United States Patent [19]

Tabiichi et al.

[11] **3,749,220**

[45] **July 31, 1973**

[54] **COIN DISCRIMINATING APPARATUS**

[75] Inventors: **Yukio Tabiichi; Yuichi Yamazaki,** both of Tokyo; **Takao Saito,** Kawasaki; **Toshimitsu Kataoka,** Tokyo, all of Japan

[73] Assignees: **Nippon Telegraph and Telephone Public Corporation; Anritsu Electric Company, Ltd.,** Tokyo, Japan

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[52] **U.S. Cl.** ..... **194/100 A**

[51] **Int. Cl.** **G07f 3/02**

[58] **Field of Search** ..... 194/100 R, 100 A

[56] **References Cited**

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Primary Examiner—SAmuel F. Coleman

Attorney—Charles W. Helzer

[57] **ABSTRACT**

The coin discriminating apparatus comprising a bridge circuit including an electromagnetic detection coil, a reference element, a bandpass filter connected to the output of the bridge circuit, an amplifier responsive to the output of the bandpass filter and a feedback circuit for positively feeding back the output of the amplifier to the bridge circuit. The reference element includes a reference metal piece which compensates for the variation of the characteristic of the electromagnetic detector coil caused by the variation in the ambient temperature.

13 Claims, 14 Drawing Figures

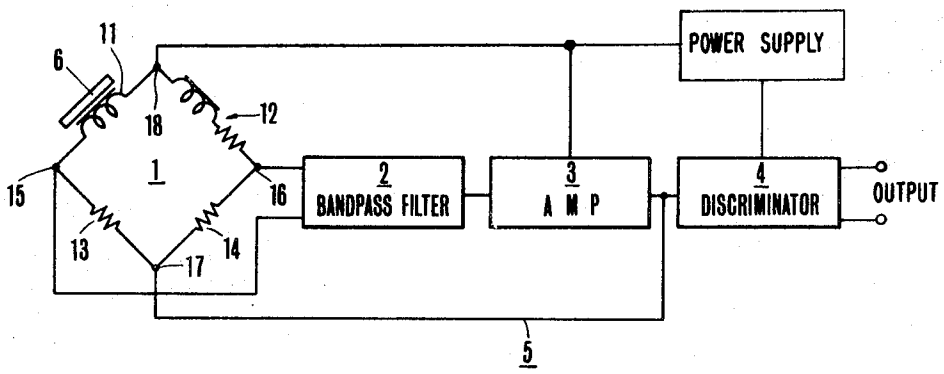


FIG. 1

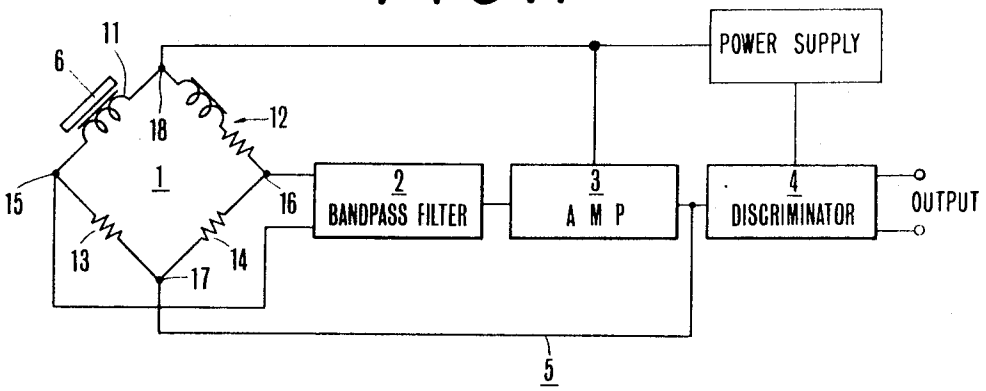
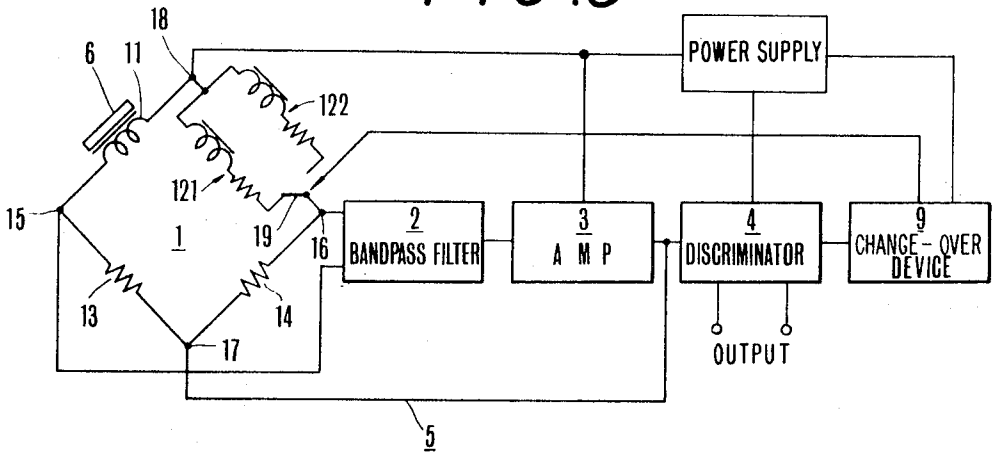


