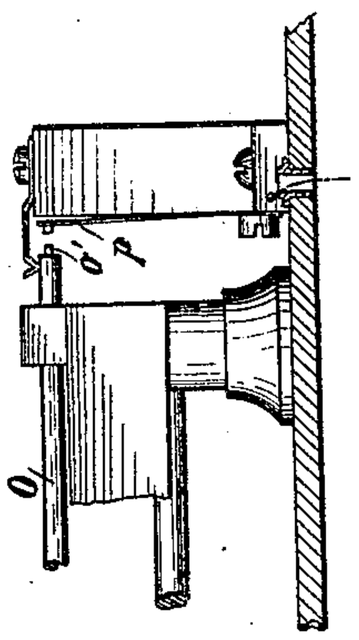

Fig 13

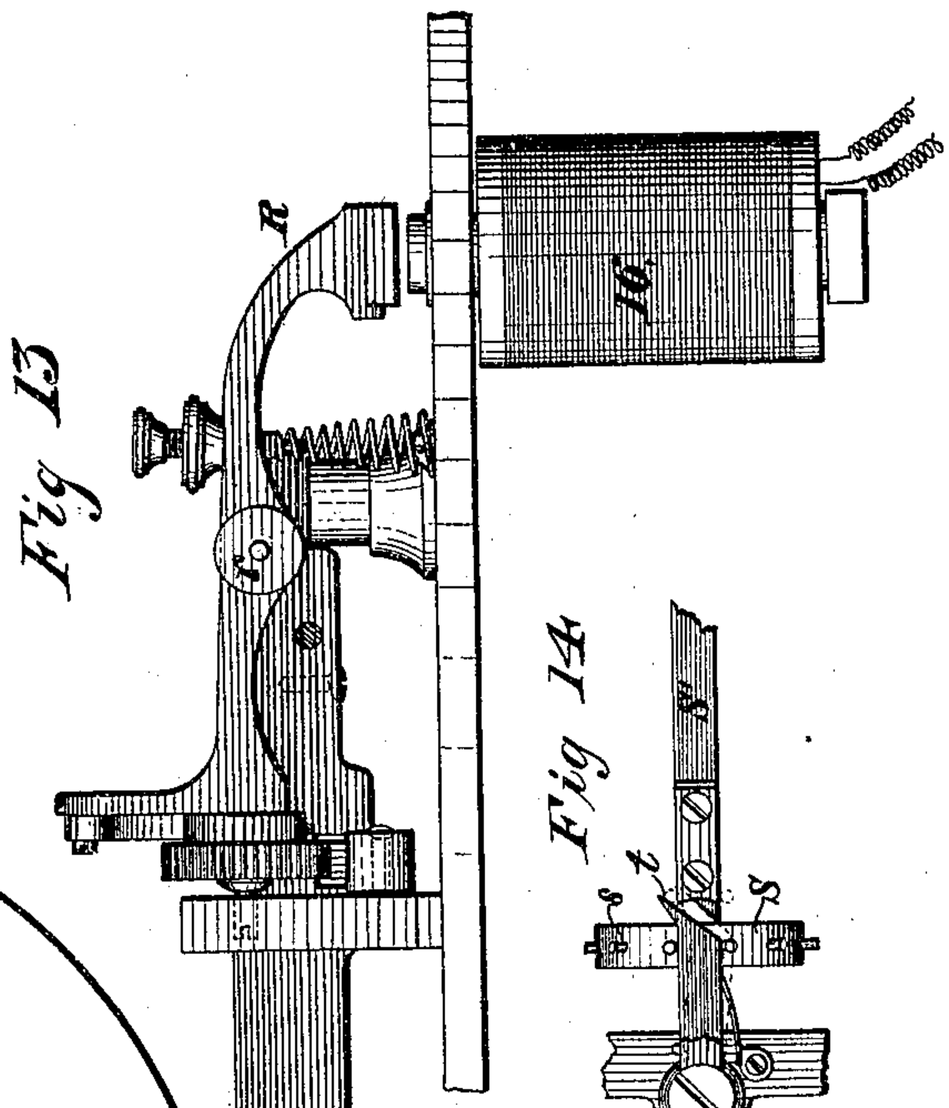

Fig 14

WITNESSES

Wm A Skinkle.

F. Stick

By his Attorney

INVENTOR

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Wm D. Baldwin

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E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 16.

