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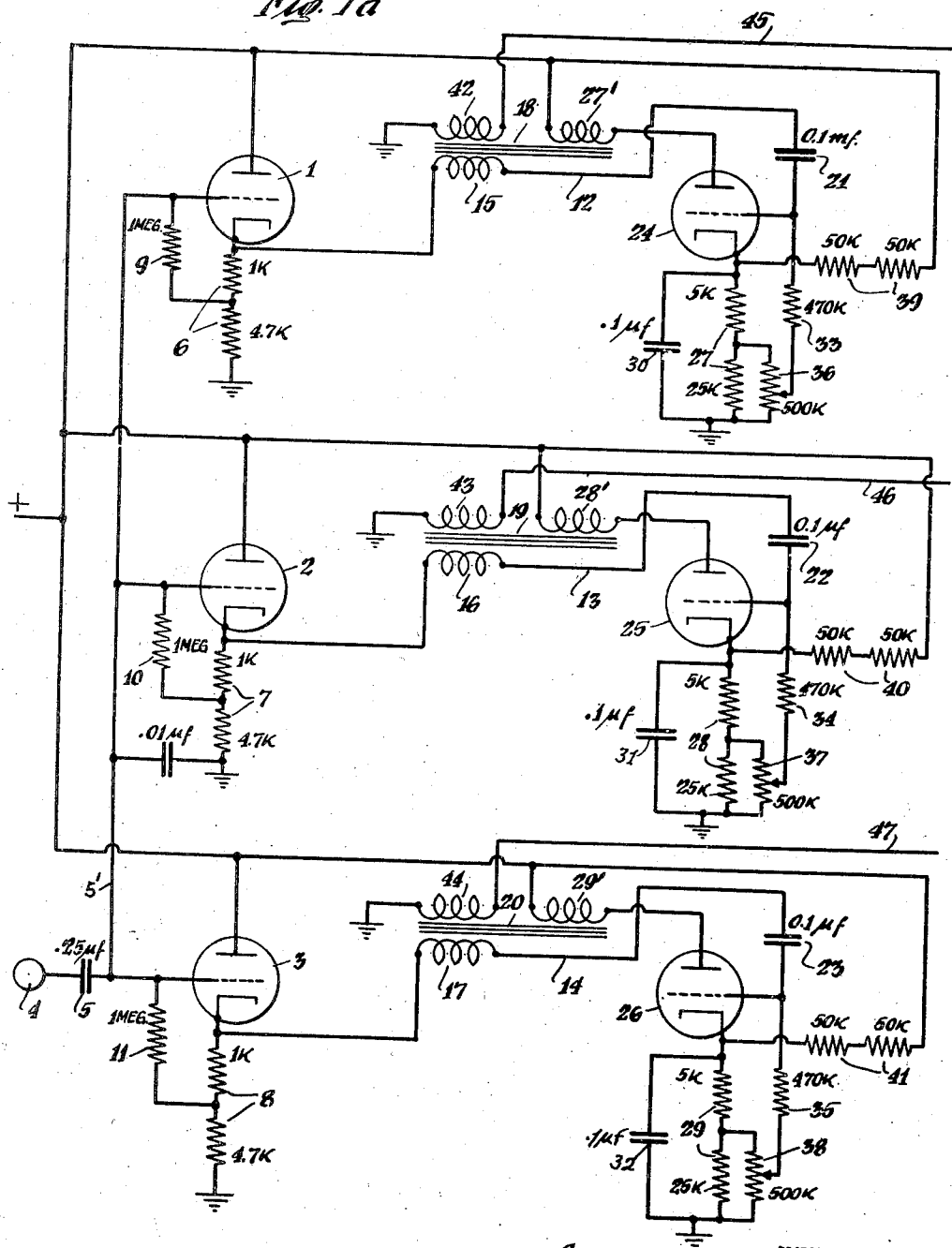
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DEVICE FOR SELECTING METAL PIECES

