

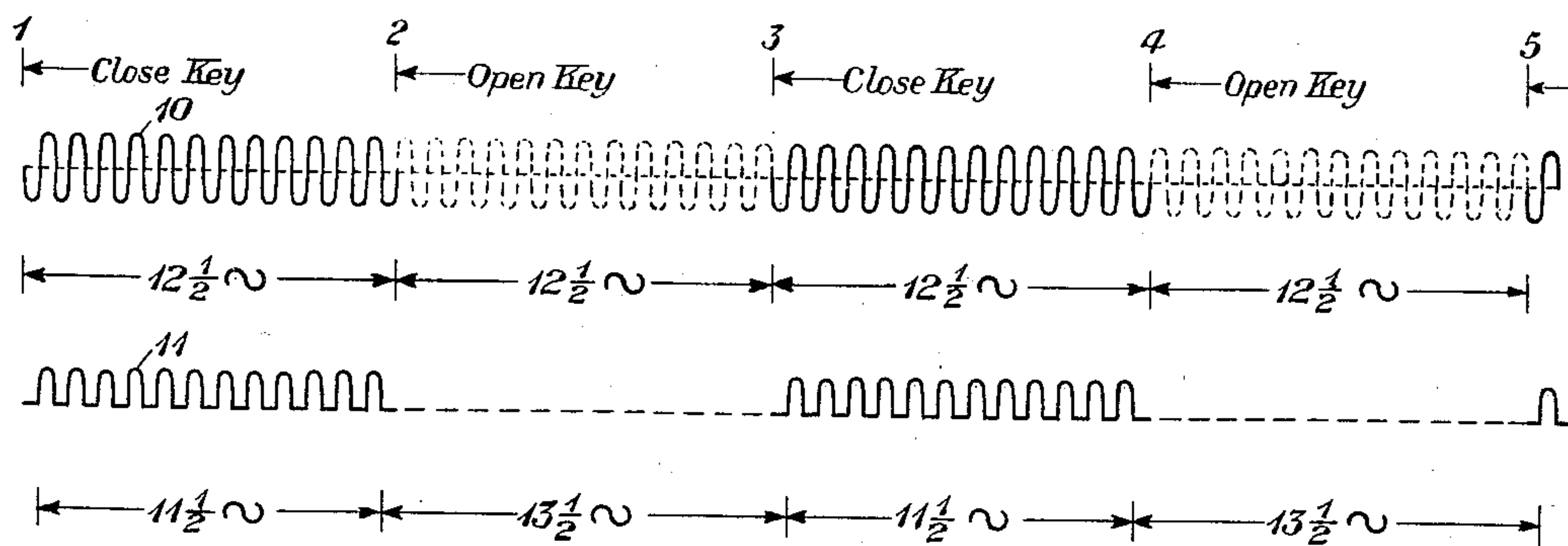
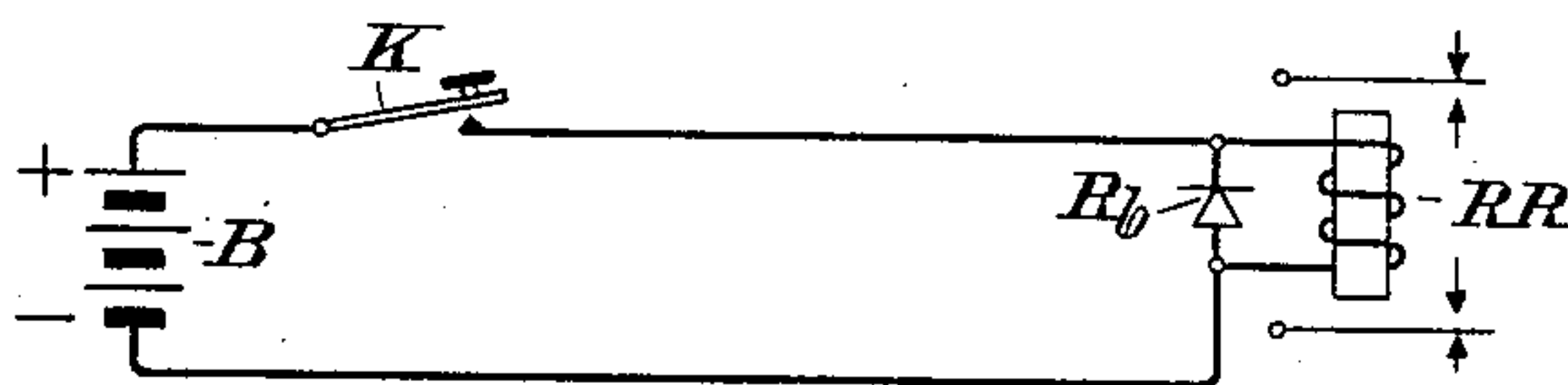