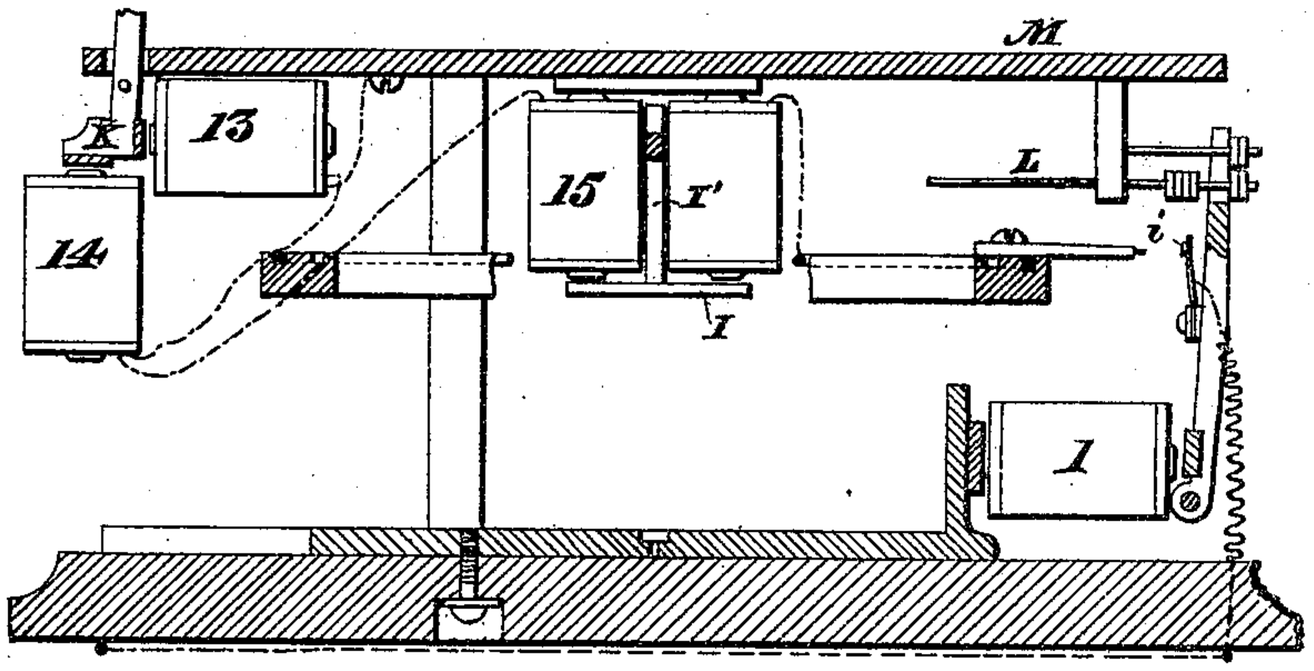
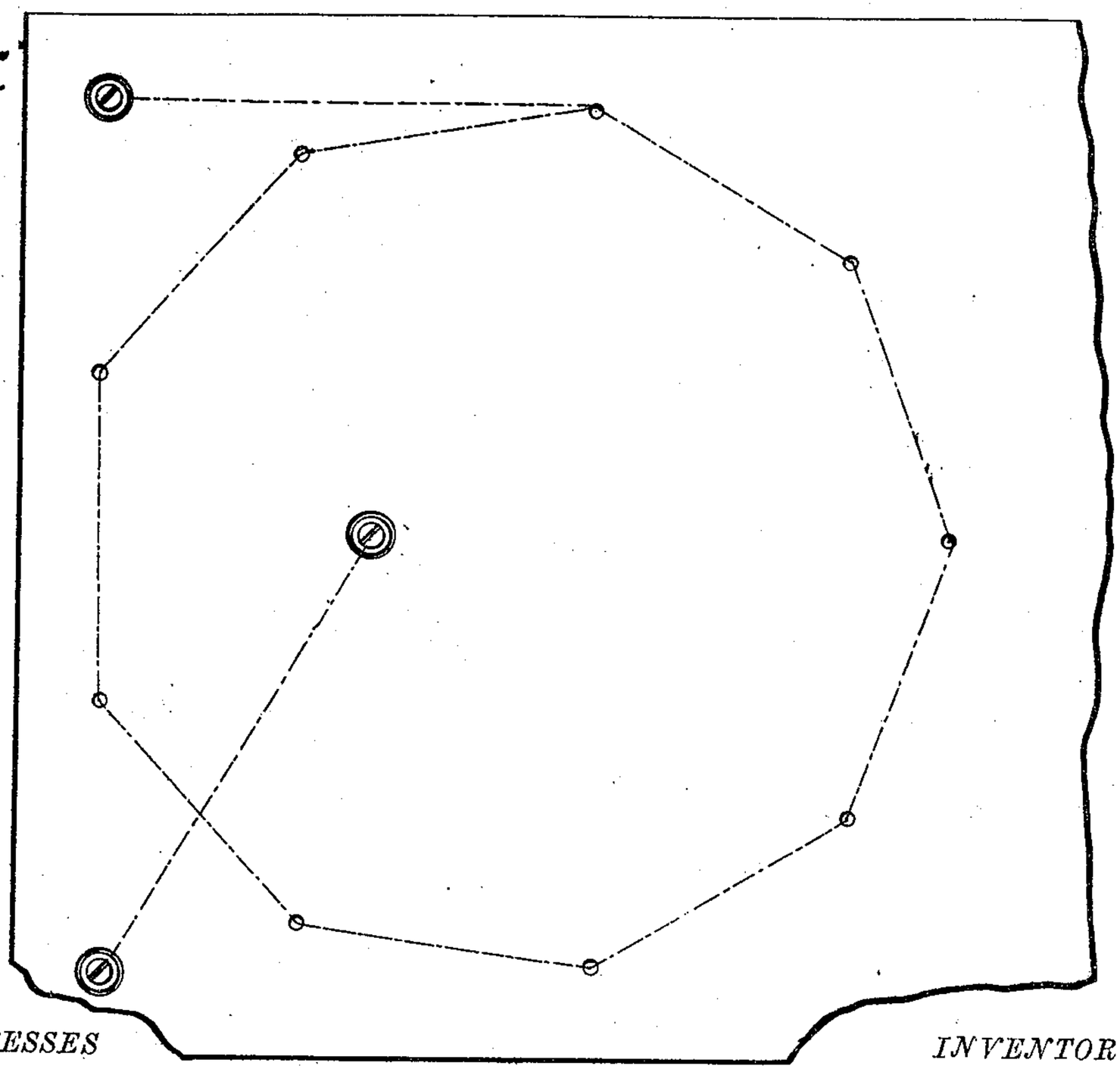


Fig 15.