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2 Sheets-Sheet 1

Fig. 1a



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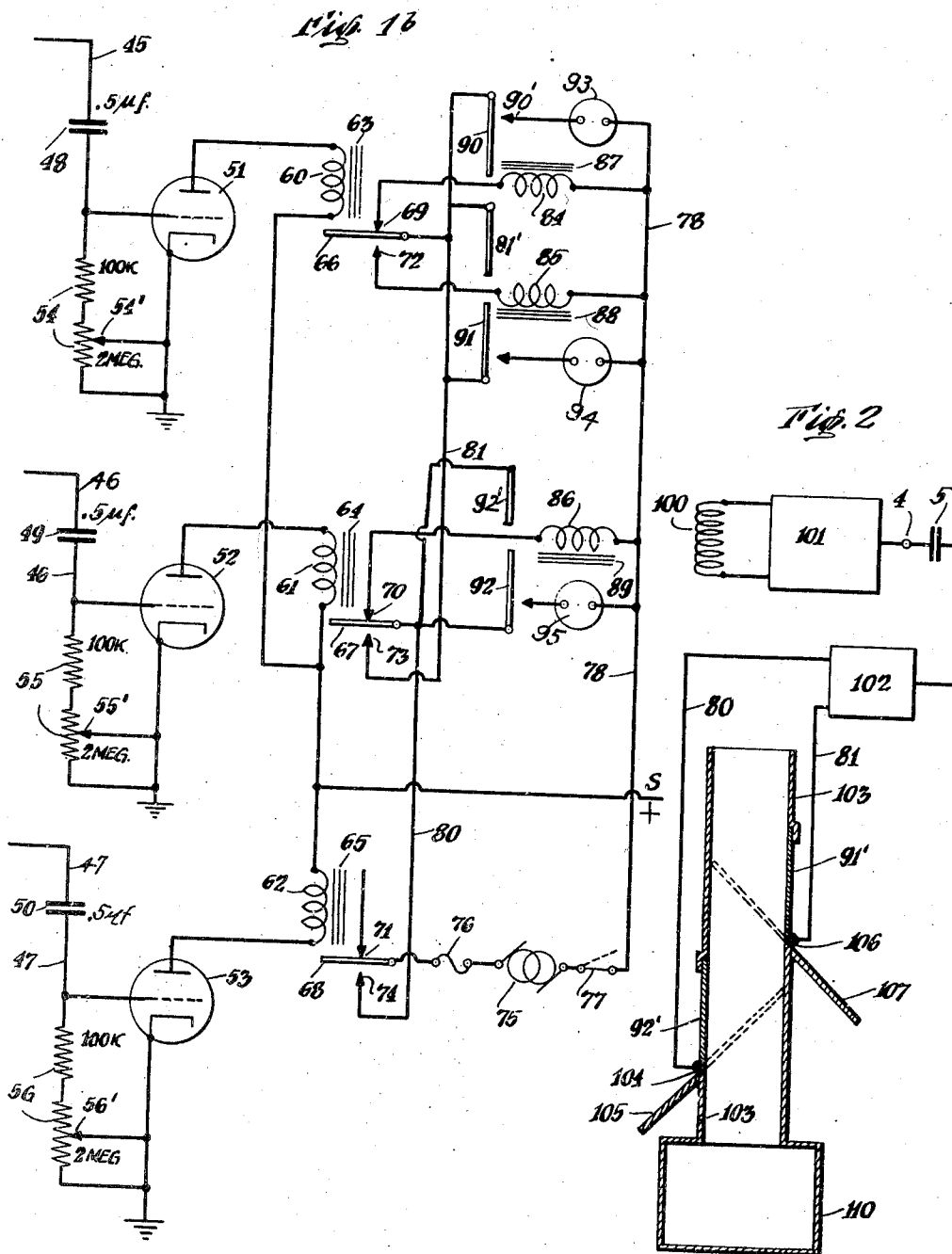
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DEVICE FOR SELECTING METAL PIECES

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This invention relates to a device for selecting metal pieces, or separating such pieces from others which may look like them and are of the same shape and size.

It is known that when metal articles are made from metal stock the articles often differ from each other because of differences in the metal stock due to composition or heat treatment or other causes.

By the present invention such articles or metal pieces can be rapidly examined by means of a device that is simple in operation and rapid and accurate in results. The device does not require a high degree of skill or prolonged training on the part of the operator. The unsatisfactory pieces can be separated by reason of signals they produce with the device or they can be separated from the satisfactory pieces automatically.

In carrying out the invention signals are obtained by passing the articles in succession through an inductance coil which is a portion of a device which is already known but which is not a part of the present invention, but which produces different signals in accordance with the core losses such as hysteresis losses, eddy current losses, etc., that occur when the metal articles are passed through a coil that is a portion of the tank circuit of a high frequency oscillator. Signals from such a device are applied to the present device. This signal-producing device is indicated diagrammatically in Fig. 2 of the drawings and will be briefly described later.