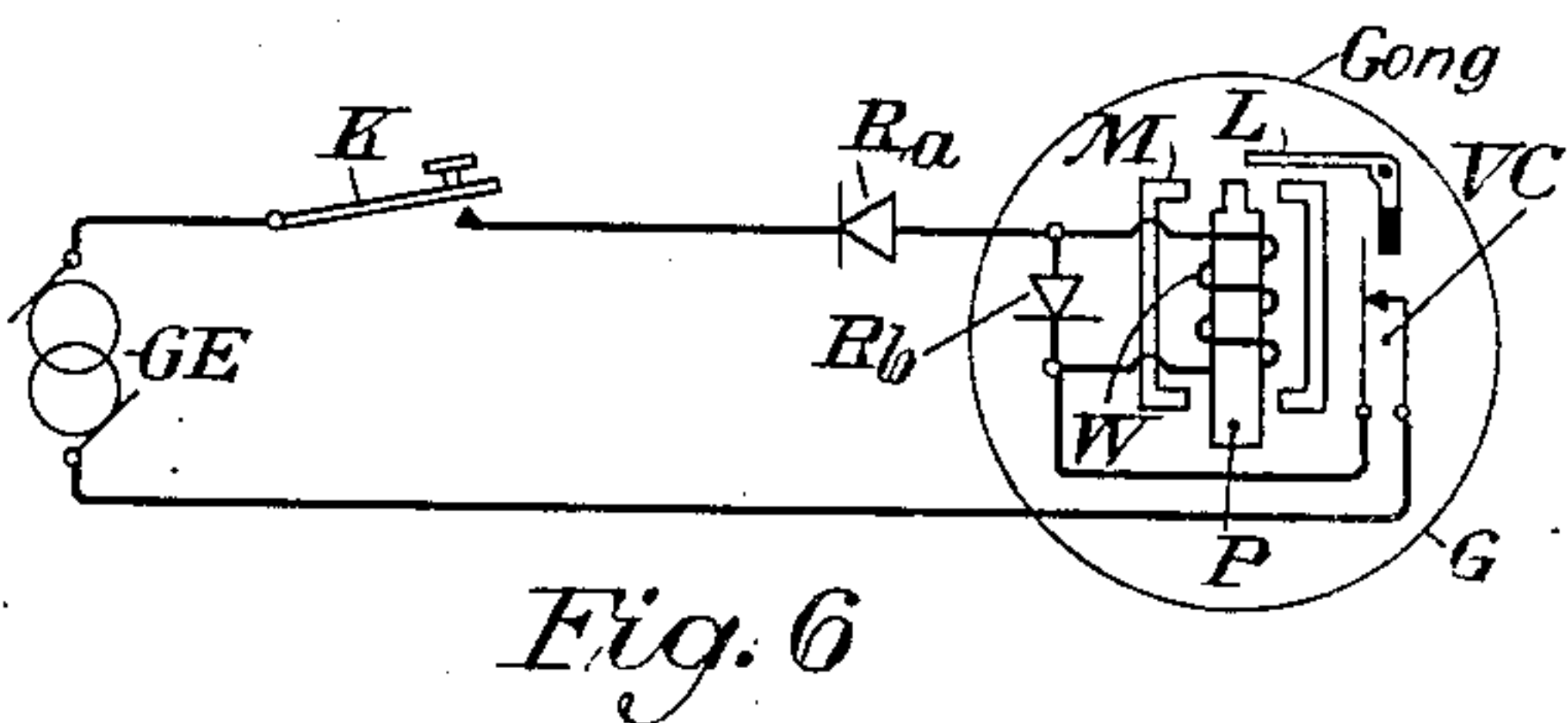
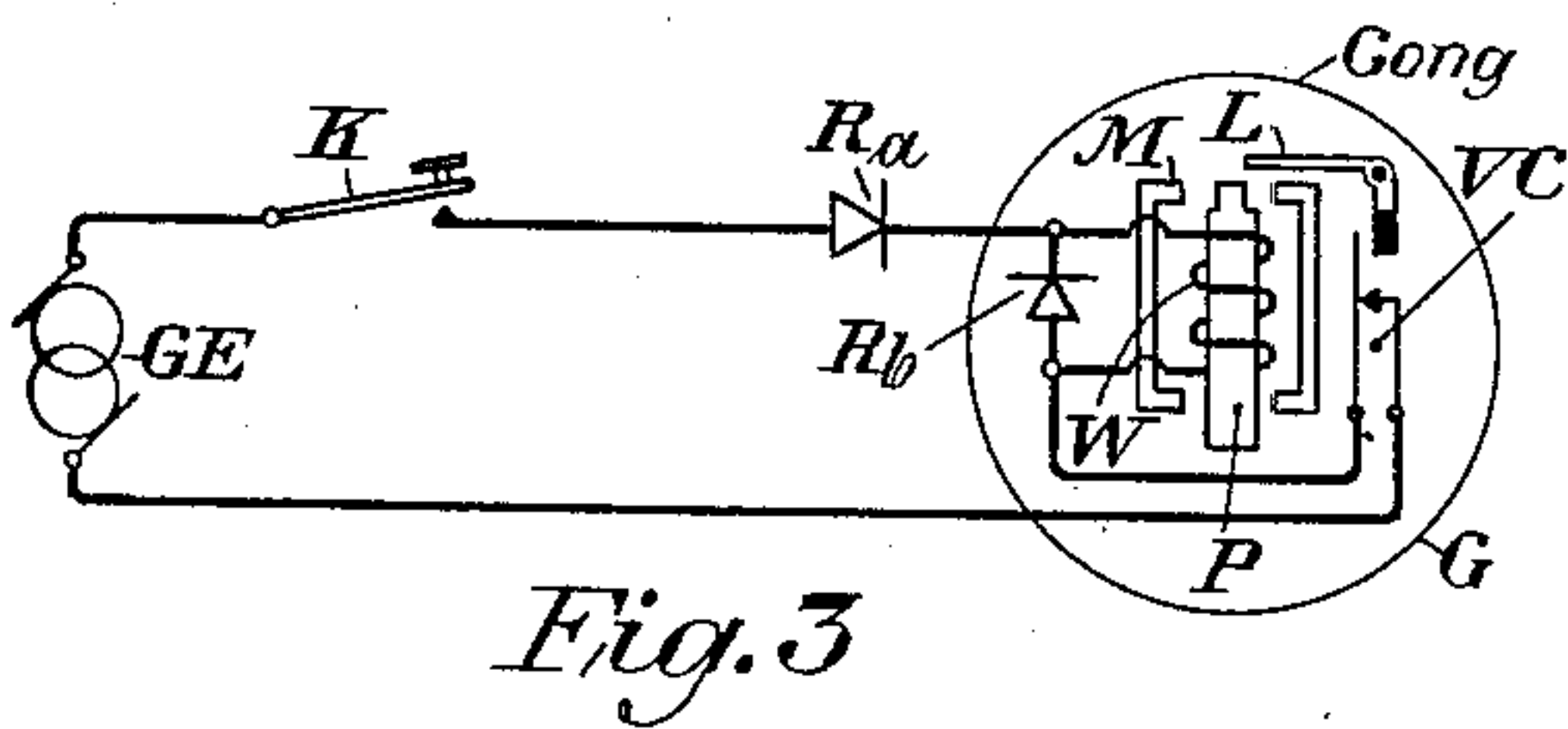