WITNESSES

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E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

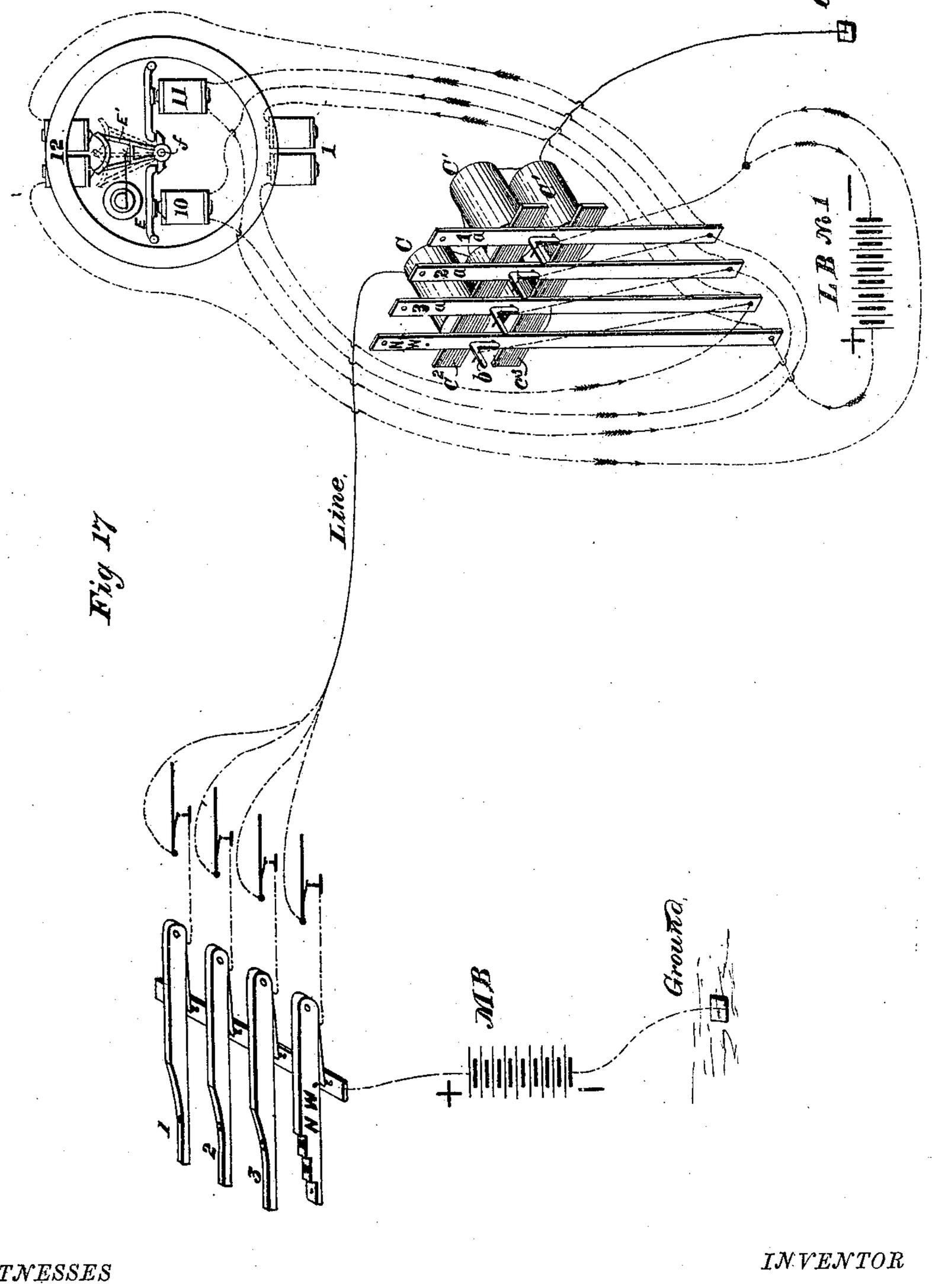

Fig 17

WITNESSES

Wm a Skinkle
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By his Attorney

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E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 19

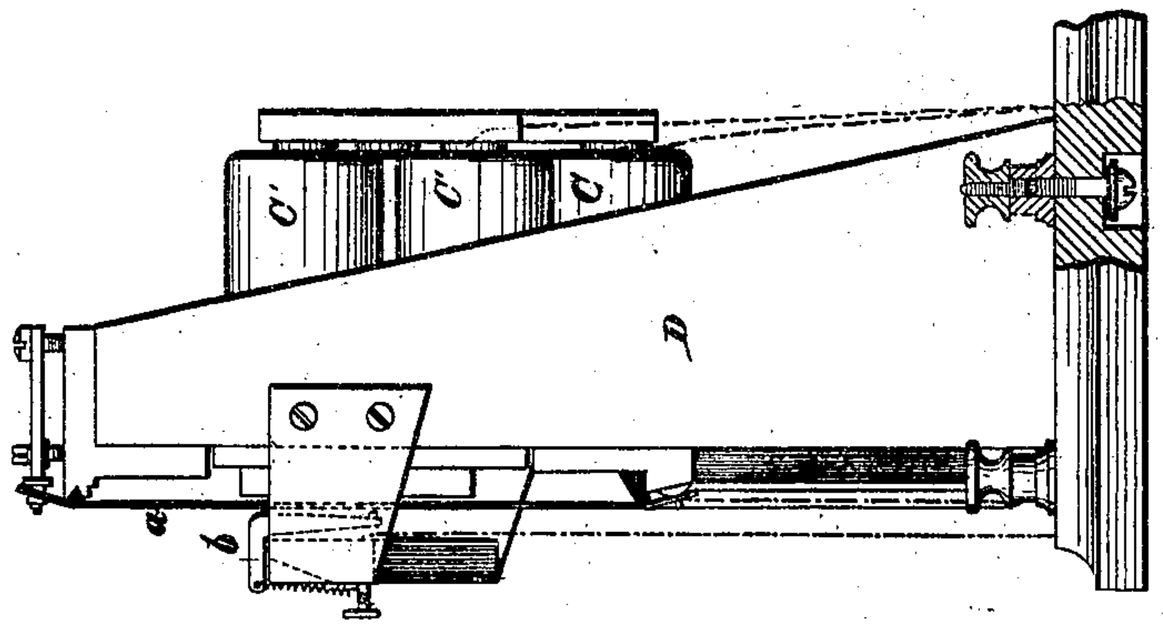


Fig 21.