FIG. 5



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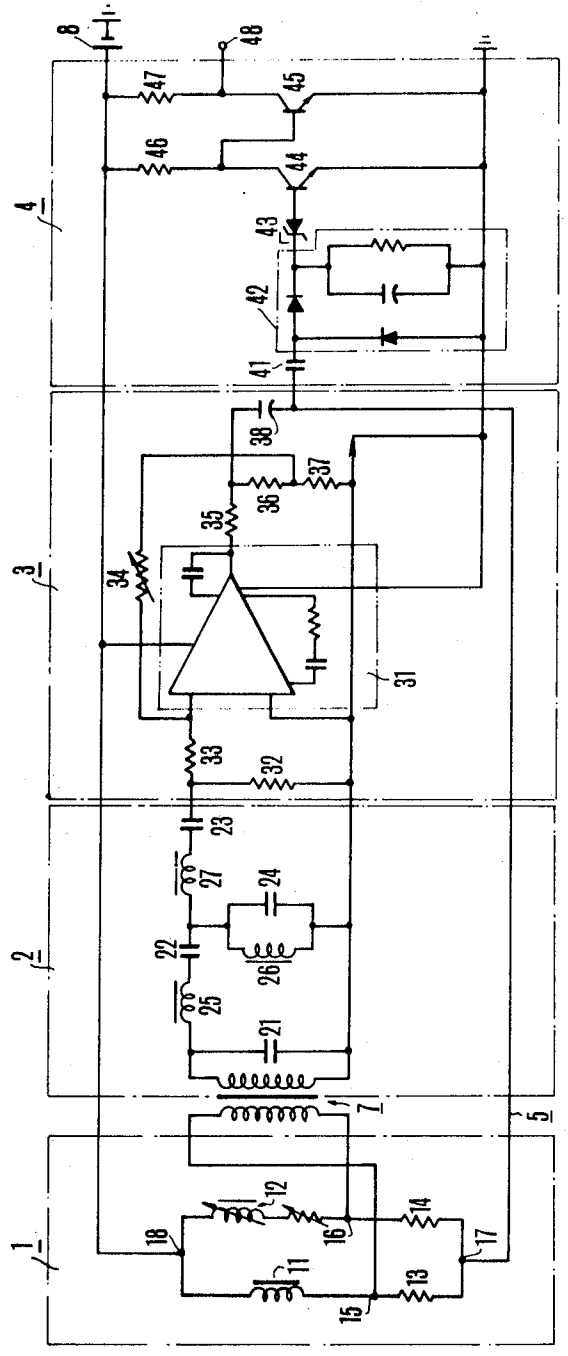


FIG. 2

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FIG. 3

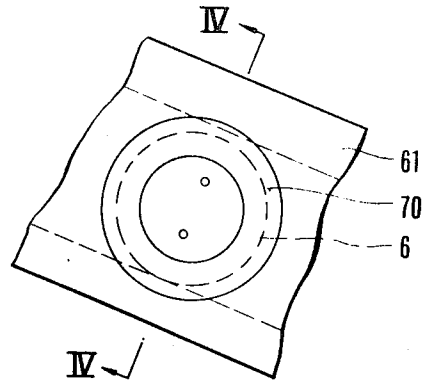
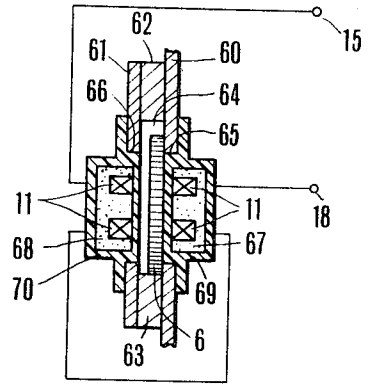