The present invention may be understood from the description in connection with the accompanying drawings, in which:

Fig. 1a is a diagram showing a portion of the device;

Fig. 1b is a diagram showing another portion thereof; and

Fig. 2 is partly in section and partly diagrammatic showing how the pieces may be automatically separated into groups.

In the drawings, the indicated values of resistances and capacitances are illustrative.

Reference characters 1, 2 and 3 indicate vacuum tubes the control grids of which are coupled to the input terminal 4 by capacitor 5 and lead 5'. Resistors 6, 7 and 8 are provided between the cathodes of tubes 1, 2 and 3 and ground. Grid bias resistors 9, 10 and 11 of the tubes 1, 2 and 3 are connected to intermediate points on the resistors 6, 7 and 8, respectively.

The cathodes of tubes 1, 2 and 3 are coupled by primaries of transformers 15, 16 and 17, leads 12, 13 and 14, and capacitors 21, 22 and 23, re-

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spectively, to the grids of the blocking oscillator tubes 24, 25 and 26. The plates of these tubes are connected through secondaries 27', 28' and 29' of the transformers 18, 19 and 20, to a source of direct current which is also connected to the plates of tubes 1, 2 and 3.

Cathode biasing resistors 27, 28 and 29 are connected in the cathode circuits of the tubes 24, 25 and 26. By-pass condensers 30, 31 and 32 are provided for the resistors 27, 28 and 29. Grid biasing resistors 33, 34 and 35 are provided for the tubes 24, 25 and 26 and are connected by sliding contactors to the resistors 36, 37 and 38 that are in parallel with portions of the resistors 27, 28 and 29, respectively. Resistors 39, 40 and 41 are provided between the source of current for the plates of tubes 24, 25 and 26 and the cathodes of these tubes.

Secondaries 42, 43 and 44 of the transformers 18, 19 and 20 are connected by leads 45, 46 and 47 and capacitors 48, 49 and 50 (Fig. 1b), to the control grids of tubes 51, 52 and 53. These tubes are provided with grid leak resistors 54, 55 and 56 and are adjustable by means of the sliding contactors 54', 55', 56'.

Coils 60, 61 and 62 of relays 63, 64 and 65 are located between a source S of direct current and the plates of tubes 51, 52 and 53, respectively. The relay arms 66, 67 and 68 are provided with contactors 69, 70 and 71 for their upper positions and with contactors 72, 73 and 74 for their lower positions.

A source 75 of alternating current is connected through the fuse 76 to the relay arm 66 and through the switch 77 to the lead 78. Lead 80 connects the contactor 74 to the relay arm 67, and lead 81 connects contactor 73 to the relay arm 66.

Relay coils 84, 85 and 86 are provided for relays 87, 88 and 89, for which relay arms 90, 91, 91', 92 and 92' are provided. The arms 90, 91 and 91' are connected to lead 81 and the arms 92 and 92' are connected to the lead 80. Electric lamps 93, 94 and 95 are connected between lead 78 and relay arms 90, 91 and 92, respectively. When these arms 90, 91 and 92 are in their closed positions, the lamps 93, 94 and 95 are lighted.

Reference character 100, Fig. 2, indicates the inductance coil mentioned above through which the articles to be tested or examined are passed, and reference character 101 indicates diagrammatically the already known device which produces high frequency signals of different amplitudes in accordance with the core losses, such as hysteresis losses, eddy current losses, etc., which

occur when the specimens are passed through the coil 100, these specimens being of the same shape, size and material. Reference characters 4 and 5 indicate the input terminal 4 and capacitor 5 shown on Fig. 1a, and the block 102 represents the device described above in connection with Figs. 1a and 1b.

The hinge 104 in the side of the conduit 103 is for the door 92' that is operated by the coil 86, Fig. 1b, simultaneously with the arm 92 to swing the door 92' to the dotted line position and the hinge 106 is for the door 91' that is operated by the coil 85 simultaneously with the arm 91 to swing the door 91' to the dotted line position. Plates 105 and 107 along the sides of the conduit 103 are for diverting the articles that are not standard to the sides so that they are separated from the standard ones which enter the container 110.

The operation is as follows:

The sliding contact on the resistor 38 in the cathode circuit of tube 26 is adjusted so that the oscillator 26 will oscillate when a signal is applied at the input terminal 4 due to a test specimen being dropped through the coil 100, Fig. 2, that has a smaller core loss than the standard. Tubes 24 and 25 are kept from oscillating at this signal level by adjusting the contactors on resistors 36 and 37.