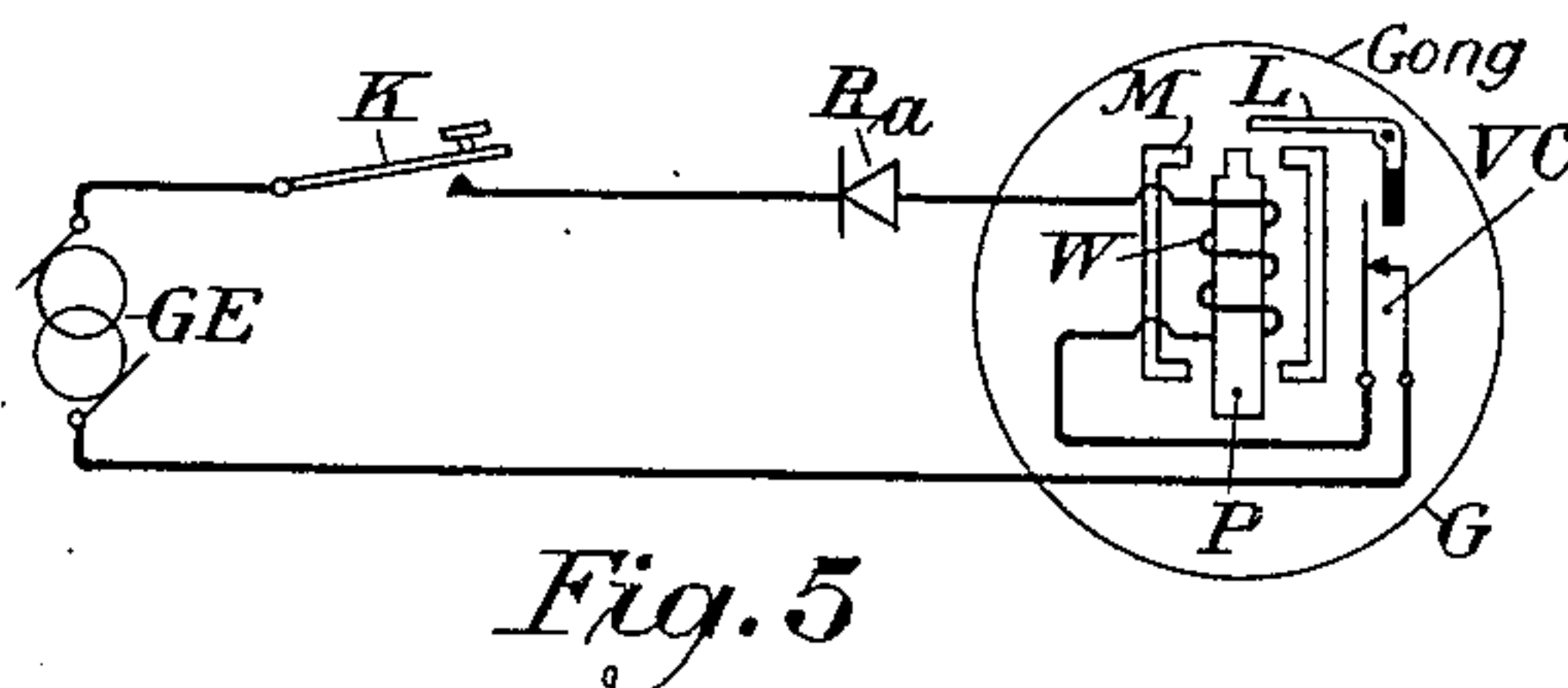
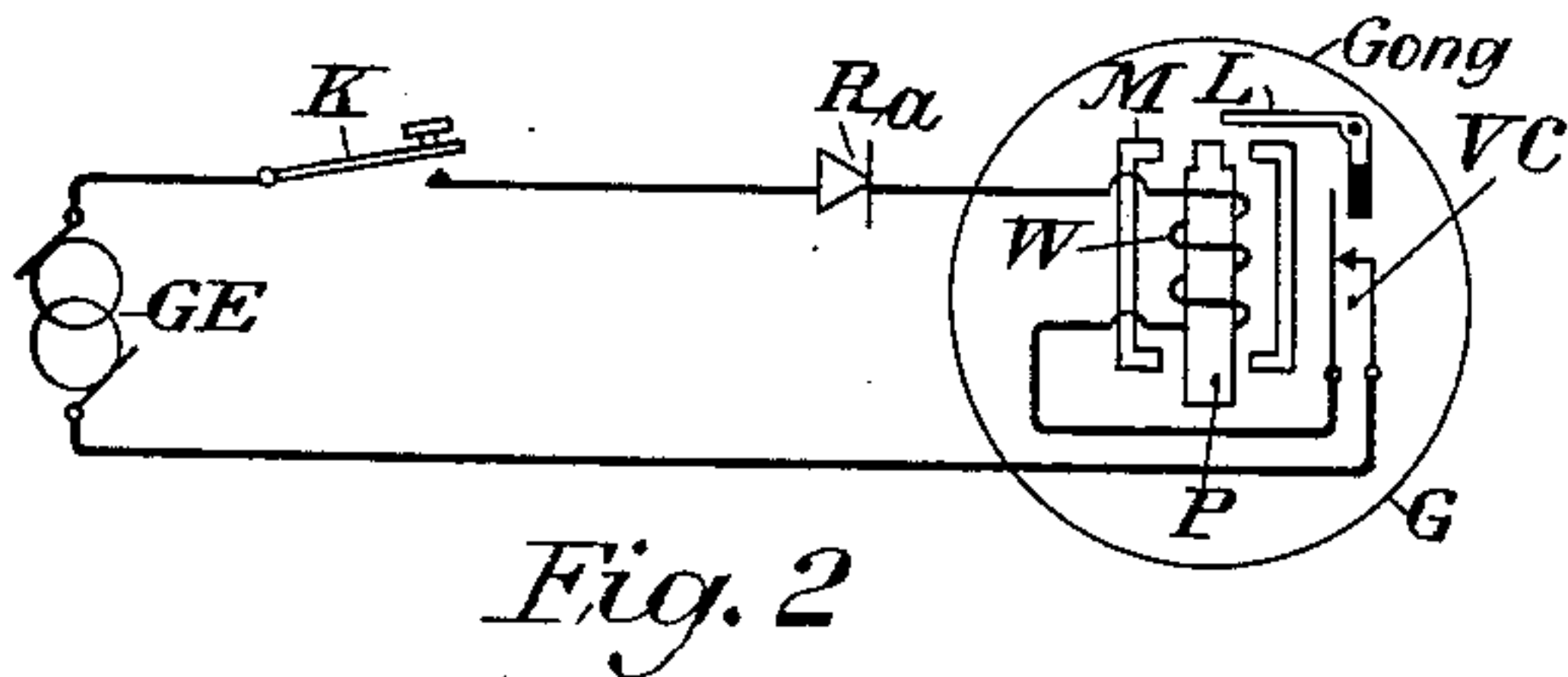