FIG. 4



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FIG. 6

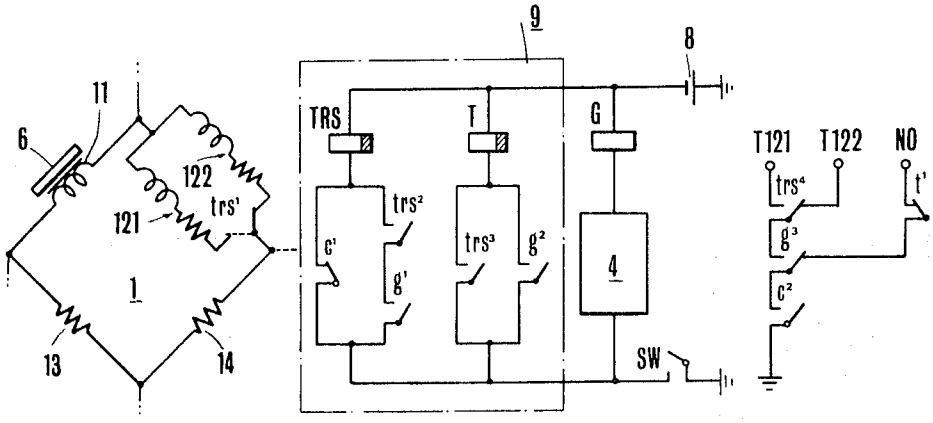
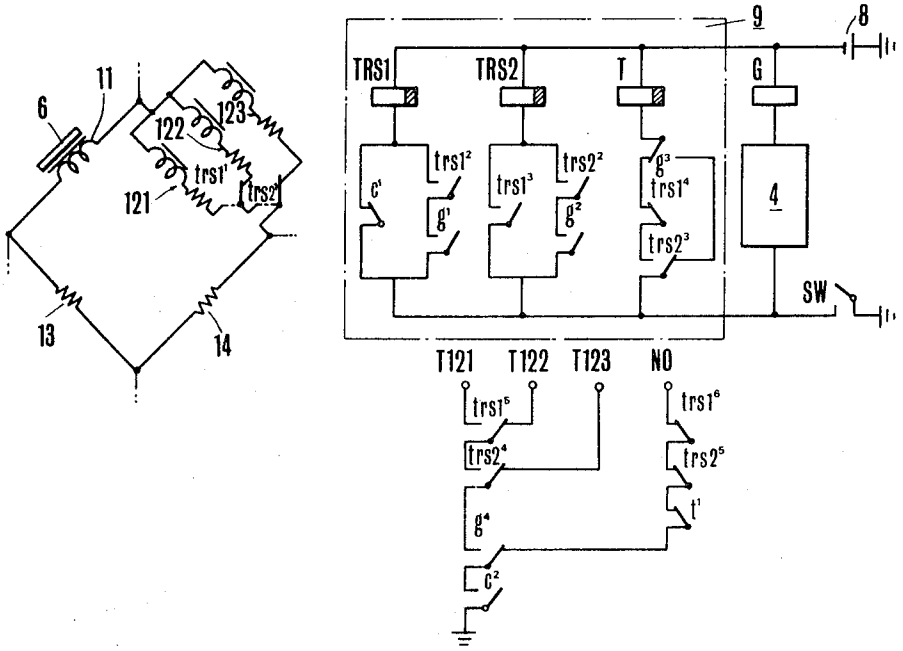


