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Ioffe et al.

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[54] METHOD OF ORIENTATION OF ELECTRICALLY CONDUCTIVE BODIES BY MAGNETIC FIELD AND DEVICE FOR PERFORMING THIS METHOD

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[52] **U.S. Cl.** **335/219**
[51] **Int. Cl.** **H01f 7/00**
[58] **Field of Search** 335/219, 229, 250

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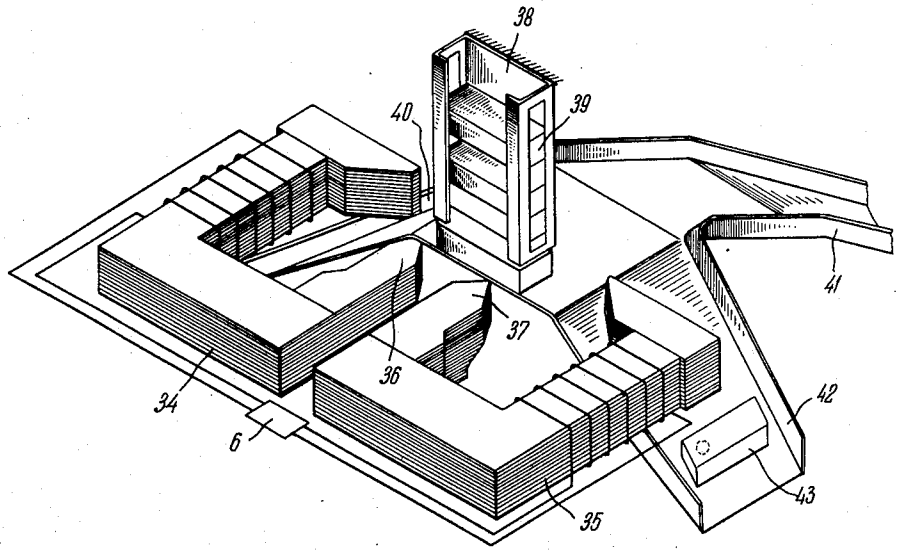
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Attorney—Waters, Roditi, Schwartz & Nissen

[57] **ABSTRACT**

A method and device for establishing within a zone of orientation at least two cyclically varying magnetic fluxes spaced from each other by a distance not exceeding the length of a body being oriented; with the body being positioned in this zone so that one of the two fluxes should pass through one portion of the body and the other one of said two fluxes should pass through the other portion of the body.

