A. C. FERGUSON.

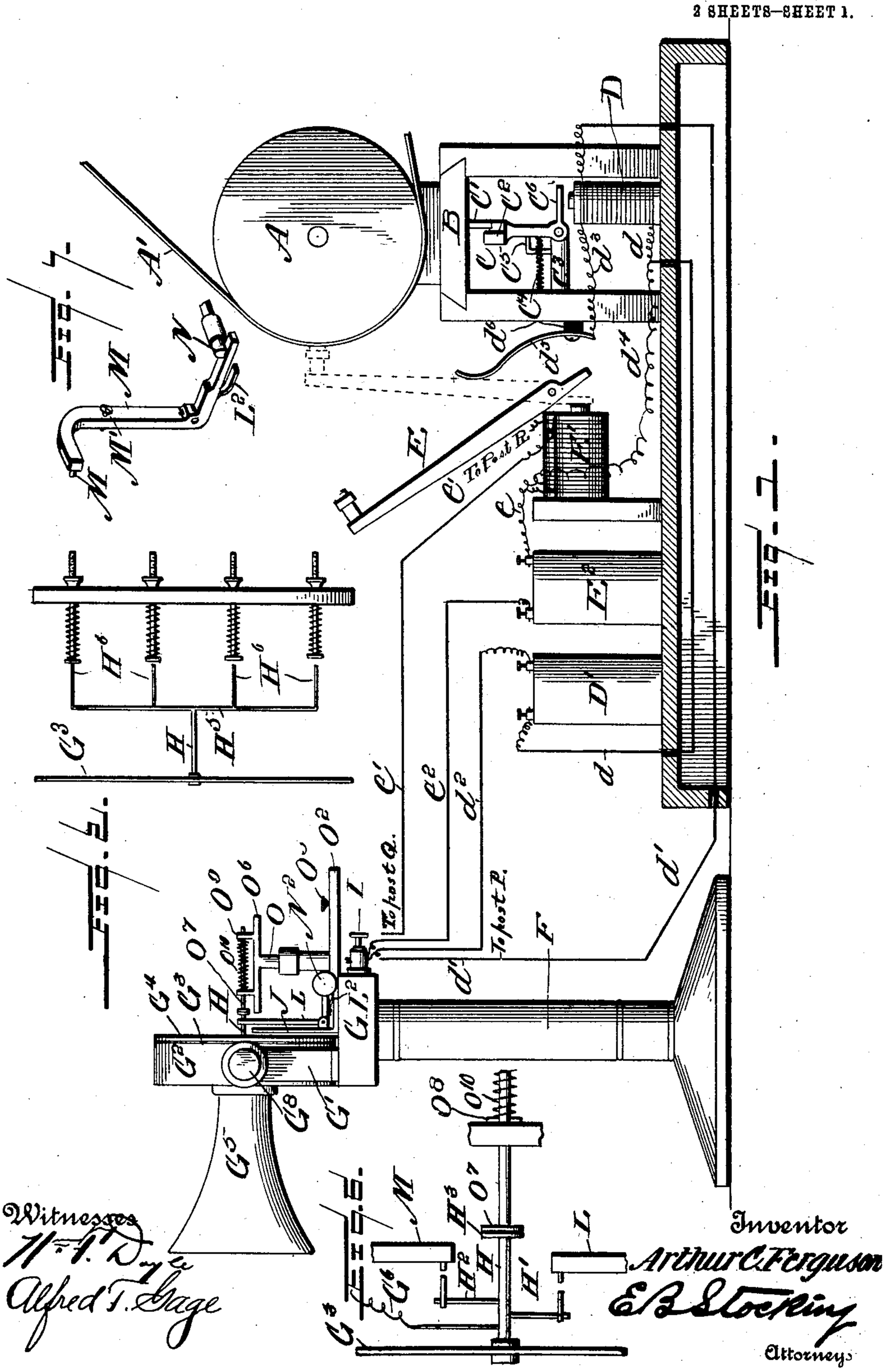
METHOD OF PRINTING BY SOUND.

APPLICATION FILED JAN. 21, 1903.

999,975.

Patented Aug. 8, 1911.