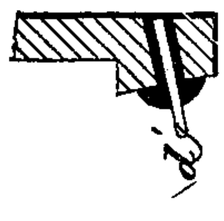


Fig 18

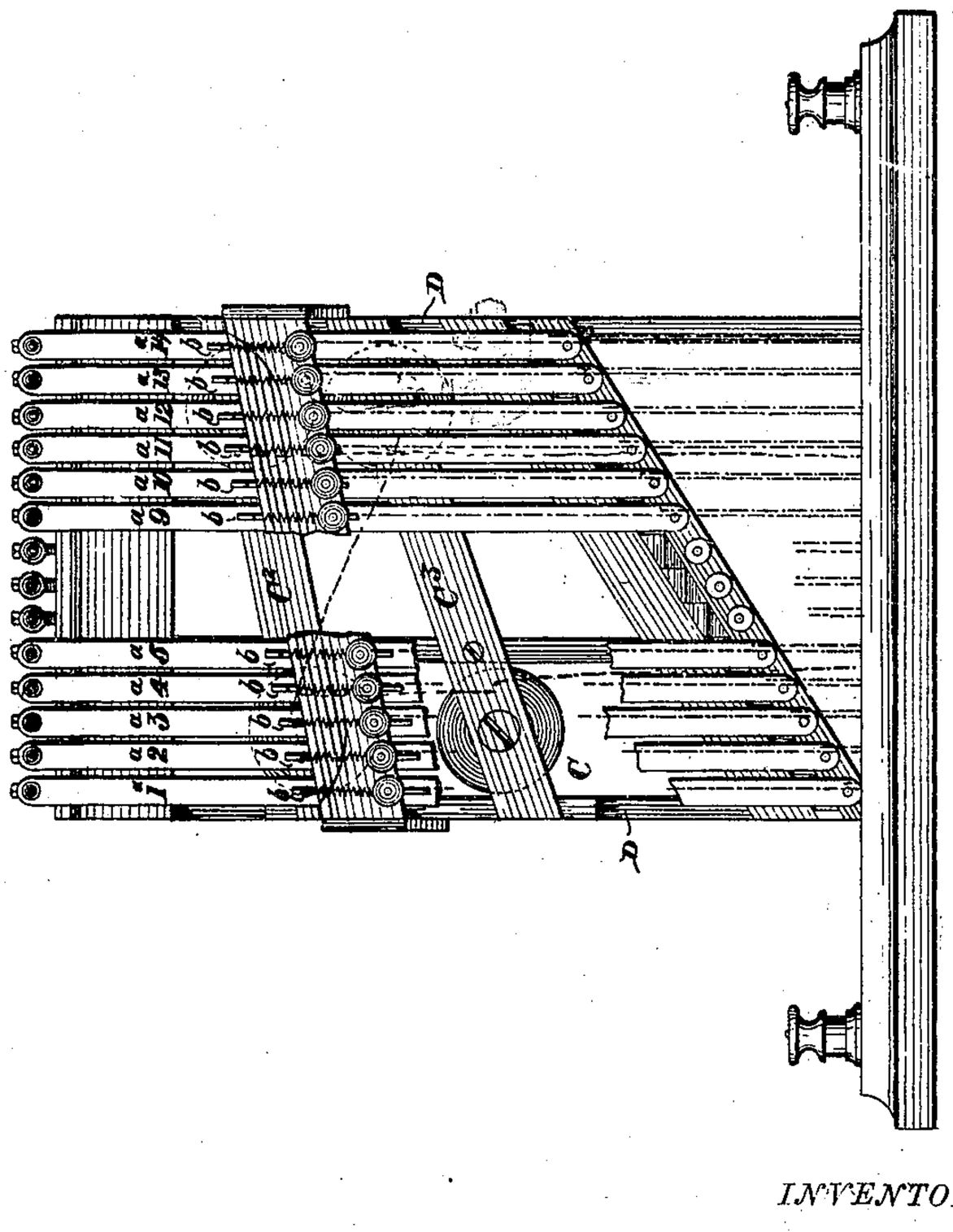
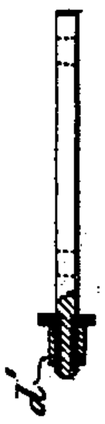


Fig 20



WITNESSES

Wm A Kinsley
F Smith

By his Attorney

INVENTOR

Elisha Gray.

Wm D Baldwin

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILL., ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE HARMONIC TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN ELECTRO-HARMONIC PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **179,549**, dated July 4, 1876; application filed April 12, 1876.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Art of Electro-Harmonic Telegraph-Printing and an Improved Electro-Harmonic Telegraph-Printing Apparatus, of which the following is a specification:

My present invention is based upon a system of electro-harmonic telegraphy described in sundry Letters Patent of the United States granted to me within the past year, and in various applications for Letters Patent of the United States made by me, and now pending.