6 Claims, 9 Drawing Figures



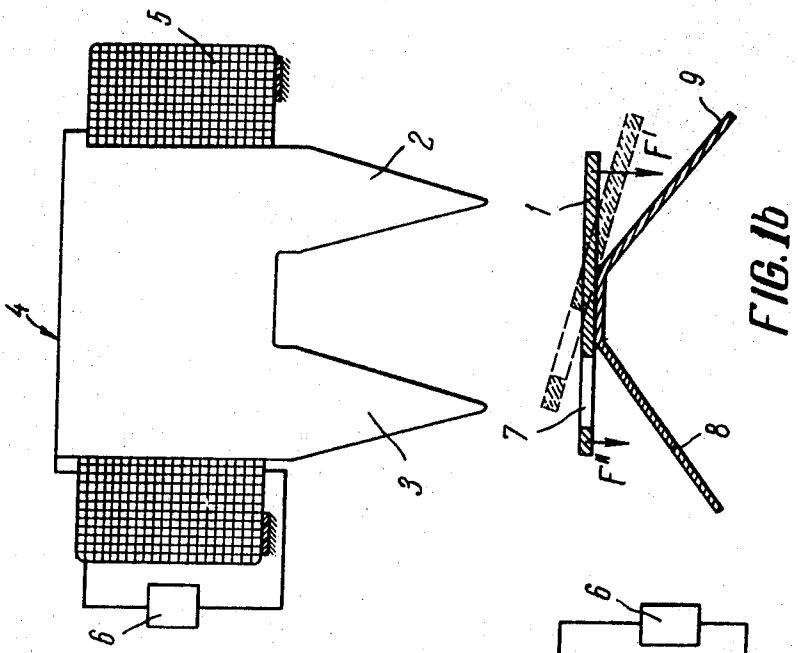


FIG. 1b

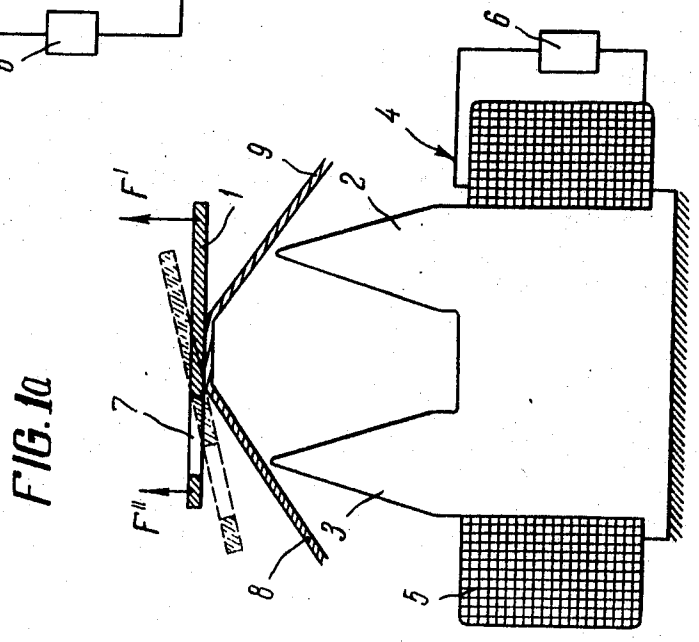


FIG. 1a

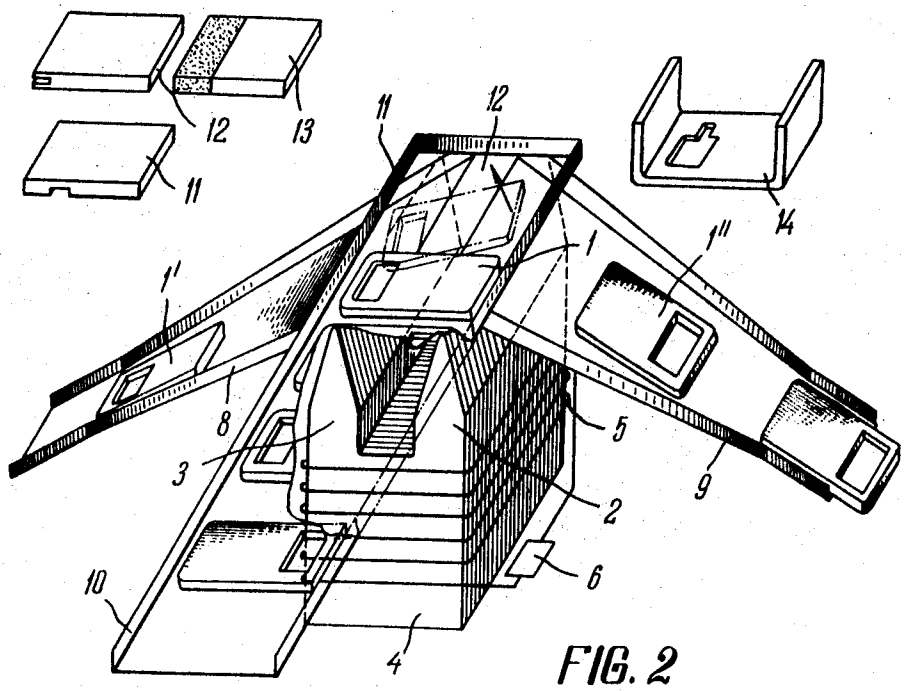


FIG. 2

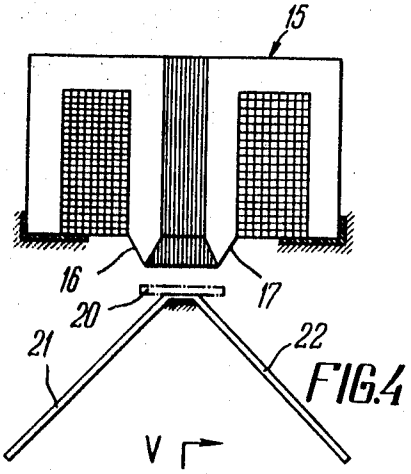