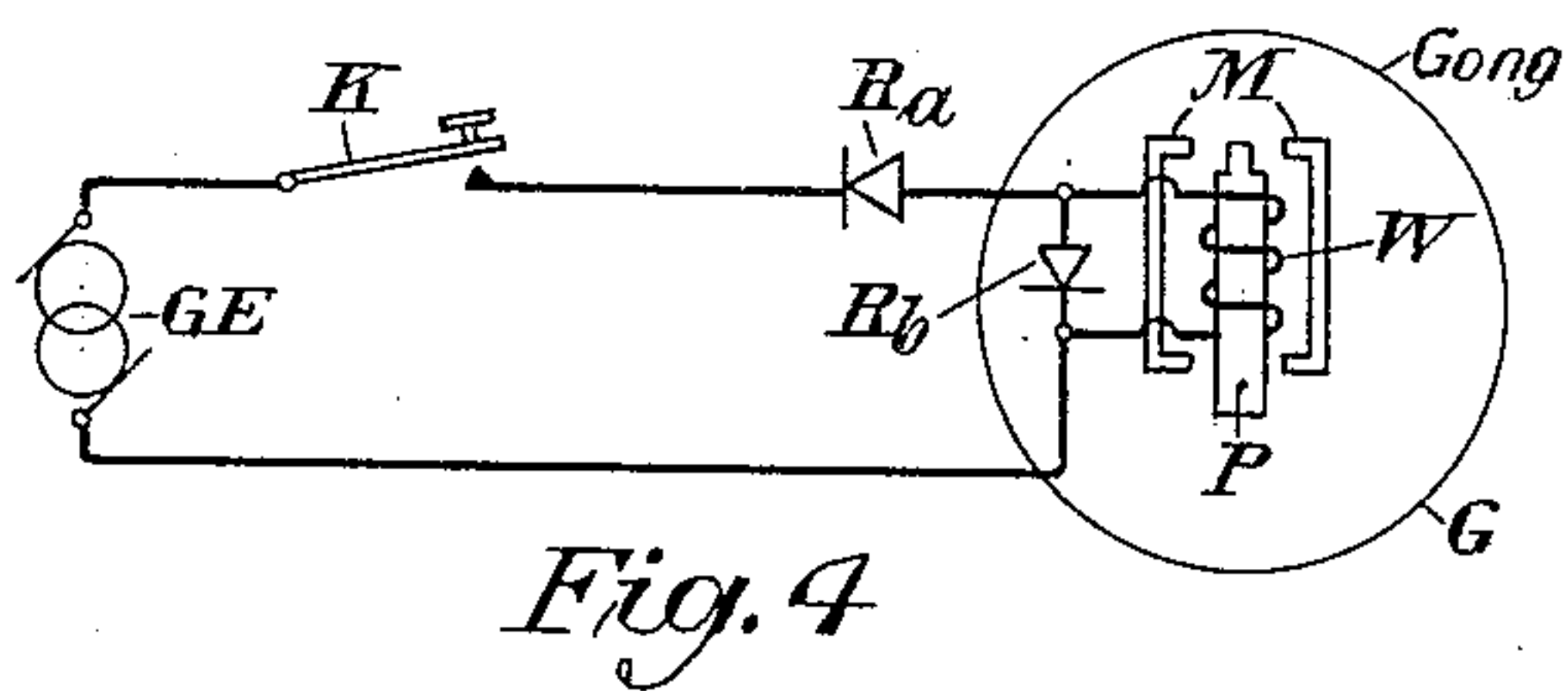
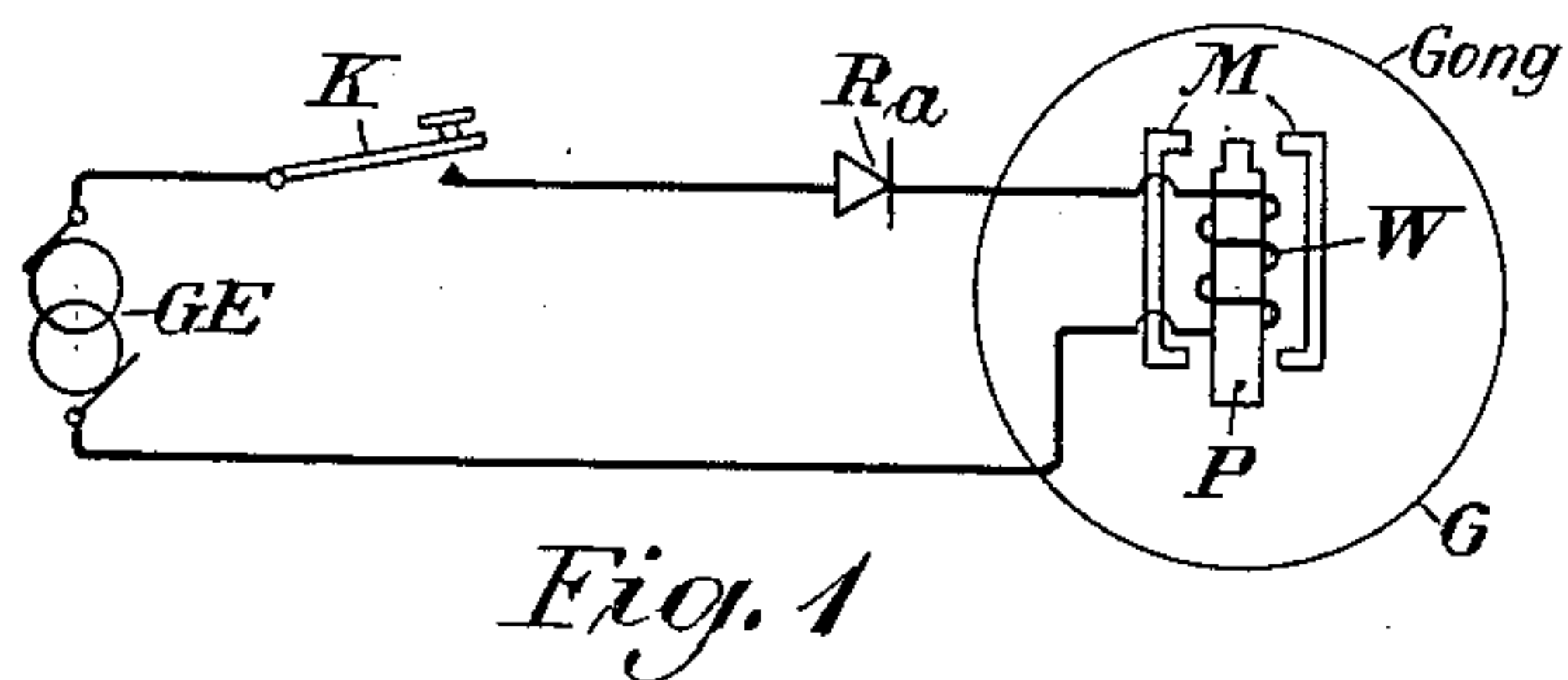
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CODE CALLING SIGNALS

