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3,246,096

STEPPING RELAY

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FIG. 1

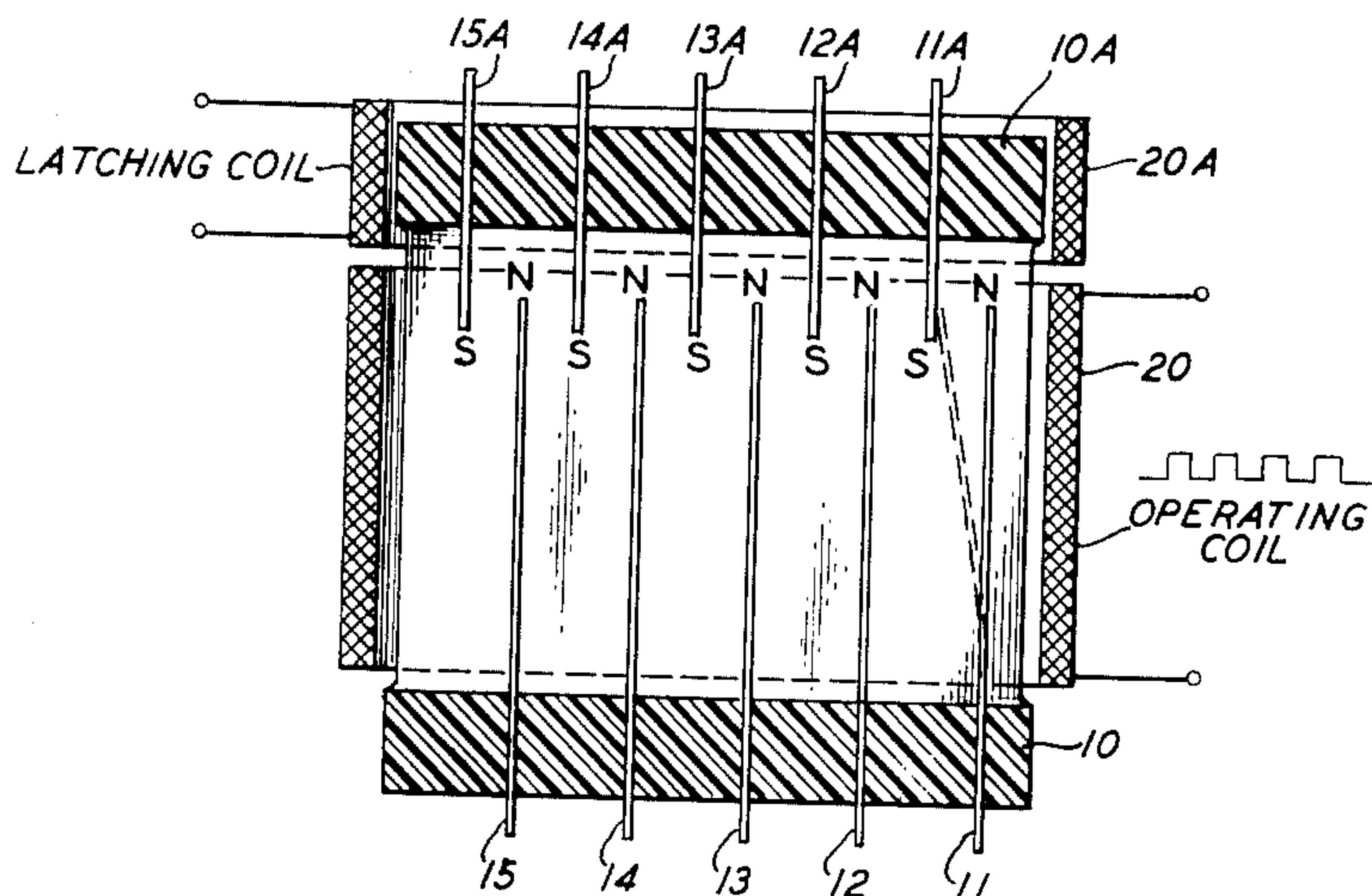