2 SHEETS—SHEET 1.



Witnesses

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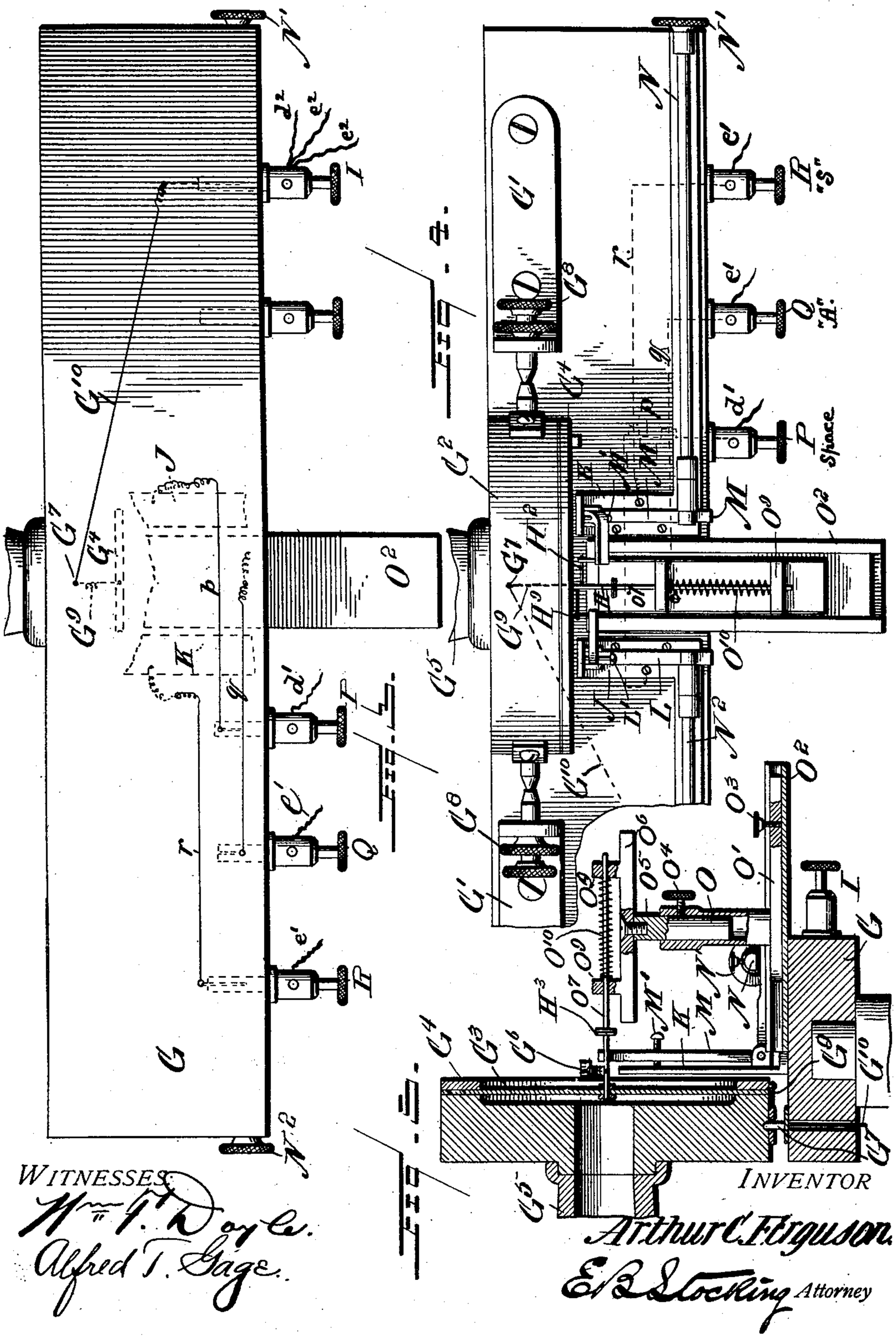

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METHOD OF PRINTING BY SOUND.

999,975. Specification of Letters Patent. Patented Aug. 8, 1911.

Application filed January 21, 1903. Serial No. 140,023.

To all whom it may concern:

Be it known that I, ARTHUR C. FERGUSON, citizen of the United States, residing at Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Methods of Printing by Sound, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention is intended for the purpose of transmitting and producing a printed record of a code or other signal comprising sound waves which are spoken or enunciated before a transmitter. These signals may be either a letter or a series of letters comprising a word which, when pronounced, produces a sound varying in its vibrations from other sounds used, and thus being capable of actuating the transmitter to an extent different from other sounds and thus print through an interposed member a character corresponding to the sound produced before a transmitter. These characters are capable of being used as codes for the transmission of intelligence by secret letters or combinations thereof constituting words, but the invention is not confined in its scope to this application alone a d can be applied in various arts, as found desirable.