The objects of invention are, first, to adapt my electro-harmonic system of telegraphy to the printing of a message by means of independently-movable type, and by means of mechanism thrown into action by the depression of a key at the transmitting-station, without necessitating the employment of isochronously-moving type-wheels, or of waiting for mechanism to register accurately before printing; second, to print a message on a letter-sheet, type-writer fashion, by the direct operation of keys at the transmitting-station controlling local batteries actuating the printing mechanism; third, to transmit a series of tones of different pitch through an electric circuit, each tone independently actuating a local battery, to print a letter, sign, or character corresponding with that of the particular key controlling the tone; fourth, to determine, in advance, through the action of a local battery, which one of a series of letters, numbers, or characters, actuated by a common motor, shall be printed; fifth, to determine, in advance, the point on the letter-sheet at which the printing of the message shall begin; sixth, to move a particular type to the point at which the printing is done, and there to make its impression upon the paper by means of mechanism thrown into action by the movement of the type itself; seventh, to feed the paper upon which the message is printed, by mechanism thrown into operation by the printing of the preceding letter; eighth, to determine, in advance, what particular letter of a series shall be printed, to actuate the printing mechanism by the movement of the particular type selected, and to actuate the feeding mechanism by the type thus selected; and, ninth, to control the printing mechanism by means of a compound magnet constituting, in fact, a single one.

These objects I attain by certain novel apparatus hereinafter set forth, the novel construction and combinations of which apparatus form a portion of the subject-matter of my invention, which is hereinafter specifically designated.

The accompanying drawings represent an apparatus embodying all my improvements in the best way now known to me. Obviously, however, the details of construction of the apparatus may be greatly varied in various ways without departing from the principle of my invention; and some of my improvements may be used without the others, and in apparatus differing in construction from that herein shown.

My improved apparatus consists of two main portions—a transmitter and a receiver.

Figure 1 represents a plan or top view of the transmitter, with portions of the casing removed, to show the internal construction more clearly. Fig. 2 represents a vertical longitudinal section through the transmitter, on the line 1 1 of Fig. 1. Fig. 3 is a bottom plan view of the transmitter, showing the method of running the circuits. Fig. 4 is a back view of one set of transmitting-reeds. Fig. 5 is a diagram showing the method of running the main and local circuits through a single transmitting-key and vibrating reed of a series. Fig. 6 is a plan or top view of the receiving apparatus, on the line 2 2 of Fig. 10. Fig. 7 is a bottom plan view of the top plate of the receiver. Fig. 8 is a vertical longitudinal section therethrough, on the line 4 4 of Fig. 7. Fig. 9 is a transverse section on the line 5 5 of Fig. 8. Fig. 10 is a vertical longitudinal section on the line 3 3 of Fig. 6. Fig. 11 is a top view of the apparatus for carrying the paper, and Fig. 11^a is a vertical transverse section therethrough on the line 6 6 of Fig. 11. Fig. 12 is a detail view of a portion of the local circuit-breaking mechanism which releases the paper-carrying mechanism. Fig. 13 is a similar view of another

portion of the same apparatus. Fig. 14 is a detail view of the paper-feeding apparatus for spacing the lines of the message. Fig. 15 is a bottom plan view of the parts shown in Fig. 6, showing the mode of running the circuits. Fig. 16 is a detail view showing the method of running the circuits of the printing and paper-feeding mechanism. Fig. 17 is a skeleton diagram of the receiving and transmitting mechanisms, showing the method of connecting the circuits. Fig. 18 is an end view, and Fig. 19 a side view, of the compound analyzing-receiver. Figs. 20 and 21 are detail views of the shunting-pins of the analyzing-spring, and Fig. 22 shows a plan view of a star-wheel, for actuating the type-shifting levers, detached.

The transmitting apparatus shown in the accompanying drawings is substantially similar, in its general construction, to that shown in Letters Patent of the United States, granted to me February 16, 1876, as No. 173,618, with the exception hereinafter stated.

In this instance the apparatus is designed for printing twenty-seven characters, and for operating a tripping apparatus, whereby the printing mechanism at the receiving end of the line may be automatically restored to its normal position during any portion of its operation of printing a line.

In order to avoid the complication of using twenty-eight different keys and their corresponding transmitting-reeds, I have devised means whereby the whole twenty-eight characters may be transmitted by the employment of nine primary keys, three shifting-keys, and a "trip-key," thus reducing the number of keys employed more than one-half.

The primary keys are each marked with three letters, numbers, or characters, and together with the trip-key and shifting-keys are arranged organ-fashion, as shown in Fig. 1, on a suitable base board or frame, A, upon which the transmitting-reeds are mounted, in the manner shown in the drawings.

In order to secure convenience of construction, and a compact arrangement, the series of transmitting-reeds are arranged in two sets, B B′, of similar construction mounted upon the base-board of the frame, as shown.

The broken lines in Fig. 1 represent the connection of the keys with the transmitters. Fig. 3 shows a view of the connections as arranged beneath the base-board directly under the transmitters. Fig. 5 shows a method in which the main and local batteries are connected with a single key and vibrating reed of the circuit. Each one is a duplicate of the other, and their circuit-connections are substantially similar to those shown and described in my patent of February 16, 1876, above-mentioned; and as they, moreover, will be readily understood from the figure, a detail description of the construction and operation of these parts is deemed unnecessary.

In the operation of this apparatus the circuit is normally open, but the depression of any key connects the main battery to line through its corresponding transmitter. Each of the thirteen keys above-mentioned has its own independent analyzer at the receiving end of the line.