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2,389,082

CODE CALLING SIGNAL

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2 Claims. (Cl. 177—7)

This invention relates to signal devices for code calling systems, but is applicable to many other types of systems and apparatus.

In establishments such as factories, mills and other industrial plants it is common to install code calling systems. These systems enable a person at an office or other central point to ring variously located bells in accordance with a code assigned to a wanted person, thereby calling to their stations executives or others who are at the moment elsewhere in the plant. Such systems are frequently useful in connection with P. B. X telephone service in the plant, to enable an operator, when a call comes in for some person who is away from his station, to notify him that he is wanted on the telephone. In such case the operator usually has available an automatic code calling arrangement so designed that, by operating a particular key or lever, a desired combination of pulses may be transmitted over a local power system to ring the bells in accordance with the code of the person called.

The bells ordinarily employed in such systems are usually either of the so-called single stroke type or of the type known as vibrating bells. Such bells are intended to be used with either direct current or alternating current, but in actual practice some of these bells have been found to be faulty in their operation when an alternating current power supply is used, particularly if the frequency is of the order of 25 cycles per second.

Single stroke bells usually have a cast magnetic circuit inside of which a single operating coil is located. Within the coil a plunger, preferably laminated, is free to move in the field of the coil. Usually the bell is mounted so that the long axis of the plunger is vertical. Therefore, when the coil is energized by a signal pulse and the plunger is lifted against gravity by the magnetic circuit, it rises at an accelerating speed and strikes the gong. It then falls back slightly and "floats," because in the steady-state condition the momentum that caused it to strike the bell has been dissipated. When the pulse (which may be a succession of alternating current waves) ceases, the plunger is supposed to drop back to normal.

Unfortunately, in signal devices of this type the plunger fails to strike the bell with equal force on all pulses of a digit or digits constituting a code signal. This is probably due to the fact that the no-current interval following a pulse is too short to enable the plunger to fully return to its normal position. The result is that the succeeding pulse, in raising the plunger from

a position part way towards its striking position, fails to drive the plunger against the gong with sufficient momentum. One of the objects of the present invention is to overcome this difficulty by employing a rectifier of some known type in circuit with the bell coil.

When the bells employed are of the vibrating type, they are of similar construction but are provided with contact springs which normally close the bell coil circuit. As the plunger rises in response to a signal pulse to strike the bell, it actuates a pivoted arm which opens the operating circuit. Consequently, so long as the pulse continues, the operating circuit is automatically opened and closed, causing the plunger to successively strike the gong a number of times for each pulse.

In actual operation it is found that bells of this type have a tendency to stutter, due probably to the fact that the plunger does not always strike the gong with the same force. A further object of the invention, therefore, is to overcome this difficulty, and in accordance with the invention it is likewise proposed to do this by connecting in circuit with the bell coil a rectifier of known type.

As rather heavy currents are used in operating the bells, some difficulty is encountered, particularly in the case of the vibrating bells, due to the magnetization of the coil tending to persist for a while after the circuit has been opened. This causes a spark to pass between the vibrating contacts and sometimes tends to produce sparking at the control contacts of the code-sending device located elsewhere in the circuit. Another object of the invention is therefore to reduce the sparking either at the vibrating contacts of the bell or at the control contacts of the sender. Preferably this is accomplished by connecting a rectifying device of some known type in shunt with the coil in such manner that the energy built up in the coil, and which persists for a time after the circuit is opened, may be dissipated by passing through the rectifier instead of over the circuit including the contacts.

One of the effects of a rectifier connected across a coil is to cause the coil to be slow to release. This action is similar to that resulting when a relay is provided with a copper sleeve or its winding is shunted by a non-inductance resistance. The use of a rectifier for this purpose, however, has a considerable advantage over the copper sleeve or shunted coil, because it is effective only on the "break" of the circuit. The usual type of slow release relay is also slow to operate, whereas

a rectifier across the coil of the relay renders it slow to release, but permits it to operate without delay because of the one-way effect of the rectifier. Therefore, one of the objects of the invention is to improve the operation of magnetic devices, by so associating rectifiers with them that they become slow to release, without at the same time being made slow to operate.