FIG. 4

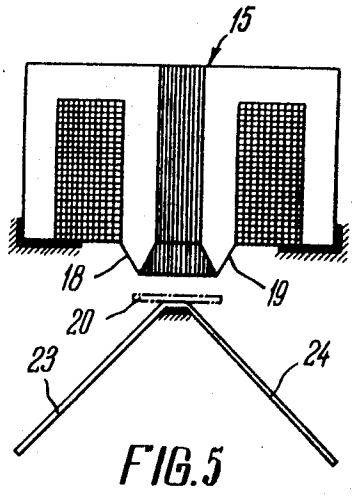


FIG. 5

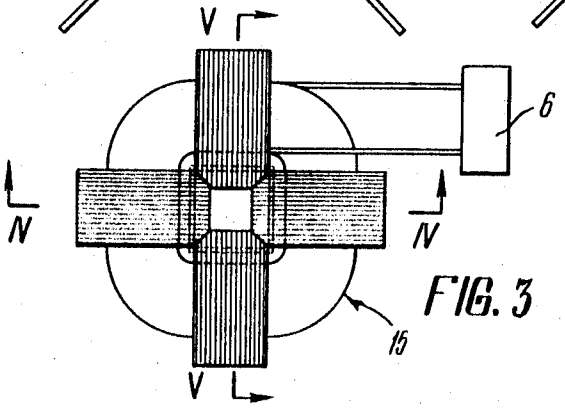


FIG. 3

FIG. 6

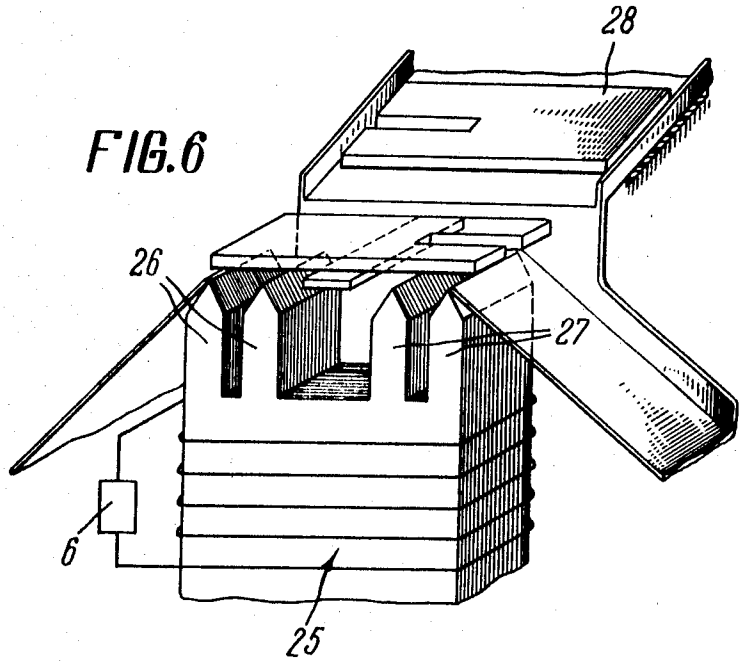
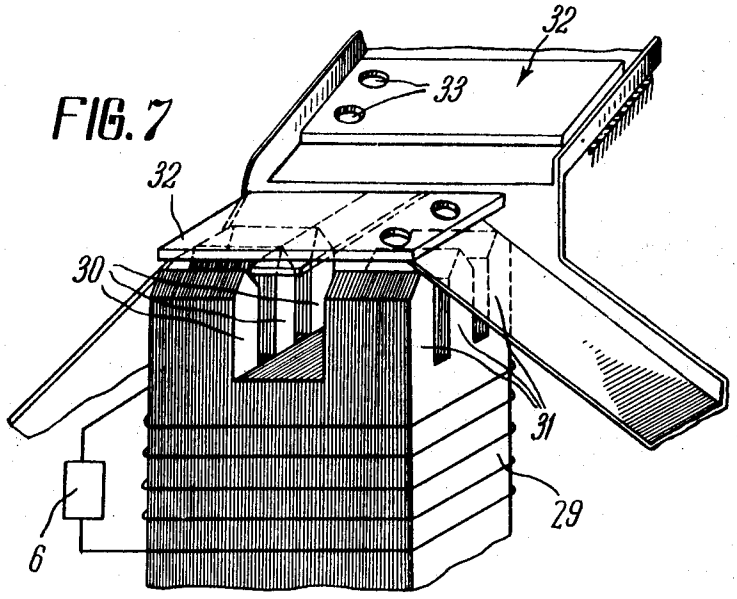