FIG. 7



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FIG. 8

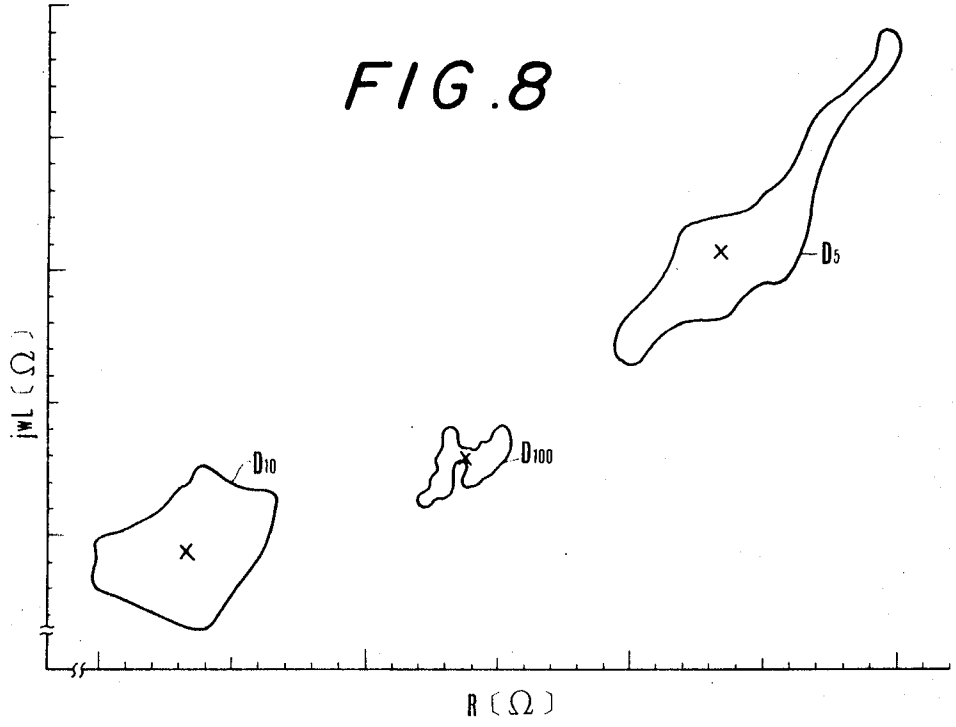
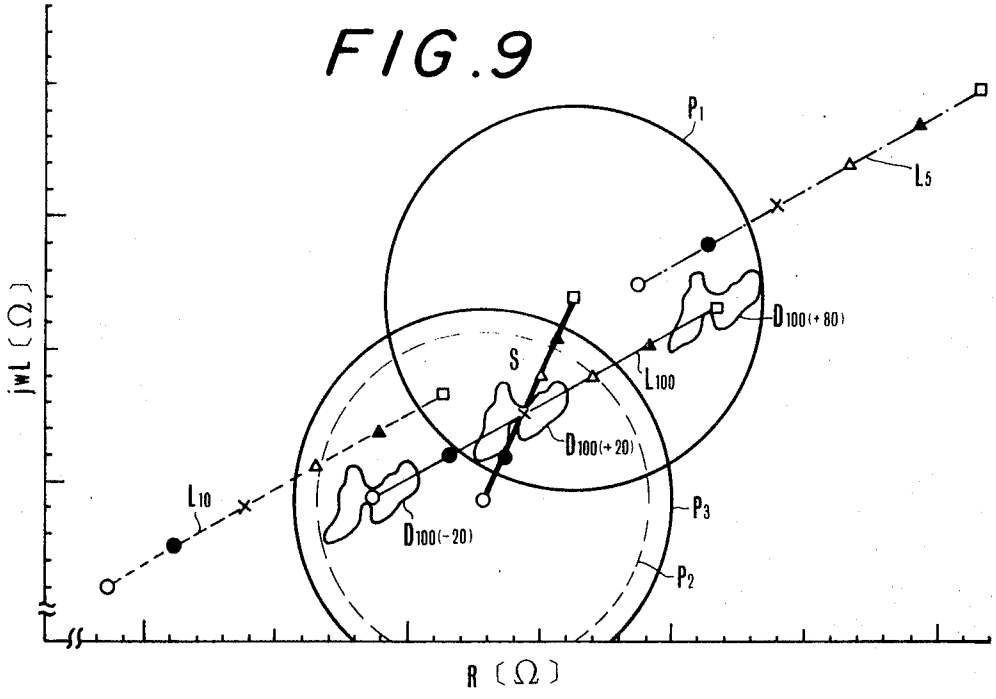