In the present arrangement the organization is such that there are twenty-seven printing-type at the receiving-end of the line, corresponding with the lettered keys, as will hereinafter be more fully explained.

These type are arranged in sets of three, one of each set being operated by each lettered key. Which one of these three letters shall be printed is determined by depressing one of the shifting-keys 1 2 3, which operate the type-shifting mechanism of the receiver in such manner that, in the present instance, when the key 1 is depressed, the depression of the lettered keys will print the letters on the row included between the letters E and N in Fig. 1. When key 2 is depressed, the middle row of letters only will be printed at the receiving end of the line; and when key 3 is depressed, the type corresponding with the outer row only will be acted upon. When the key marked "trip" is depressed, it operates to restore the paper-carrying mechanism to its normal position or starting-point, as will be hereinafter more fully explained.

In the organization shown in the drawings, the keys 1 2 3 are operated independently of the lettered keys or trip-key; but when either of said numbered keys is depressed, it makes no difference where the lettered keys are touched, as they can only print the letter of the row corresponding with the numbered key depressed.

As a modification of this device I contemplate so constructing and combining the keys that each letter shall be mounted on an independent movable section, attached to the key by a movable connection, in such manner that when a particular letter is depressed it shall operate the correspondingly-numbered key, and thus cause it to shift the proper type without the necessity of touching both the lettered and the trip key, as is necessary under the organization shown in the drawings.

This result can readily be attained in two ways; first, by means of a contact-point on the key which shall close the circuit or tone of the properly-numbered key, thus actuating the type-shifter at the receiving end of the line before the lettered key closes its own circuit to actuate the type. This result may also be attained by combining levers or other suitable devices connecting each key with the contact-point of the numbered key, although I prefer the first-mentioned plan, as being less complicated.

The manner in which the transmitters and receivers are connected will readily be understood by inspection of Fig. 17, in which 1, 2, and 3 represent the numbered keys, and N W a lettered key. It should be stated, however, that the local battery of the transmitter is omitted in this figure, to avoid complication,

but it is shown in Fig. 5. The depression of either key closes both the main and local circuits of the transmitter, and sends to line vibrations or impulses of the electro-tone or vibrating reed corresponding with the key. These vibrations pass through the magnet C C^1 of the analyzing-receiver, and are reproduced on the corresponding vibrating tuned bar or reed 1 2 3 or N W. Each bar is provided with a circuit-breaking lever, *b*, vibrating more slowly than the bar, as described in Letters Patent No. 166,094, granted to me July 27, 1875. These circuit-breaking levers control a local battery, L B, No. 1, which remains normally closed, and is short-circuited through the vibrating bars or analyzing-springs and levers above mentioned. Each analyzing-spring is provided with a loop passing through a corresponding local magnet, 1, 10, 11, or 12, the terminals of which loop connect, respectively, to the analyzing spring and with its circuit breaking lever, so that when the circuit-breaking lever is out of contact with its vibrating-bar the shunt or short circuit is taken off from its corresponding magnet, and the current flows through the magnet; but when the vibrating bar and circuit-breakng lever are in contact, the shunt comes into play, and no current passes through the magnet.

The circuit-breaking devices, as above remarked, are shown in my patent of July 27, 1875; but the method of running the circuits and actuating the magnets herein shown is new.

Four vibrating bars only are shown in Fig. 17, to avoid complication; but it will, of course, be understood that the bars will correspond in number with their transmitting-keys—that is to say, in the present instance, there would be thirteen in number, each bar having its own loop and local magnet. In this instance nine magnets are employed for actuating the type—three for the shifting mechanism, and one for the tripping mechanism.

In Fig. 6 the relative arrangement of the nine type-actuating magnets, 1 to 9, and the shifting-magnets 10, 11, and 12 are clearly shown.

Having thus indicated in a general way the method of running the circuits, I will now proceed to describe the details of the receiving apparatus.

I will first describe the compound magnet C C^1, by which the vibrating bars are actuated.

In another application for Letters Patent of the United States filed by me simultaneously herewith, I have shown a different method of mounting a series of vibrating bars or analyzing-receivers, each tuned to a different pitch, upon a common magnet, so that each will analyze its own tone from a series simultaneously transmitted through the single magnet. I do not, therefore, broadly, claim in this application this device, except in combination with other mechanism not shown in the application above mentioned. In this instance the magnets C C^1 are mounted upon bars C^2 C^3 connecting their respective poles, and mounted in a frame, D, (see Figs. 18 and 19,) which also show a method of mounting the vibrating bars and circuit-breaking springs.

It should be observed that the bar marked 14 in Fig. 18 is inoperative in the organization hereinbefore described, having no corresponding transmitter. The bars are connected with the frame by means of insulated pins d^1 d^1, (shown in Figs. 20 and 21,) one set of pins being made adjustable, as shown in Figs. 18 and 19, by set-screws, or otherwise, and admit of the proper tuning of the bars to correspond with their transmitters.

I will now proceed to describe the organization I have effected for actuating the type-shifting and type-actuating mechanism, so as to cause one lever to actuate either one of three type.

Fig. 7 represents a plan view of the type-bed, showing a series of guideways or grooves radiating from a common center, in each of which a type slides freely endwise. In the present instance the organization is such that each type successively moves to a common center, and is struck up against a platen, to make an impression on the paper carried thereby, and is then retracted out of the way of the succeeding one, all these operations being performed automatically. In this instance the type is shown as made in the form of a bent lever, with the letter put on the end of the short arm of the lever, as moving forward radially to their working position, and then, being struck laterally to make their impression, retracting in the same way as they advanced.

The type are actuated by a vibrating shifter-lever, which I will now describe.