The invention may now be more fully understood from the following description, when read in connection with the accompanying drawing, in which Fig. 1 shows a single stroke gong operated by rectified current; Fig. 2 shows a vibrating bell operated by rectified current; Fig. 3 shows a similar vibrating bell arrangement having in addition a rectifier to reduce sparking; Fig. 4 is an arrangement similar to Fig. 1 but with the rectified current reversed and with a rectifier added to reduce sparking; Figs. 5 and 6 are arrangements similar to Figs. 2 and 3 but with the rectifiers reversed; Fig. 7 shows how a rectifier may be used for making a relay quick to act and slow to release; while Fig. 8 is a series of curves to graphically illustrate how a rectifier in series improves the bell operation.

Referring to Fig. 1, a single stroke bell arrangement is shown. This has a magnetic circuit M which is preferably cast in one piece with a coil W mounted inside. Within the coil W a plunger 2 is arranged to be raised when the winding W is energized, and to be lowered to its normal position when the winding is de-energized. When a pulse of operating current flows through the winding W, it raises the plunger which, as it rises, acquires sufficient momentum to strike the gong G. Immediately upon striking the gong G the plunger reacts slightly and the continuance of the pulse causes the plunger to "float" in its raised position without again striking the gong. The result is that for a single continuous pulse of current, no matter how long, the gong is struck only once.

In order to operate the bell a source of alternating current GE is provided and the circuit is arranged to be closed and opened in accordance with a code by means of a master calling device, which is symbolically represented by a key K. The master calling device, as well known, is provided with buttons or levers, one for each code to be sent. Whenever a button or lever corresponding to a particular code such as 1—2—5 is operated, a rotating code sending wheel causes the circuit to be successively closed and opened in accordance with the code.

For example, in the case of the code 1—2—5, a closed circuit pulse will first be transmitted for the digit 1, followed by an open circuit pause of some length. For the digit 2, two closed circuit pulses are sent, separated by an open circuit interval of length substantially equal to that of the pulses, and the second pulse will be followed by a pause. Then for the digit 5, five pulses are sent, separated by no-current intervals of equal length, and the last pulse is again followed by a pause.

The lengths of the pulses and no-current intervals are determined by the rotating code wheel, and are usually equal in length and so spaced as to produce approximately one pulse per second for a code digit of more than one pulse. When alternating current is used to energize the system, and especially when the current has a frequency of about 25 cycles per second, it has been found that the plunger P sometimes fails to fully fall back to its normal position during the no-

current interval. Consequently, when it is raised during the succeeding pulse, it may not attain sufficient momentum to strike the gong G as sharp a blow as was the case for the preceding pulse. The result is that the bell strokes corresponding to digits of more than one pulse have an uneven and uncertain sound.

Since the relative lengths of the pulses and the no-current intervals between pulses cannot be regulated when a mechanical calling device is employed, it is proposed to remedy the condition above referred to in accordance with the present invention by inserting a rectifier R_a in series with the winding W of the bell. The bell coil W will then be energized by pulses which consist of a succession of rectified half-waves instead of a succession of full alternating current waves.

In practice this has been found to improve the operation of the bells and render the strokes more uniform. While the reason for this is not wholly understood, it is probably due to the fact that a part-wave of a cycle at the beginning of a pulse, or at its end, or both, is eliminated by the rectifier, thus causing the pulses to be relatively shortened, and the pauses between pulses to be somewhat longer.

This is shown more clearly in the diagram of Fig. 8. Here the current conditions existing in the circuit during a plurality of pulses are indicated by the curve 10. Let us assume that the key K (which corresponds to the circuit-closing element of the master calling device) is closed at the instant designated 1, opened again at 2, closed again at 3, opened at 4, closed at 5, etc. In the case of 25-cycle current, if the pulses are equal to the no-current intervals, and occur once per second, we have a condition such that during each closure of the key, $12\frac{1}{2}$ cycles of current are sent through the winding W, and during each no-current interval a time elapses equal to $12\frac{1}{2}$ cycles.

When, however, a rectifier such as R_a is provided, the current conditions will be as shown by the curve 11. Here for each pulse we have 12 half-cycles, all passing through the winding in the same direction. The operating current therefore flows through the winding only during a period equal to $11\frac{1}{2}$ cycles. This lengthens the succeeding no-current interval by two half-cycles which were lost during the operating pulse by rectification. Therefore, the interval between pulses lasts for a time equivalent to $13\frac{1}{2}$ cycles. This lengthening of the no-current interval between successive pulses gives the plunger more time to fall back to its normal position, so that each pulse of current will cause a full and regular stroke of the gong.

In some cases the bells used in signaling systems such as above described are of the vibrating type instead of being single-stroke bells. In the vibrating type of bell a lever L is provided which is struck by a shoulder on the plunger P as it rises. The lever L when operated in this manner opens a normally closed vibrating contact VC in series with the winding W. Consequently, when the key K is closed and held closed for a pulse of $\frac{1}{2}$ second, the circuit will not continue closed as in the case of Fig. 1, but will be self-interrupted by the action of the lever L and the vibrating contact VC, so that several strokes of the plunger P will tap the gong G.