FIG. 9



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FIG. 10

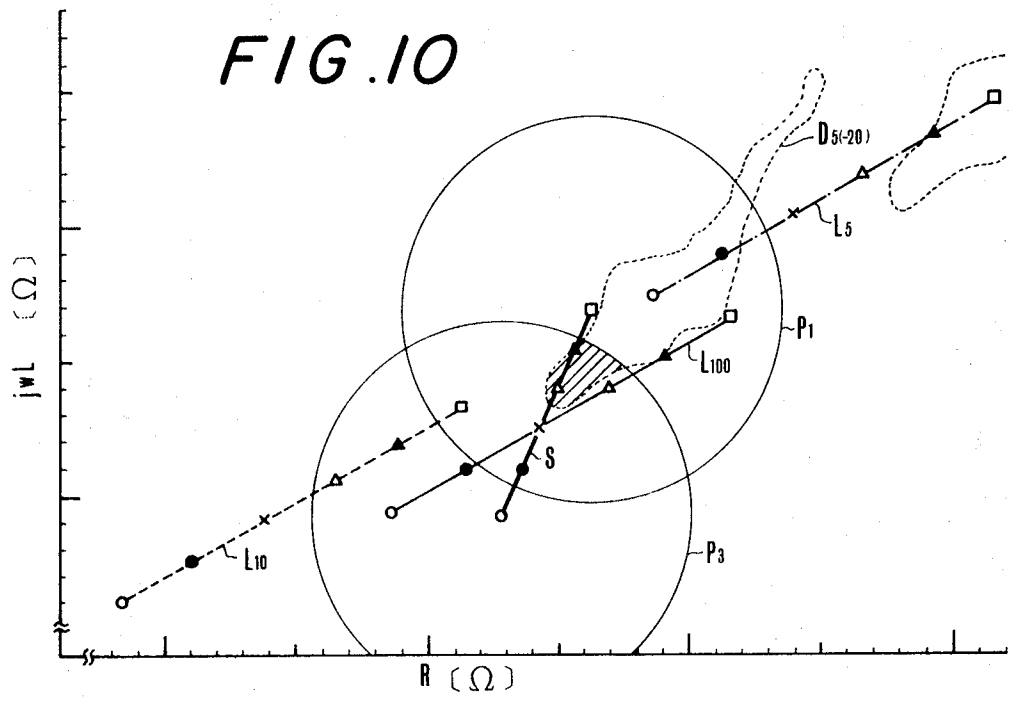
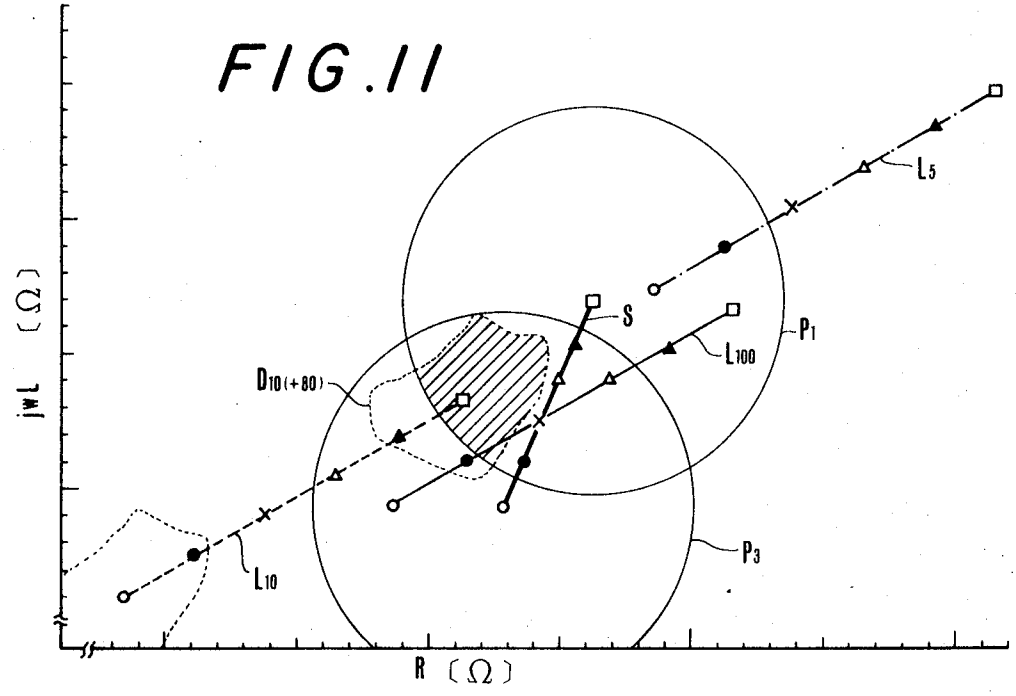