The details of the shifting mechanism are shown in Figs. 6, 7, 8, 9, 10, 17, and 22. In this instance the twenty-seven type shown in Fig. 7 are arranged in sets of three, corresponding with the respective transmitting-keys.

The operation of the type shifting and printing mechanism will readily be understood by reference to Fig. 17, which shows the three type-shifting keys 1 2 3 and a letter-key, N W. If it is desired to print the letter N, the key 1 is first depressed, thus sending vibrations to line synchronizing with the fundamental of the reed 3^a. This takes off the shunt from the corresponding loop at the point where the vibrating lever *b* comes in contact with the bar, and allows the current of the local battery to p ss through the magnet 10 of the series of shifting-magnets 10, 11, and 12. A lever, E, on the armature of this magnet is thus attracted toward it and vibrates a shifter-frame, E′, upon a vertical rock-shaft, *f*, carrying a star-wheel, F, having nine arms radially slotted to correspond with

each set of the type-actuating magnets 1 to 9, inclusive. On the armature of each of these magnets is mounted a rod, L, movable radially and endwise in the frame M, and carrying upon it a rocking shifter-bar projecting both above and below it. The lower end of this bar slides in the corresponding slot in the star-wheel above mentioned, while its upper end moves in a path coincident with one or the other of the type-slides in which it is adapted to work, as shown in Fig. 9.

Now, when the armature-lever E is attracted, as above explained, the rocking of the shifting-frame E′ causes a partial rotation of the star-wheel, which correspondently shifts the position of the whole series of shifter-bars. In this instance the bar described would be shifted to the position shown in dotted lines, Fig. 9, marked with the letter N, which would correspond with the position of that letter in Fig. 7, and each shifter-bar would occupy the same relation to the letters included between E and N of Fig. 1. Were the shifter-bar vertical or on the letter W each shifter-bar would occupy a corresponding relation to the middle row of letters in Fig. 1, and so in regard to the outer row. This movement takes place before the type-actuating mechanism begins to operate, and, consequently, this movement is exerted upon the type or series of types previously determined by the shifting mechanism.

The armature H of the magnet 1 is connected with and actuates the slide-bar above mentioned, which carries the shifter-bar. In this instance, as soon as the shifting-bar is shifted in line with the type N, the armature H is attracted by the magnet 1, which forces the sliding rod L and shifter forward against the type, thus driving it forward in its groove to the central point of the machine where the impression is made. At this moment a contact-point, *i*, on the armature H, strikes a point which closes the circuit of the independent local battery and actuates a series of electro-magnets, 15, 14, and 13, the two latter operating on one armature. The attraction of the armature I by the magnet 15 throws up a printing-lever, I′, which strikes the type up against the paper carried on a platen, J, and makes the impression at the same time the magnets 13 and 14 draw down their armature K, Fig. 10, which retracts the pawl *k* operating on a spur-pinion, L, gearing into a feeding-rack, *l*, connected with the paper-carrying mechanism. As soon as the key is released at the transmitting-station the circuit is shunted, thus releasing the type-actuating armature of the magnet 1, and breaking the circuit of the printing and paper-feeding magnets 13, 14, and 15, which allows the type to drop and be retracted by its spring M′ to its normal position. A spring, *k*′, then retracts the armature K of the magnets 13 and 14, forcing the pawl forward and actuating the feed-bar and moving the paper-carrying mechanism forward a distance sufficient to afford space for the next letter, in a manner similar to an ordinary writer. This process is repeated with each successive letter.

When the paper-carrying mechanism has been fed along a distance equal to the length of the line which the machine is adjusted to print, the feed-carriage N strikes a lug, *o*, on a sliding bar, O, and moves it endwise in its frame until its point *o*′ comes in contact with a spring, *p*, which closes the local battery of the magnet 16. This draws down an armature mounted on a lever, R, rocking on a pivot, *r*, and carrying the gear-wheel above mentioned, which actuates the feed-bar. The drawing down of the armature lifts this gear out of contact with the feed-bar, and the paper-carrying mechanism is immediately retracted by the spring F′. The platen in this instance consists of a roller around which the paper passes, which roller rotates in bearings in the sliding carriage. During its forward movement the platen is prevented from rotating by means of a series of pins, *s*, on a wheel, S, on the same axis as the platen, which pins pass on each side of a guide-bar, S′. On the backward movement of the sliding carriage, however, one of these pins strikes against a pivoted spring-switch, *t*, under the guide-bar, which deflects the pins and turns the platen a distance equal to that desired for the distance between the rows of type. On the next forward movement of the feeding-carriage the point of the spring-switch yields to allow the pin to pass without turning the platen, and as soon as the pins pass the point of the switch it is thrown open again by a spring in readiness for the next backward movement of the carriage after the printing of the line is completed.

The carriage can be thrown back at any desired point in the line by pressing the trip-key of the transmitter, which, through a corresponding analyzing-spring in the receiver, throws the local circuit into connection with the magnet 16 in the same manner as that described as taking place by the operation of the sliding bar, thus releasing the sliding carriage and allowing it to return to its starting-point.

It will thus be observed that the operator at the transmitting-station is not only enabled to print at the receiving-station any letter desired, and automatically to shift the paper to commence a new line, type-writer fashion, but he is also enabled to shift the sliding carriage at the receiving-station at will by means of his trip-key to commence a new line.

I propose to employ a ribbon fed between the paper and type by well-known mechanical means, such as commonly used in type-writers, which, to avoid complication, is not shown in the drawings, and which needs no description.

I contemplate using a web or long strip of paper, so as to dispense with the constant watching of the receiving instrument by the attendant, and by means of the trip-key above

mentioned the paper can be fed along so as to leave a space between each message to permit of their being separated and delivered without rewriting.