The oscillation of tube 26 applies a positive signal pulse from coil 44 through lead 47 to the control grid of tube 53. This causes flow of grid current in tube 53 which charges condenser 50 and grid of tube 53 negatively, thus decreasing the current through coil 62 and permitting the relay arm 68 to contact with contactor 74 which closes the circuit from generator 75 through fuse 76, contactor 74, lead 80, contactor 70, coil 86, and switch 77 back to generator 75. This causes the coil 86 to close the relay arm 92 to flash the lamp 95. The coil 86 also operates the gate 92' in the usual way which causes the specimen to be diverted to the outside along the plate 105, Fig. 2. The length of time the gate 92' remains open can be controlled by the position of contactor 56' on a portion of resistor 56.

The sliding contact on the resistor 37 in the cathode circuit of tube 25 is adjusted to a point where a standard specimen passed through the coil 100 will cause the oscillators 25 and 26 to oscillate because of the core losses without causing the oscillator 24 to oscillate. The grid of tube 52 is made negative as described above in connection with tube 53 so that the relay arm 67 contacts with contactor 73 and prevents current from passing through coil 86. Current passes from generator 75 through arm 68, since coil 62 is then also de-energized at the same time as coil 61. This current also passes through the lead 80, contactor 73, lead 81, relay arm 66, contactor 69 and coil 84 back to generator 75. The flow of current through coil 84 closes contactor 90 and flashes the light 93. The standard specimen, or one like it, therefore passes through the conduit 103 into the container 110.

The sliding contact on resistor 36 in the cathode circuit of tube 24 is adjusted to a point where the oscillator will oscillate only when a specimen that has core losses greater than the standard piece is passed through the coil 100. Under such a condition the outputs from the coils 42, 43 and 44 of oscillators 24, 25 and 26 decrease the currents through coils 60, 61 and 62 so that contact arms 66, 67 and 68 drop to contacts 72, 73 and 74, respectively. Therefore,

current passes from source 75 through arm 68, contactor 74, lead 80, arm 67, contactor 73, lead 81, arm 66, contactor 72, coil 85, and lead 78 to source 75. The current through coil 85 causes it to close the relay arm 91 and flash the lamp 94. The coil 85 also operates the gate 91' which causes the specimen to be diverted to the outside along the plate 107, Fig. 2. The length of time the gate 91' remains open is controlled by the position of contactor 54' on a portion of resistor 54.

By the present invention means are provided whereby each object to be tested is caused to produce a relatively short impulse signal while passing through a coil. The circuit converts this short signal to an output control pulse by means of one or more blocking oscillators which in turn actuate time constant networks illustrated by condensers 48, 49 and 50 working respectively with resistors 54, 55 and 56, so that delayed action longer interval signals are produced. Thus the passage of an object through the coil 100 is caused to generate a controlling signal lasting sufficiently long for a finite travel interval of the object through the coil 100 and on through the sorting conduit 103 and gates 105 and 107. This memory mechanism is highly important for satisfactory sorting.

While most of the above description of the invention relates to the sorting of metal pieces that are capable of producing electrical signals characteristic of core losses, the invention is also suitable for or useful in selective sorting of various other types of objects, including non-metallic objects. It is only necessary that the several objects under test be capable of producing respective electrical signals which can be applied to the input terminal 4 of the device.

A particular advantage of this invention, applied to any types of objects, is the ability of the device to respond to a predetermined middle range of amplitudes and at the same time it is non-responsive to signals both above and below the predetermined mid-range of amplitude of the electrical signals that may be produced.

What is claimed is:

1. A device for separating metal pieces of the same shape and size but having different core losses when subjected to alternating magnetic fields, which comprises a series of blocking tube oscillators connected in parallel and so adjusted that a stronger pulse is required to cause each one in said series to oscillate than is required for the preceding one, relays connected to the outputs of said oscillators and adapted to be closed serially by said oscillators, and means controlled by said relays to sort said metal pieces in accordance with their having high, medium or low core losses when subjected to said fields.
2. The device of claim 1 in which there are three blocking tube oscillators in said series.
3. The device of claim 1 in which there are time constant networks actuated by the outputs of said blocking tube oscillators.
4. The device of claim 1 in which there are time constant networks actuated by the outputs of said blocking tube oscillators and located between the outputs of said oscillators and said relays.
5. The device of claim 1 in which signalling means are provided to show when said relays are closed.

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