FIG. 11



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FIG. 12

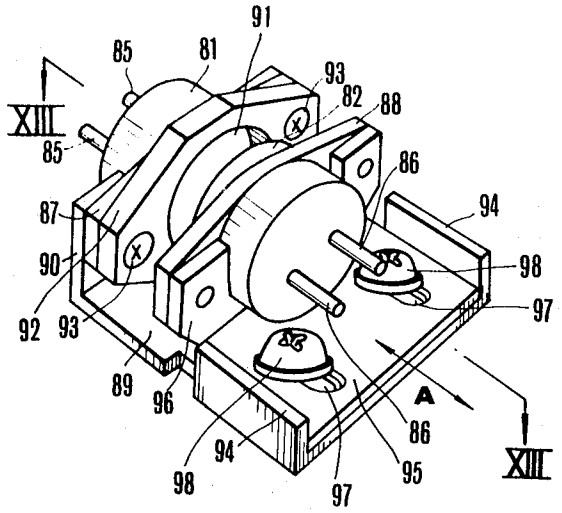
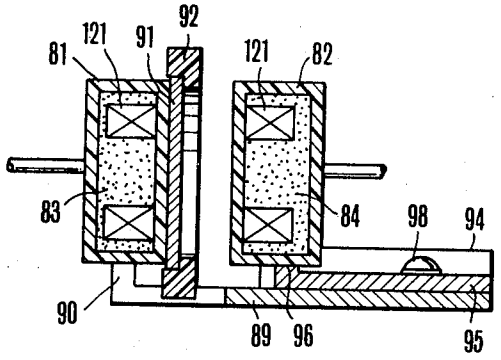
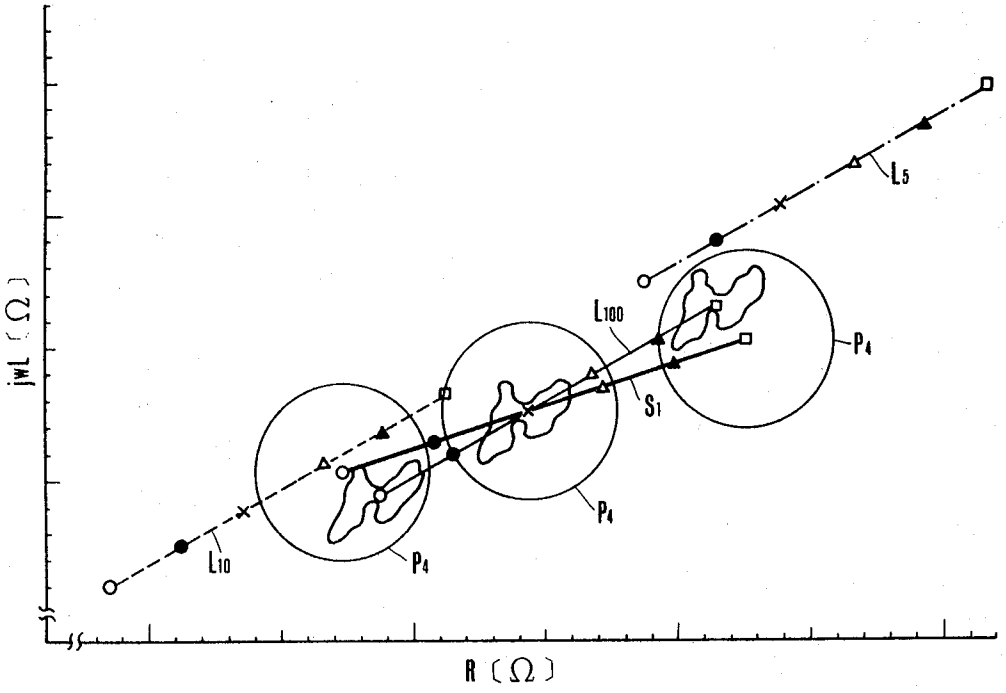


FIG. 13



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FIG. 14



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COIN DISCRIMINATING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to coin discriminating or sorting apparatus for use in coin telephone sets or slot machines and more particularly to coin discriminating apparatus utilizing the variation in the impedance of an electromagnetic detection coil which occurs when a coin is inserted in the magnetic field created by the electromagnetic detection coil.

In the well known coin discriminating apparatus, an electromagnetic detection coil is connected in one arm of a bridge circuit so as to detect the variation in the impedance of the detection coil caused by the insertion of the coin in the magnetic field created thereby thus discriminating the type of the coin. However, this type of the well known coin discriminating apparatus not only requires to use an AC oscillator having a stabilized output level as the source for the bridge circuit but also to use an amplifier of a large gain in order to stabilize the operation of the discriminating circuit.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a new and improved coin discriminating apparatus of the type employing a bridge circuit containing an electromagnetic coil in one arm thereof but does not require to use an AC oscillator as has been the prior practice.

A further object of this invention is to provide an improved coin discriminating apparatus capable of discriminating genuine and counterfeit coins without the necessity of using an AC oscillator.