FIG. 7



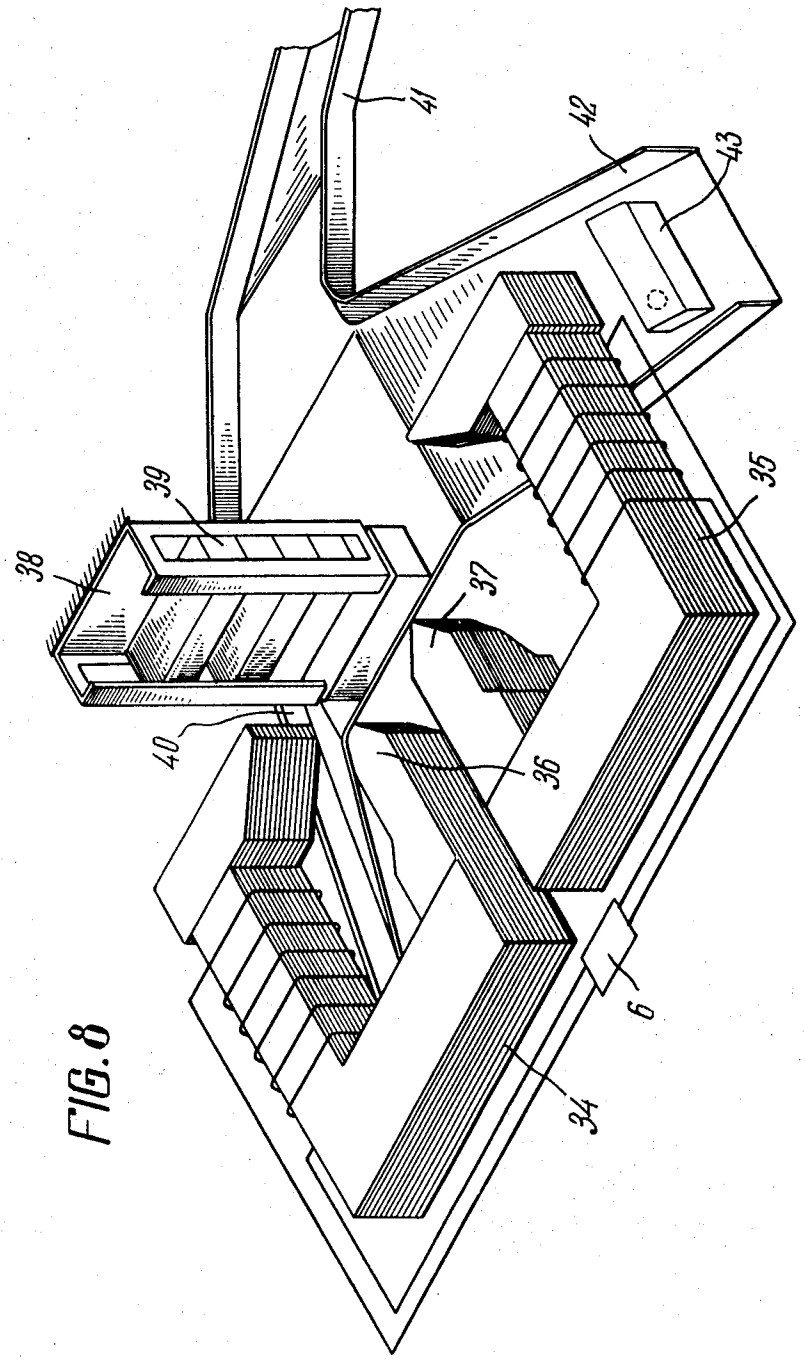


FIG. 8

METHOD OF ORIENTATION OF ELECTRICALLY CONDUCTIVE BODIES BY MAGNETIC FIELD AND DEVICE FOR PERFORMING THIS METHOD

The present invention relates to the branches of industry where electrically conductive bodies are to be oriented in a desired direction; it can be used in the various fields of industry, particularly, during automation of production processes for orientation of diverse workpieces and constituent parts in the course of their machining, treatment and assembling into the corresponding units, machines, apparatuses and instruments.