It has been found in practice that when a vibrating bell of this type is operated by alternating current having a frequency of the order of 25 cycles per second, the bell has a tendency

to stutter. This is apparently due to a phenomenon similar to that described in connection with Fig. 1, namely, the open circuit condition following each closed circuit condition during a given pulse gives the plunger insufficient time to fall completely back to its normal position. This situation has been improved by inserting a rectifier R_a in series with the winding W in Fig. 2. The rectifier, by eliminating part of a cycle at the beginning of the closed circuit condition, or at the end, or both, makes the no-current interval between successive closed circuit intervals somewhat longer than the closed circuit intervals.

It has also been found that the bell contacts, such as VC, spark considerably when alternating current is used for operating the bells. Likewise, the control contact of the master calling device, represented in the drawing by K, sparks occasionally when it opens the alternating current power circuit. The sparking here depends on the point in the alternating current wave at which the opening occurs. It will obviously not spark when there is no current flowing at the instant of opening.

In accordance with the invention this difficulty is overcome by shunting a rectifier such as R_b in Fig. 3 across the winding W of the bell. When the winding W is energized by a pulse consisting of a number of successive one-way semi-cycles of current, the impressed electromotive force builds up a magnetic field in the coil which tends to continue after the applied electromotive force has been removed, and only dies down gradually. As the applied electromotive force ceases due to the opening of the contact VC, the slowly decaying energy built up in the coil causes a spark at the contact VC if the key K is still closed. On the other hand, if the key K is opened at a time when the vibrating contact VC is closed, sparking will occur at the key K.

By connecting the rectifier R_b in shunt with the winding W , the energy which tends to persist in the coil will be dissipated through the rectifier R_b , and will be diverted from the vibrating contact VC and from the contact of the key K. This substantially eliminates sparking at either of these points.

It will be understood that the rectifiers R_a and R_b , used in the circuits of Figs. 1, 2 and 3, may be of any well known type. While in practice it has been found that the copper oxide type of rectifier, sometimes known as the "Varistor," has been very satisfactory in these circuits, other known types of rectifiers such as crystal rectifiers, vacuum tube rectifiers, etc., may be employed instead.

Figs. 4, 5 and 6 are substantially the same as the corresponding Figures 1, 2 and 3, except that in each case the rectifier R_a is connected in the circuit in the reverse direction, thereby reversing the rectified current which energizes the winding W . Because the energizing current is reversed in direction, the rectifier R_b in the circuit of Fig. 6 is also reversed with respect to the corresponding rectifier of Fig. 3. Fig. 4 also differs from Fig. 1 in that a rectifier R_b is shunted across the winding W for the purpose of reducing sparking at the key K.

When a rectifier such as R_b is shunted across the winding W of the bell as shown in Figs. 3, 4 and 6, its action is such as to make the coil slow to release in a manner somewhat similar to the effect of a copper sleeve or a non-inductive resistance associated with the winding of a relay.

The sluggish action caused by the rectifier occurs only upon the "break" of the current through the winding. It does not occur at the beginning of the pulse whereas, as is well known, the effect of the copper sleeve or the non-inductive resistance shunt is to cause a delay at the beginning or "make" of a pulse. Because the rectifier R_b is a one-way device the effective short-circuiting of the winding is in one direction only. The retardation takes place only at the end of the pulse, because the rectifier is connected across the circuit in such direction that the initial operating current cannot flow through it.

In order to utilize the effect just described, one of the features of the invention comprehends connecting a rectifier R_b across the winding of a relay such as shown at RR in Fig. 7. The result is that whenever the key K is closed to energize the relay winding, the relay will be quick to act but slow to release.

While this invention has been disclosed in certain specific arrangements which are deemed desirable, it will be obvious that the general principles herein set forth may be embodied in many other organizations, widely different from those illustrated, without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In a signaling system, a circuit including a source of alternating current, a bell including an operating coil, a plunger so sluggish in movement as not to be able to oscillate with each cycle of alternating current, and a gong to be struck by said plunger when said coil is energized by a number of successive cycles of alternating current, means to close and open said circuit to produce operating pulses of such length as to include a plurality of alternating current cycles, a rectifier in series with said coil to apply a succession of one way half cycles to said coil during each pulse and suppress half cycles in the opposite direction, thereby eliminating a part of a cycle at the beginning or end of an operating pulse to lengthen the no-current interval between pulses, and a second rectifier connected in shunt with said coil and in series with said first rectifier but oppositely poled thereto so as to reduce sparking when the circuit is opened.

2. In a signaling system, a circuit including a source of alternating current, a bell including an operating coil, a plunger so sluggish in movement as not to be able to oscillate with each cycle of alternating current, and a gong to be struck by said plunger when said coil is energized by a number of successive cycles of alternating current, means to close and open said circuits to produce operating pulses of such length as to include a plurality of alternating current cycles, a rectifier in series with said coil to apply a succession of one way half cycles to said coil during each pulse, a vibrating contact operated by said plunger as it strikes the gong to automatically interrupt the alternating current circuit at successive intervals during each pulse to produce a plurality of strokes upon the gong for each pulse, said rectifier operating to suppress a part of a cycle at the beginning or end of each closed circuit condition thereby correspondingly lengthening the no-current intervals, and a second rectifier connected in shunt with said coil and in series with said vibrating contact and said first rectifier but oppositely poled with respect to said first rectifier, whereby sparking is reduced when the circuit is opened.

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