FIG. 2

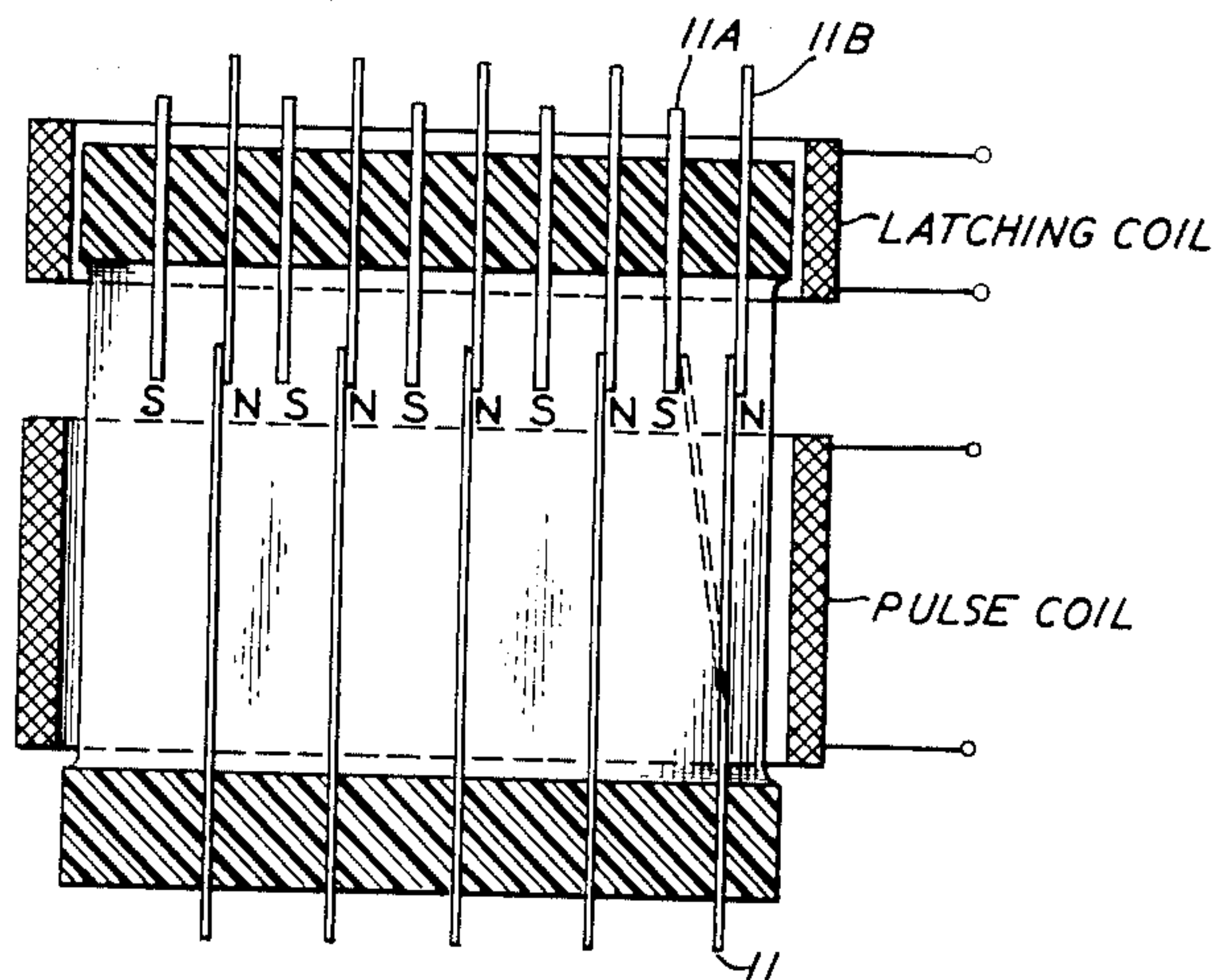


FIG. 3