Known in the art is method of orientation of electrically conductive bodies, according to which the bodies are oriented by the interaction of a magnetic field produced by a permanent magnet with the alternating currents induced in the body being oriented.

However, this known method does not provide a high degree of accuracy of the orientation of electrically conductive bodies; it is performed by devices of a comparatively complicated structure and is unable to deal with various widely used plate-like parts characterized by electrical asymmetry, i.e. either of an asymmetrical geometrical shape, or of a symmetrical geometrical shape but of a non-uniform composition, e.g. having portions thereof made of different materials.

It is, therefore, an object of the present invention to eliminate these disadvantages.

The main object of the present invention is to provide a method which should be performed by comparatively simple means and should provide for accurate and reliable orientation of a broad range of electrically conductive, preferably non-magnetic, substantially flat bodies characterized by electrical asymmetry; and also the creation of a device for performing such method.

This object is accomplished by the hereinafter disclosed method of orientation of electrically conductive bodies, wherein, in accordance with the present invention, there are established within a zone of orientation at least two cyclically varying magnetic fluxes spaced from each other by a distance not exceeding the length of a body being oriented, the bodies being successively positioned so that one of said two magnetic fluxes passes through one portion of said body being oriented, and the other one of said two magnetic fluxes passes through the other portion of said body.

It is advisable for these at least two magnetic fluxes established within said zone of orientation to produce each a non-uniform magnetic field, with the induction characteristic of said magnetic field increasing toward the central zone of the respective one of said magnetic fluxes.

It is expedient according to the present invention to provide a device for orientation electrically conductive bodies, performing the method of the present invention, in the form of an electromagnet adapted to be supplied with an alternating electric current, said electromagnet having one of its pole pieces provided with at least two wedge-shaped projections having the respective pointed ends thereof positioned adjacent to said zone of orientation, aligned with each other and spaced from each other by a distance not exceeding the length of said body being oriented, the device further comprising means for supplying said bodies in succession toward said zone of orientation and troughs for removing said bodies after the orientation.

According to another preferred embodiment of a device for orientation of electrically conductive bodies, performing the method of the present invention, such device comprises a pair of electromagnets adapted each to be supplied with an alternating electric current, said pair of electromagnets having the respective similar pole pieces thereof wedge-shaped in configuration, with the respective pointed ends of said pole pieces being aligned with each other, positioned adjacent to said zone of orientation and spaced from each other by a distance not exceeding the length of said body being oriented, said device further comprising means for supplying said bodies in succession toward said zone of orientation and trays for removing said bodies after orientation.

The contemplated method can be accomplished by means of a comparatively simple, inexpensive and compact devices, which can be readily incorporated in various production lines and units where the parts and articles being treated are conveyed in succession. Moreover, the invention may be used to a maximal profit for orientation a broad range of substantially flat parts which cannot be oriented by the methods of the prior art.

A method embodying the present invention can be performed by simple means providing rejection and assorting of parts being treated, depending on either the presence or absence of an obvious feature or a hidden one, such as a crack, a hollow, an opening, a channel, a cutaway portion, etc.

There follows hereinbelow a detailed description of some of the preferred embodiments of the present invention in a device for orientation electrically conductive bodies, with due reference being had to the accompanying drawings.

FIGS 1*a* and *b* illustrate the proposed method of orientation of bodies by a magnetic field;

FIG. 2 shows schematically a device for orientation of electrically conductive bodies, embodying the invention, the device including an electromagnet having one of its pole pieces provided with two projections extending parallel to each other;

FIG. 3— same, as in FIG. 2, including an electromagnet having one of its pole pieces provided with four projections disposed at the apices of a square;

FIG. 4 — same, taken along line IV— IV of FIG. 3;

FIG. 5 — same, taken along line V—V of FIG. 3;

FIG. 6 — same, including an electromagnet having one of its pole pieces provided with two pairs of projections, extending parallel to each other;

FIG. 7 — same, including an electromagnet having one of its hole pieces provided with two rows of projections extending parallel to each other;

FIG. 8 — same, including a pair of electromagnets.