The interposed member whose duty is to differentiate the vibrations of different sounds impinged upon the diaphragm and to select the required printing member according to such differences of sound vibrations, is in this instance actuated by an electric current or circuit which may be either an undulatory current or a make and break circuit as desired. I have in this instance employed the open or make and break circuit and I apprehend the use of an undulatory current with the special and well known adjuncts thereto adapted as an equivalent intermediary for selecting desired printing devices, the control of said current being the peculiar sound waves of each letter or word to be printed. The invention in this regard is based upon the principle that as the sound waves of every sound produced at the diaphragm differ from the waves of every other sound so the vibrations of the diaphragm differ in amplitude and therefore the effect on the selective intermediary is correspondingly varied so that the required printing member for each letter or word, *i. e.*, sound or combination of sounds, is controlled or set into operation by only the peculiar effect which is produced on the intermediary by the particular vibrations of the diaphragm produced by the particular word or sound directed thereto. The initial force employed is that of the sound waves upon the diaphragm but for performing the operation of actual printing an extraneous force is used and released or brought into operation by the initial motive agency residing in the sound waves themselves. As hereinafter shown waves spacing may be accomplished independently of the printing mechanism and by an independent intermedially applied force controlled by the aforesaid initial force.

Other features, objects and advantages of the invention will be hereinafter described and the novel features thereof will be particularly pointed out in the claims.

Referring to the drawings, Figure 1 is a diagrammatic side elevation of one form of printing apparatus embodying my method; Fig. 2 is a modification of a detail of construction; Fig. 3 is a bottom plan showing in detail certain electrical connections; Fig. 4 is a plan of the diaphragm-operated selecting devices; Fig. 5 is a central vertical section of the parts shown in Fig. 4; Fig. 6 is an enlarged view of the diaphragm-operated contacts; and Fig. 7 is a detail in perspective of one of the co-acting contact-carrying arms.

Like letters of reference refer to like parts in the several figures of the drawings.

A is the platen of a typewriter, B the carriage, C the step by step feed, comprising the rack C′ and dogs C^2 pivotally mounted on the brackets C^3 and retracted by a spring C^4 against the stop C^5 and moved in a direction opposite the pull of the spring by an electro-magnet D, the armature of which is an arm C^6 formed on one of the dogs C^2 all as commonly formed in electrically operated typewriters. The magnet D is energized by a battery D′ through conductors *d*, *d′* and d^2 having closing contacts located and operated in a manner hereinafter to be set forth.

E represents the usual series of type bars each having a type or types to print a letter, letters or a word or words and arranged to coöperate with the platen A and to print upon the paper A′ thereon. In an application of my invention to a matrix making

machine the paper A′ should be of any suitable matrix material.

E′ is one of a series of magnets, one for the operation of each bar E, as usual in electrical typewriters. The magnets E′ are each connected to a battery E^2 which may be designated as the printing battery as it supplies the power or motive agent to perform that work and for the same reason battery D′ may be designated as the spacing battery. The printing battery is connected to the magnets E′ by lines *e*. From each magnet there is a line *e′* and from the battery a line e^2 between which lines *e′* and e^2 contacts are provided for closing the circuit through any desired magnet by connections hereinafter to be described.

A shunt circuit d^3 extends from the spacing magnet D to contact d^5 insulatedly supported at d^6 in the paths of each of the type bars E and a line d^4 connecting lines *d* and *e* complete said shunt circuit. This shunt circuit takes the place of the well-known universal bail whereby after an impression a type bar performs the function of letter spacing. The main line *d′* d^2 enables such spacing to be done by sound in the interval of printing, as, for example, between words. It is apparent that either means may be employed and that the specific printing devices and the particular electrical connections shown may be displaced by others well-known or devisable by the expected skill of an electrician. In the form shown it is apparent that a closure of the circuit *e′* e^2 will, by reason of the energy stored in the battery E^2 energize the magnet E′ and cause the type bar E to imprint its character on the paper or other surface A′ on the platen A (see dotted position) and at the same time or immediately thereafter through magnet D, actuate the feed dogs C^2 by contacting on d^5 and as before stated the type bar E being retracted (see full lines) said magnet may be energized through the main circuit *d′* d^2 before described. As will hereinafter appear batteries D′ and E^2 provide a reserve energy extraneous to the initial agent employed to release and control said extraneous forces.

The circuit from battery D′ extends by line *d* to magnet D and thence by line *d′* to post P (Fig. 3). The opposite pole of this battery is connected by line d^2 with return post I whereby the circuit through the spacer magnet D may be completed by the means shown by dotted lines in Fig. 3. The battery E^2 is also connected to the post I by line e^2 and its opposite pole is connected by line *e* with magnet E′ which is also in circuit with the post Q by line *e′*. Extending from the line *e* is a shunt line d^4 connected to line *d*, while the magnet D is also provided with shunt line d^3 extending to contact d^5 whereby when the parts are in dotted line position in Fig. 1 a circuit passes through the bar E and magnet D to operate the spacing mechanism.