Still further object of this invention is to provide an improved coin discriminating apparatus capable of discriminating not only the type of the coin but also whether it is a genuine coin or a counterfeit coin.

Another object of this invention is to provide a coin discriminating apparatus capable of discriminating the coins at high accuracies without being affected by the variation in the characteristic of the electromagnetic detection coil caused by the temperature rise thereof.

Still another object of this invention is to provide a reference element of novel construction to be incorporated in the bridge circuit of the coin discriminating apparatus of the type referred to above.

Further objects and advantages of the invention will become apparent as the description proceeds.

According to one feature of this invention, there is provided coin discriminating apparatus comprising a bridge circuit including an electromagnetic detection coil for detecting a coin, a reference element and two proportionability elements, a bandpass filter connected across the output terminals of the bridge circuit, an amplifier connected to the output of the bandpass filter, and means to feed back the output of the amplifier to the bridge circuit. With this construction the AC oscillator can be eliminated. Further, in accordance with this invention, the reference element of the bridge circuit is comprised by a plurality reference elements which are selectively connected into the bridge circuit through a transfer switch and there is provided a change-over device driven by the output from the discriminating means so as to actuate the transfer switch. This arrangement permits discrimination of a plurality of the types of the coins. Further, a reference metal piece having the same characteristic as the genuine coin is included in the reference element so as to accurately determine the type of the coin irrespective of the variation in the characteristic of the electromagnetic detection coil caused by the rise in temperature.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing;

FIG. 1 is a simplified block diagram of the coin discriminating apparatus embodying the invention;

FIG. 2 shows a detailed connection of the block diagram shown in FIG. 1;

FIG. 3 shows a portion of the coin passage;

FIG. 4 shows a sectional view taken along a line shown in FIG. 3;

FIG. 5 shows a simplified block diagram of a modified embodiment of this invention capable of discriminating two types of the coins;

FIG. 6 shows a connection diagram showing the relationship between the discriminating means, the change-over device and the bridge circuit and is utilized to explain the operation of the embodiment shown in FIG. 1;

FIG. 7 shows a connection diagram of the discriminating means the change-over device and the bridge circuit of another embodiment capable of discriminating three types of coins;

FIG. 8 is a plot showing the impedance distribution of the coins manifested by the electromagnetic detection coil when three types of the coins are subjected to the magnetic field produced by the detection coil;

FIG. 9 is a graph showing temperature-impedance characteristics of respective electromagnetic detection coils used to discriminate three types of coins, a temperature-impedance characteristic curve of a reference element used to detect one type of coin and the threshold value region of the discriminating means;

FIGS. 10 and 11 are graphs to explain the probability of miss-discrimination of the coin caused by temperature rise;

FIG. 12 is a perspective view of the reference element of the bridge circuit utilized in this invention;

FIG. 13 shows a cross-section taken along a line XIII — XIII shown in FIG. 12 and

FIG. 14 is a graph to explain how the miss-discrimination of the coin can be prevented by the use of the novel reference element.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the coin discriminating apparatus illustrated in FIG. 1 comprises a bridge circuit 1 including an electromagnetic detection coil 11 for discriminating the coin, a reference element 12 which exhibits an impedance equivalent to the impedance exhibited by the detection coil 11 when a given coin to be discriminated is subjected to the magnetic field produced thereby, and a pair of proportionality arm elements 13 and 14. The electromagnetic detection coil 11 and the reference element 12 are connected in adjacent arms of the bridge circuit, and the proportionality arm elements 13 and 14 and connected in the two remaining adjacent arms. The juncture 15 between electromagnetic detection coil 11 and the proportionality arm element 13 and the juncture 16 between reference element 12 and proportionality arm element 14, are connected to a bandpass filter 2 and the output of filter 2 is connected to a discriminator 4

through an amplifier 3. A portion of the output from amplifier 3 is fed back to juncture 17 between proportionality arm elements 13 and 14 via a feedback conductor 5. The bridge circuit is adjusted such that it becomes balanced when a given coin 6 to be discriminated is brought to the position of electromagnetic detection coil 11 as will be described later. Under the balanced state, the bridge circuit 1 produces a small output whereas when a coin other than the given coin is brought to the electromagnetic detection coil the bridge circuit becomes unbalanced to produce a large output. The bandpass filter 2 may be a well known bandpass filter that produces a small attenuation in a predetermined frequency band and wherein the phase angle of the frequencies at both ends of the band varies more than 360°. The amplifier 3 is designed to have a gain which is smaller than the absolute value of the sum of the attenuation of the bridge circuit when detecting the given coin and the attenuation of the bandpass filter. Consequently, the attenuation of the bridge circuit is increased when the given coin 6 is brought to the electromagnetic detection coil 11 so that the voltage fed back to the bridge circuit through conductor 5 is decreased whereby the feedback system does not oscillate. On the other hand, when a counterfeit coin is brought to the electromagnetic detection coil the attenuation of the bridge circuit will be decreased thus causing the feedback system to oscillate. Thus, it is possible to determine whether the coin is a genuine coin or a counterfeit coin by discriminating the oscillation and non-oscillation conditions described above.