The proposed method resides in the following.

A body, for example, plate 1 (FIG. 1*a*) is positioned in the zone of orientation disposed above the wedge-shaped projections 2 and 3 of the electromagnet 4 the winding 5 of which is connected to a source 6 of electric alternating current. Two similar magnetic fluxes are originate, shifted relative to each other.

The first flux from the projection 2 penetrates the right-hand solid portion of the plate 1, and the second flux from the wedge-shaped projection 3 penetrates the left-hand portion of the plate 1, said portion has an aperture 7. This gives rise to electrodynamic forces F′ and F″ due to interaction of the magnetic fluxes and currents induced thereby in the corresponding portions of the plate. 1. The intensity of current in the solid portion of the plate, naturally will be greater than in the apertured portion thereof. Therefore, the force F′ will exceed the force F″, the plate 1 will turn anticlockwise and, subject to the action of gravity, will be brought away from the orientation zone by left-hand trough 8. Obviously, should the plate 1 be brought into the orientation zone in such a manner, that its portion with the aperture 7 be found above the wedge-shaped projection 2, it will turn clockwise and be brought away from the orientation zone by trough 9. The wedge shape of the projections 2 and 3 ensures an increase of the amplitude in the direction towards the middle of each flux, whereby the magnetic fluxes prove to be considerably concentrated, and the parts are oriented with a greater precision and rapidity.

The above-considered method can be effected not only when the parts are disposed above the wedge-shaped projections of the electromagnet, but also when said parts are found beneath the projections, as shown in FIG. 1*b*.

Referring now in particular to the drawings, a device for orientation electrically conductive bodies includes an electromagnet (FIG. 2) with a winding 5 adapted to be connected to an A.C. source 6, one of the pole pieces of the electromagnet being provided with a pair of wedge-shaped, or pointed projections 2 and 3.

These projections extend toward a zone **5** where successive bodies **1** are oriented. The device further includes a device **10** for feeding bodies **1** to the zone of orientation and troughs **8** and **9** removing oriented bodies **1** and **1'**.

The device mentioned above can orient different details, for example, plates **11**, **13**, clips **14** and the other, one part of which has more electrical resistance than the other.

The embodiment illustrated in FIG. **3–5** differs from the one already described by the pole piece **15** of the electromagnet having four projections **16**, **17**, **18** and **19** disposed at the apices of a square.

Such device provides for orientation of bodies **20** of a shape, resembling that of a square, in four directions and, consequently, to remove or assort them in four directions, onto the respective four troughs **21**, **22**, **23** and **24**. Apart from this last-mentioned feature, the embodiment shown in FIG. **2** and the operation thereof are similar to those described above in connection with FIG. **2**.

The embodiment illustrated in FIG. **6** is characterized by the pole piece **25** of the electromagnet having two opposite pairs **26** and **27** of parallel projections. Such a device may be preferred for dealing with bodies of the kind designated by the numeral **28** in the drawing, i.e. bodies wherein one end portion has a longitudinal slot, an open cutaway area or a similar structural feature extending in the longitudinal direction of the body. It has been found that the arrangement shown in FIG. **6** makes the operation of orientation of such bodies considerably more efficient.

In the embodiment shown in FIG. **7** the electromagnet **29** has the pole piece provided with two parallel rows **30** and **31** of parallel projections. The last-mentioned device proves to be particularly efficient for orientation of bodies **32** having in one end portion thereof a transversely extending slot, a cutaway area a series of apertures **33** extending transversely of the body, or a similar feature.

In the embodiment illustrated in FIG. **8** there are two electromagnets **34** and **35** which have their respective similar pole pieces **36** and **37** provided with wedge-shaped projections, with the pointed ends of these projections extending toward the zone of orientation; a feeding device **38** supplying bodies **39** in succession toward the zone of orientation and discharge troughs **40**, **41** and **42** onto which the bodies **43** are directed as a result of the orientation.