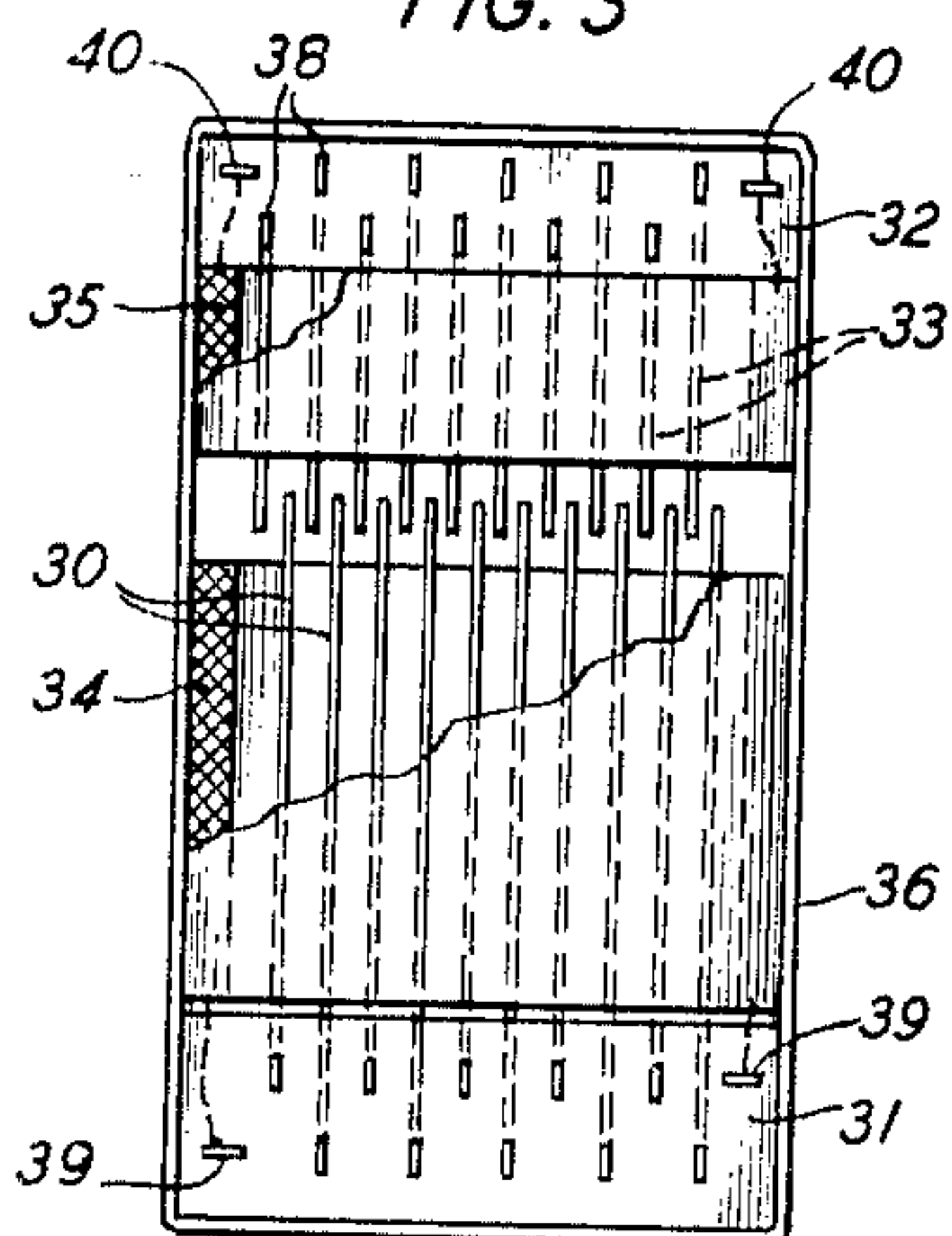
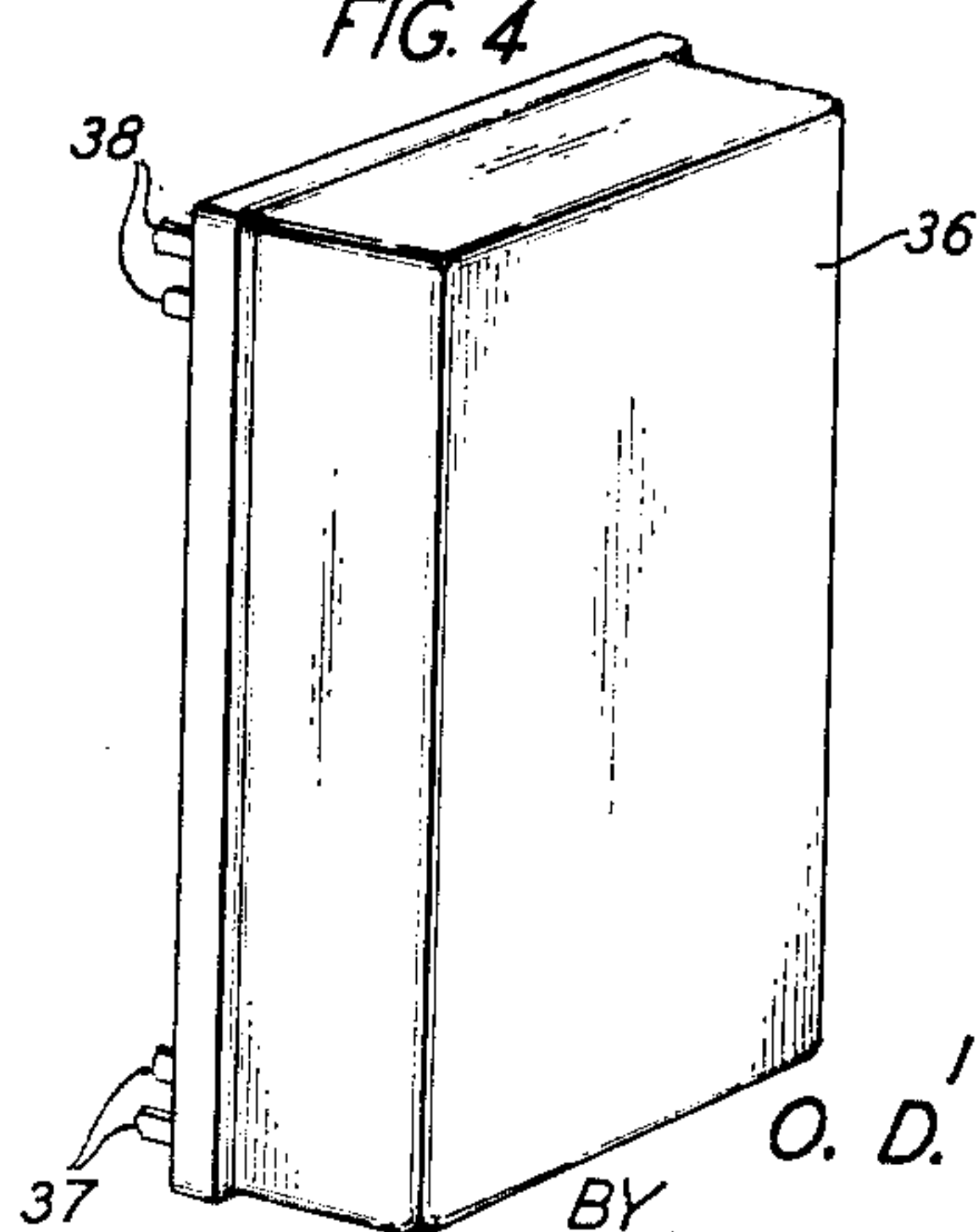