One form of apparatus for embodying my method of producing printed impressions will now be described.

Upon a suitable standard or support F is a bar G having thereon suitable standards G′ for the support of a disk G^2 containing a diaphragm G^3 clamped by a metal ring G^4. A mouthpiece G^5 of usual construction is arranged in rear of said diaphragm and from the latter there projects a rod H having branches H′, H^2, said rod being electrically connected with the ring G^4 by a flexible conductor G^6. At the bottom of the disk G^2 (Fig. 5) there is a metallic pin G^7 rising from the bar G into a slight depression in the disk which with the screws G^8 serve to removably support the disk. A short wire G^9 connects the ring G^4 with said pin and the latter by conductor G^{10} is connected to a binding post I to which all the return or battery lines d^2 e^2 extend.

The lines going to the individual printing magnets and to the spacing magnet proceed from the contacts now to be described.

As shown in Fig. 6, the rod H projecting from the diaphragm G^3 is provided with branches or contacts H′ H^2 and H^3, the last being the end of the rod and the other on arms projecting from the rod. The contact H′ serves to complete the spacing magnet circuit and the remaining contacts the printing magnet circuits. The number of contacts may be as many as desired, but for the purpose of clearness of illustration and description of my invention I have limited the contacts as shown. Mounted on the bar G are brackets J K, one at each side of the bar H and in each of said brackets is mounted a bell-crank lever L and M respectively, the vertical arm of which carries an adjusting screw L′ M′ respectively. The horizontal arms of the levers L and M are pressed upward by a suitable spring L^2 beneath them on the base of the bracket and are adapted to be depressed by the rotation of a shaft N having a flattened portion and operated by a thumb-nut N′ at its end. A companion shaft N^2, Fig. 4, serves to control the bell-crank L which is a duplicate of crank M in construction and purpose. Fig. 7 shows in perspective one of the bell-crank levers, and its contact point which is designed to coact with the contact H^2 of the rod H. There is also mounted upon the bar G a standard O, the base O′ of which is adjustably secured in a grooved plate O^2 by means of the thumb-nut O^3, this adjustment being toward and away from the diaphragm. In the standard there is mounted for vertical adjustment by means of a nut O^4 against the stem O^5 a plate O^6 carrying a spring cushioned contact rod O^7 adapted

to co-act with the contact H^3 on the rod H. The plate O^6 has two standards O^9 in which the contact rod O^7 is mounted movably and between the standards is a coiled spring O^{10} which serves yieldingly by engaging projection O^8 to press the contact O^7 toward the companion contact H^3. From the contact members there extend individual electrical conductors to a series of binding posts with which separate lines extending from individual printing magnets are connected. From the bracket J a line *p* extends through to the lower surface of the bar G and to the binding post P, to which the spacing battery line d^2 is connected. From the support of the contact O^7 there extends a line *q* to a binding post Q, to which the line *e'* of one printing magnet is connected. From the bracket K there extends a line *r* to the binding post R, to which another printing magnet line *e'* is connected. For convenience of description and a ready understanding of the invention and its operation let the printing member operated by the magnet E' be adapted to print the letter "A", and let the line *e'* from said magnet be connected with the binding post Q and thus with contacts H^3 O^7. Then let the bracket K, carrying the contact lever M, be connected to the binding post R and let the individual line of another printing magnet E' be connected with said post and thus with contacts H^2 M and let said latter magnet operate a type lever to print the letter "S". It is of course understood and is readily apparent that the lines extending from the diaphragm contacts to the printing mechanism may be of any practical length and that such length is within the limits of the transmission of an electric current and for that reason the sample apparatus herein shown and described is one that has no mechanical connection in the usual meaning of the term with the printing mechanism, the only connection being the electrical conductors employed.

If desired the form and arrangement of the diaphragm contacts may be varied as also the number thereof. In Fig. 2 there is shown an arrangement differing somewhat from that illustrated in other figures of the drawings in which the rod H has a transverse rod H^5 on which are four contacts H^6 and opposite these four are adjustably mounted spring cushioned co-acting contacts which are subject to the same mechanical and electrical lines and conditions of use as are those shown in the remaining figures.

By means of the screws L' M' in the contact levers L and M an exceedingly fine adjustment of the distance between the contact points on said levers and those on the rod H is attainable. In the same manner a light, fine, adjustment between the contacts H^8 and O^7 may be secured. After such an adjustment of the contacts either of those on either side of the rod H may be thrown out or separated by a partial rotation of one or the other of the shafts N or N^2. So also may either be varied in adjustment with extreme nicety by bringing the flattened portion of the shaft N with a slight pressure upon the horizontal arm of the contact lever thereby depressing the same against the tension spring beneath it.