I am thus enabled by my invention not only to print a telegraph-message without the use of a type-wheel, and without the use of synchronously-moving step-by-step (or steadily-revolving) mechanism such as has heretofore been universally employed, so far as my knowledge extends, and thus save the time necessary for the type to come into position, the operator's ability to transmit being thus, by my invention, the only limit to the speed of the apparatus.

I am also enabled by my invention to print messages in the form of a page or letter-sheet in contradistinction to printing it in a single line and on a narrow strip, as heretofore has been the case.

I am further enabled to determine in advance, by the transmission of one tone, which one of a series of type shall move to make its impression, by throwing it into connection with mechanism actuated by the tone appropriated to the particular type to be printed.

I claim as my invention—

1. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in printing each letter at the receiving-station by the direct and instantaneous action of a local battery controlled by a key at the transmitting-station corresponding with said letter.

2. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in printing a message on a letter-sheet, type-writer fashion, by the direct operation of keys at the transmitting-station controlling local batteries actuating the printing mechanism.

3. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in transmitting tones of different pitch through an electric circuit by means of corresponding keys, and reproducing said tones at the receiving-station as a means of actuating local batteries controlling printing mechanism, which prints a letter corresponding with that of the key controlling the particular tone which throws the local battery into operation.

4. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in determining in advance, through the action of one local battery, which one of a series of letters, numbers, or characters shall be printed by mechanism actuated by another local battery.

5. The improved art of electro-harmonic telegraph-printing, which consists in determining in advance, by means of one local battery, the point at which the printing of the message, by another local battery, shall begin.

6. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in throwing forward a particular type to be printed by one local battery, and making an impression by that particular type by another local battery automatically thrown into action by the movement of the type.

7. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in feeding forward the paper upon which the message is printed by mechanism thrown into operation by a local battery controlled by the printing of the preceding letter.

8. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in touching a key which transmits a particular tone, by which one local battery determines in advance what particular letter shall be printed; carries forward the type selected, which, in turn, actuates another local battery which makes the impression and controls the feeding mechanism.

9. The combination, substantially as hereinbefore set forth, of a reciprocating type moved in one direction by the armature of the electro-magnet, and in the other by a spring.

10. The combination, substantially as hereinbefore set forth, of the armature of the magnet, the endwise-moving frame, the type pivoted thereon, and the retracting-spring attached directly to the type.

11. The combination, substantially as hereinbefore set forth, of a series of type, movable radially relatively to a common center, a shipper acting upon one of the series, and a series of electro-magnets, which control the action of the shipper.

12. The combination, substantially as hereinbefore set forth, of a series of type, a carrier or shifter bar acting upon either one of said type, a series of electro-magnets which control the selection of the type to be acted upon, and a second electro-magnet which actuates the type selected.

13. The combination, substantially as hereinbefore set forth, of a series of type, a shifting-carrier acting upon one of the types of the series, a series of electro-magnets which select the type to be acted upon, a second electro-magnet which actuates the type selected, and a third electro-magnet which actuates the printing-hammer, to make an impression of the selected type.

14. The combination, substantially as hereinbefore set forth, of an electro-magnet for actuating the printer-hammer, and an electro-magnet for actuating the paper-feeding mechanism.

15. The combination, substantially as hereinbefore set forth, in an electric circuit, of a vibrating reed producing a musical tone, or a definite number of vibrations per unit of time, a key controlling said vibrations, a corresponding reed at the receiving end of the line, a local battery controlled by said vibrating reed or circuit-breaker, and an electro-magnet, the armature of which carries a type, for the purpose specified.

16. The combination, substantially as hereinbefore set forth, in an electric circuit, of a

series of circuit-breakers capable of producing tones of different pitch, a series of corresponding receivers, a series of keys controlling the transmission of said tones, a series of local batteries controlled by the vibrating receivers, and a series of type controlled directly by the electro-magnets of the local batteries.

17. The combination, substantially as hereinbefore set forth, in an electric circuit, of a series of transmitting-keys, printing mechanism controlled by said keys, and a shifting-key for determining in advance which letter of a series, marked on each key, shall be printed.

18. The combination, substantially as hereinbefore set forth, in an electric circuit, of printing mechanism, keys controlling said printing mechanism, and a trip-key, which determines the point at which the printing of the message begins.

19. The combination, substantially as hereinbefore set forth, in an electric circuit, of printing mechanism, keys for controlling the printing mechanism, keys for determining which one of a series of type shall be printed, and a trip-key which determines the point on the paper at which the printing shall begin.

20. The combination, in an electric circuit, substantially as hereinbefore set forth, of apparatus for transmitting tones of different pitch, keys controlling said apparatus, receivers which analyze and reproduce said tones, and independently-movable type, each controlled by its particular tone.

21. The combination, substantially as hereinbefore set forth, of a paper-carrier, a spring for moving it in one direction, a feed-bar, and a gear-wheel mounted on the armature of the electro-magnet, and adapted to be thrown into or out of gear with the feed-bar by the movement of the armature.

22. The combination of the paper-carrying mechanism, a feed-bar, a gear-wheel actuating said bar mounted on the armature of one electro-magnet, and a feed-pawl mounted on the armature of another electro-magnet.

23. The analyzing-receiver hereinbefore described, consisting of the combination of two or more magnets, with their like poles united by connecting-bars, constituting in fact one magnet, and a series of tuned receiving-springs vibrating near said bars, so that each shall receive its proper tone from said magnet.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:

WM. A. SKINKLE,

WM. J. PEYTON.