FIG. 4



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STEPPING RELAY

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3 Claims. (Cl. 200-87)

This invention relates to relays in which magnetic members are attracted to each other by the application of a suitable magnetic field to them. More particularly, the invention is concerned with a relay having an array of deflectable and fixed magnetic members, for example, deflectable contacts or reeds and fixed contacts, associated with magnetic means for their operation. The arrangement is such that a plurality of successive pulses properly applied serially operates pairs comprising a reed and a contact. Thus we have a stepping or pulsing relay.

It is old in the relay art to operate successively the pairs of contacts of a stepping relay. In the prior art devices, however, each pair of contacts has related to it some kind of a latching, unlatching, or other mechanical conditioning means so that operation of one pair on a pulse makes the next pair ready for operation by the next pulse, and so on.

On a "black box" basis, the relay of this invention would appear to be the same as the devices of the prior art but it is not because it differs therefrom in its mechanism and operation. The interrelation of the contact pairs of this device is magnetic and no mechanical interconnecting means is required.

An illustrative embodiment of this invention comprises a row of deflectable magnetic reeds or armatures and a like row of fixed magnetic contacts interleaved with the reeds. The rows are longitudinally offset so that with an equal number of armatures and of fixed contacts there is an armature at the "start" and a fixed contact at the "finish" end of the rows. The elements are spaced so that each armature except the one at the start end is flanked by two fixed contacts, each of which is at the same distance from its armature as is the other.

In order for this array to perform as required, magnetic operators are associated with the magnetic contact elements. These operators comprise a holding or latching means and an operating means. Each of these means may be and usually will be an electromagnet.

A convenient way to arrange the assembly is to surround the fixed contacts with a latching coil and the deflectable contacts or reeds with an operating coil. With the parts so assembled, the stepping operation may proceed in this way:

The latching magnet is activated but nothing happens until the application of a pulse to the operating coil. The combined effect of the two coils causes the odd armature (the before noted one at the start end) to be attracted to the adjacent fixed contact. None of the other armatures is deflected by this pulse because each is equally spaced between two fixed contacts and magnetic balance obtains. The operation of the first armature applies a magnetic shunt to one side of the next magnetically balanced arrangement, thus unbalancing it and preparing it for operation at the next pulse.

The indicated operation may be continued step by step through the whole array. Each armature remains magnetically latched to its contact by virtue of the continued operation of the latching magnet. The array may be conditioned for another stepping series by a short interruption of the latching field.

The operation of this switch may perhaps be better understood by assuming that the latching magnet sets up a south pole at the free end of each fixed contact. Then the provision by the operating magnet of a north

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pole at the end of each magnetic armature causes mutual attraction if not prevented by the balanced condition, when it occurs.

Although the latching magnet may be an electromagnet, it may also be a permanent magnet. In such a case, it would probably be fixed in position but might be made movable into and out of operative position. If the latching magnet were permanent and fixed, the array could be deactivated by means of a reverse pulse on the operating coil to provide adjacent like poles to repel the armatures from the fixed contacts.

It may be noted that with the latching magnet activated, a long pulse or continuous energization of the operating magnet would cause a stepping through the array either clear to the end or to an intermediate point as dictated by the length of the long pulse. In order for this relay to operate on a one-step-per-pulse basis, the pulses must be only of sufficient duration to deflect one armature but not the next one.

In view of the foregoing, it is presumably apparent that an object of this invention is to improve stepping or pulsing relays by means of an electromagnetic arrangement featured by the elimination of mechanical conditioning means that require or permit successive operation of the individual switches of a series of switches.

The following description of exemplary embodiments of this invention will serve to illustrate the objects sought to be accomplished and the features involved in this accomplishment. This description is related to suitable drawings, in which:

FIG. 1 is a diagrammatic representation of one embodiment of the invention;

FIG. 2 is a similar representation of another embodiment;

FIG. 3 is a picturization in elevation of one rendering of an assembled switching arrangement; and

FIG. 4 is a perspective view of the device of FIG. 3.

The arrangement shown in FIG. 1 includes a series of make switches comprising deflectable contacts, armatures, or reeds 11, 12, 13, 14, and 15 cooperating respectively with fixed or stub contacts 11A, 12A, 13A, 14A, and 15A. These contacts of magnetic material are mounted respectively in base members 10 and 10A of insulation. A latching or holding coil 20A encompasses the fixed contacts 11A through 15A, and an operating coil 20 the deflectable contacts 11 to 15, inclusive.