The apparatus has demonstrated in actual use the production of printed letters to record different sounds individually by speaking the same in front of the diaphragm and the printing of said letters collectively by speaking the same as a word or combined sound in front of the diaphragm and it has also in practice accomplished the actual work of letter spacing by means of sound directed toward the diaphragm. In fact the adjustment of the apparatus is so sensitive that by merely blowing against the diaphragm the spacing mechanism has been put into regular intermittent and continued intermittent operation. This operation is accomplished as described independently of the printing mechanism and when the latter is not employed.

The various contacts employed are, as before stated, adjusted with extreme fineness and this when the distances between the same are extremely limited, none of the contacts being in actual touch with another. It is a principle of adjustment that those contacts which are to close the printing circuit of a sound or letter, the sound waves of which possess greater amplitude, are adjusted at a greater distance from each other than the contacts on the line of a printing member adapted to print the name of a sound or letter, the sound waves of which are of lesser amplitude. As in sound waves rapidity as well as amplitude exists in different degrees in different sounds, so also may differences in rapidity do the work of selecting or individualizing printing members for given sounds. From the above it follows that a series of contacts may be arranged as, for example, in Fig. 2, wherein the distances between each member and its co-acting contact may gradually increase and the printing members connected with the individual contacts of such series be adapted to print the name representing a sound by a letter or series of letters, the waves of which bear a similar relation to the several contacts in such a series.

The operation is as follows. By means of the shafts N N^2 the lever contacts L and M are separated from the contacts H' and H^2 of the diaphragm leaving the contacts H^3 O^7 in operative juxtaposition and as these are connected with the printing member which prints the latter "A" it is apparent that when the sound of said letter

is spoken in front of the diaphragm it will be printed. Now by releasing the contact lever M from depression by the shaft N it is put into operative position with its co-acting contact H^2 on the rod H and being connected with a printing member for printing the letter "S", the sound of which letter, when pronounced, produces sound waves of less amplitude than the letter "A" the diaphragm is operated to such a degree as to set into operation only the desired printing member and the letter "S" is printed. Now leaving the parts in the adjustment just described both levers L and M will contact with points H′ and H^2 and the printing members will operate to print the word "AS" when the sound thereof is spoken in front of the diaphragm. I find in practice, that, in some measure, the manner of vocalizing the sounds to be printed can be advantageously varied. It is in accord, to some degree, with the fineness of adjustment of the apparatus employed, the more sensitive the adjustment the less difference in vocalization being required.

While this invention has been described as for use in a phone typewriter, still it will be seen that it is applicable for use in sending secret or code signals which may be controlled by the contacts so that either one or a plurality of contacts may be made, depending upon the intensity of the sound.

In the form of invention shown in Fig. 1 the contact points H′ and H^2 may be separately used by a proper adjustment of the levers L and M, and when both of these levers are in operative position a predetermined sound will cause one to contact and print a character corresponding thereto, while a sound of greater intensity will close both contacts and print a plurality of characters. This is further illustrated in the modification shown in Fig. 2 where a sound of one intensity would make the first contact, while the increasing intensity of the sound vibrations would successively add an additional contact to the series until a sound adapted to throw in the contact farthest removed, would print all succeeding ones, making a word or symbol of four characters corresponding to the sound produced.

Having described my invention and set forth its merits, what I claim and desire to secure by Letters Patent is:—

1. The method of recording sound waves which consists in utilizing a succession of said waves as a motive force to initiate the operation of mechanism actuated by a separate source of energy for printing a legible character corresponding to certain tone characteristics of said waves.

2. The method of recording sound waves which consists in controlling independently driven mechanism for actuating a printing character by the vibrations of a diaphragm actuated by said waves when a sound corresponding to the character is spoken.

3. The method of recording sound waves consisting in utilizing said waves for controlling a separate source of energy to actuate a character printing mechanism.

4. The method of recording sound waves which consists in vocalizing sounds and utilizing the waves thereof for releasing stored energy for the actuating of a character printing mechanism.

5. The method of recording sound waves which consists in projecting the wave upon a diaphragm and interposing between said diaphragm and a character printing mechanism an electrical motive agent and varying the connections between said agent and diaphragm in accordance with the amplitude of the sound waves.

In testimony whereof, I affix my signature in presence of two witnesses.

ARTHUR C. FERGUSON.

Witnesses:
ALFRED T. GAGE,
GEORGE M. BOND.