When a successive body gets into the zone of orientation from the feeding device (which may be a simple hopper containing a vertical stack of bodies), it is forced by the interaction of the respective magnetic fluxes, coming from the pole pieces **36** and **37**, with the electric currents, induced in this body **39**, in a corresponding direction, depending on the character of this body, i.e. the body is directed onto the central trough **41** if it is electrically symmetrical; it is directed onto the left-hand trough **40** if the portion thereof adjacent to the pole piece **36** has a greater electrical resistance than the rest of the body (e.g. on account of this body having an aperture in the end portion adjacent to the pole piece **36**); or else it might be directed onto the right-hand trough **42**, if it is the end portion of the body **39**, which is adjacent to the pole piece **37**, that possesses a greater electrical resistance than the opposite end portion thereof. In the last-mentioned case the body **43** will slide down the inclined trough **42** in a position indicated in FIG. **8**.

What is claimed is:

1. A method of orientation of electrically conductive bodies by a magnetic field, comprising the steps of; establishing in a zone of orientation at least two cyclically varying magnetic fluxes spaced from each other by a distance not exceeding the length of a body being oriented, and positioning said body so that one of said at least two magnetic fluxes passes through one portion of said body, whereas the other of said at least two magnetic fluxes, which is identical to the first flux in direction, induction value and irregularity, passes through another portion of said body, the fluxes being so arranged with respect to any asymmetric portions of the body at an equal distance from the geometric axis of the body being oriented so that the centers of the magnetic fluxes are perpendicular to the portions of the body in its initial position.

2. A method as claimed in claim **1**, wherein each one of said at least two cyclically varying magnetic fluxes produces a non-uniform magnetic field, with the induction characteristic of said magnetic field increasing toward the center of the respective one of said magnetic fluxes.

3. A device for the orientation of electrically conductive bodies by a magnetic field, comprising an electromagnet adapted to be supplied with an alternating current; a pole piece on said electromagnet, said pole piece being provided with at least two wedge-shaped projections having the respective pointed ends thereof positioned adjacent to the zone of orientation, said respective pointed ends being aligned with each other and spaced by a distance not exceeding the length of a successive one of said bodies being oriented; means for supplying said bodies in succession toward said zone of orientation, and troughs for removing said successive bodies after the orientation, said projections of the pole piece being adapted to be located both on the lower side and on the upper side of the body being oriented, the quantity of said troughs corresponding to the number of faces of a body subjected to simultaneous action of the magnetic fluxes.

4. A device for the orientation of electrically conductive bodies by a magnetic field, comprising an electromagnet adapted to be supplied with alternating current said magnet having a pole piece, projections on said pole piece, and a trough for supplying bodies and removing the same after the orientation, the projections of the pole piece of the electromagnet facing the body in its initial position being made in the form of symmetrically arranged groups of projections, the number and location of said groups being so selected that the current induced in the body in the area of the orientation constituted by one group of projections is subjected to the maximum total distortion with respect to the current induced in the other portion of the body by another group of projections of the pole piece, the groups of projections of the pole piece being arranged with respect to one of the sides of the body which they face at a definite angle whereby when the body has a configuration in the form of a groove, in accordance with which the body is oriented, the group of projections is formed and arranged so that the line of the pointed end of each separate projection of the group is directed at right angles to the groove of the body.

5. A device for the orientation of electrically conductive bodies by a magnetic field, comprising a pair of electromagnets adapted each to be connected to a source of alternating electric current, a pair of respective similar pole pieces on said pair of electromagnets, said pole pieces being generally wedge-shaped in configuration and with the respective pointed ends of said pole pieces being aligned with each other and positioned adjacent a zone of orientation, said respective pointed ends being spaced from each other by a distance not exceeding the length of a body being oriented, said electromagnets being symmetrically located with respect to the body being oriented and acting upon the latter with non-overlapping magnetic fluxes, means for supplying said bodies in succession toward said zone of orientation, said means being located above the zone of orientation, said troughs for removing said successive bodies after orientation having at least three branches, one of said branches extending in the direction of the projections of the pole pieces and adapted for removing bodies having symmetrical features, the two other branches extending laterally with respect to the first branch.

6. A device for the orientation of electrically conductive bodies by a magnetic field, comprising at least one electromagnet supplied with an alternating current, said electromagnet having a pole piece, the pole piece of said electromagnet facing the body being oriented being provided with a plurality of projections, each of the pole pieces comprising groups of said projections having pointed ends, the pointed ends facing toward the body being oriented, so as to produce magnetic fluxes which are concentrated.

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