It will be noted that the two sets of contacts are interleaved, and that each deflectable contact except 11 is flanked by two fixed contacts, and each fixed contact except 15A by two deflectable contacts. In the quiescent or unoperated condition of this relay each flanking contact is essentially the same distance from the intervening contact as its flanking mate, that is, 11A and 12A from 12, 12A and 13A from 13, etc.

If the holding coil 20A is energized so as to make the free ends of each fixed contact the south pole as illustrated, the energization of the operation coil 20 should be so as to make the movable ends of the deflectable contacts each a north pole. Thus, a suitable pulse on coil 20 will cause the reed 11 to be deflected into contact with the contact 11A. The remaining reeds will not be deflected because of the magnetic balancing effect of their flanking contacts. The presence of the reed 11 against the stub contact 11A essentially eliminates its magnetic pole effect, leaving the reed 12 in an unbalanced field and thus conditioned to be operated by the next pulse on the coil 20. Thus, each operated switch prepares its next neighbor for operation all the way down the line. The holding or latching of each switch by the holding coil is continued until canceled in some way. One way of doing this is by deenergization of the holding coil.

If the operating power is steady rather than pulse, the

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stepping will continue from beginning to end. Therefore, if one step of the relay per pulse is required, this pulse must be short enough to allow interruption of such continuous operation. An arrangement of this kind can be used to operate a given number of switches by the application of a pulse of suitable length. Conversely, a pulse of unknown length can be measured by counting the number of switches operated. Other variants will occur to those skilled in the art.

The relay illustrated in FIG. 2 is similar to that of FIG. 1 but in addition has nonmagnetic back contacts so that it can perform transfer functions. For each deflectable reed 11, 12, etc. there is a mating nonmagnetic back contact 11B, 12B, etc. Each reed is mechanically biased against its back contact. Upon operation of the relay, the reed 11 leaves the back contact 11B and moves to the fixed contact 11A which is a front contact, and so on.

As has been indicated hereinbefore, the magnetic field for operating a relay of this kind may be set up by electromagnets, permanent magnets, magnetically remanent bodies, or combinations of them.

This kind of relay may take various forms for practical use, one of which is illustrated in FIGS. 3 and 4. The deflectable contacts or reeds 30 may be molded into a supporting block 31. A similar block 32 supports the fixed or stub contacts 33. An operating coil 34 fits around the reeds 30 and a hold or latching coil 35 around the fixed contacts 33. These elements may be fitted into a box or housing 36 as shown. The terminals 37 and 38, which may be molded respectively into the blocks 31 and 32, serve to make connections to the deflectable and the fixed contacts. The terminals 39—39 and 40—40 are for making connection to the operating and latching coils

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respectively. The housing or box 36 may have a transparent or opaque cover as required.

What is claimed is:

1. In combination:

a plurality of fixed magnetic members;
a like plurality of deflectable magnetic members interleaved with the fixed magnetic members so that each deflectable magnetic member except one is between two fixed magnetic members and equidistant therefrom;

means for generating a magnetic field with respect to the fixed magnetic members; and

means for generating a magnetic field with respect to the deflectable magnetic members.

2. A stepping relay comprising:

a plurality of aligned fixed magnetic contacts;

a like plurality of aligned deflectable magnetic contacts interleaved with the fixed magnetic contacts so that each deflectable magnetic contact except one at the end is flanked by two fixed magnetic contacts each at the same distance therefrom;

means for generating a magnetic field of a particular polarity with respect to the fixed magnetic contacts; and

means for generating a magnetic field of opposite polarity with respect to the deflectable contacts.

3. A stepping relay as in claim 2 further having a plurality of nonmagnetic fixed contacts in engagement with each deflectable magnetic contact when it is undeflected.

No references cited.

BERNARD A. GILHEANY, *Primary Examiner*.

ROBERT K. SCHAEFER, *Examiner*.