FIG. 2 shows a detailed connection diagram of the embodiment shown in FIG. 1 in which junctures 15 and 16 of bridge circuit 1 are connected across the primary winding of a transformer 7 so as to be coupled with bandpass filter 2. The bandpass filter 2 is of the known type comprising capacitors 21 to 24 and inductors 25 to 27 connected as shown. Amplifier means 3 is comprised by an IC amplifier circuit 31 and a plurality of resistors 32 through 37. The purpose of variable resistor 34 is to set the gain of amplifier circuit 31. As above described, the gain of the amplifier means 3 is set to be smaller than the absolute value of the sum of the attenuation of the bridge circuit and that of the bandpass filter when the given coin is inserted. The output from amplifier means 3 is fed to feedback conductor 5 through a coupling capacitor 38 as well as to discriminator 4 which comprises an input capacitor 41, a smoothing circuit 42, a Zener diode 43, transistors 44 and 45 and resistors 46 and 47. The Zener diode 43 functions to determine the threshold value of the discriminator 4. Numeral 8 represents a source of supply and 48 an output terminal. When the given coin is brought to face electromagnetic detection coil 11 amplifier 31 will not produce an output because of the large attenuation in the bridge circuit as above described so that the loop circuit comprising bridge circuit 1, bandpass filter 2, amplifier 3 and feedback conductor 5 does not oscillate. Accordingly, transistor 45 is rendered ON to produce a zero potential at the output terminal 48. On the other hand when a coin different from the given coin is brought to face the electromagnetic detection coil, the attenuation in bridge circuit 1 is decreased whereby amplifier circuit produces an output which is positively fed back through conductor 5 to cause oscillation. This oscillation output is converted into a DC current by means of a rectifier 42 and is then applied to a Zener diode 43. When this applied voltage exceeds a predetermined threshold voltage of the diode Zener 43, transistor 44 is turned ON and results in transistor 45 being turned OFF to supply the source voltage to output terminal 48. As above described with the circuit shown in FIG. 2, it is possible to determine whether the coin is the given coin or not by observing the voltage appearing at output terminal 48.

Turning now to FIGS. 3 and 4 which show the relationship between a coin path and an electromagnetic detection coil associated therewith, the coin path 64 is defined by a pair of parallel side walls 60 and 61 which are spaced apart by upper and lower spacers 62 and 63. Side walls 60 and 61 are provided with circular openings 65 and 66 respectively. Two sections of the coil 11 are disposed in these openings to oppose each other on the opposite sides of the passage 64. Sections of the coil are wound on pot shaped ferrite cores 67 and 68, respectively, to produce magnetic flux in the same direction. Respective sets of the coil sections and cores are enclosed by insulative casings made from polyacital resin 69 and 70 which fit in openings 65 and 66 respectively. Inner faces of the casings 69 and 70 which are exposed to the passage 64 are flush with the inner surfaces of the side walls 60 and 61. The sections of coil 11 are connected in series between terminals 15 and 18 also shown in FIG. 1. The mechanism for holding the coin 6 in passage 64 between the sections of coil 11 is not shown because it is well known in the art.

The modified embodiment shown in FIG. 5 which is used to discriminate two types of coins are identical to that shown in FIG. 1 except that reference element 12 shown in FIG. 1 is replaced by a pair of reference elements 121 and 122 which are selectively connected in one arm of bridge circuit 1 by a transfer switch 19 under control of a change-over device 9 connected to the output of discriminator 4. Reference element 121 is designed to have an impedance equivalent to that of detection coil 11 when one type of the coin is broght to the detection coil whereas the other reference element 122 is designed to have an impedance equivalent to that of the detection coil when the other type of the coin is brought to the detection coil.

FIG. 6 shows the detail of the change-over device 9 connected to the discriminator 4 for operating transfer switch 19 shown in FIG. 5. Where the invention is applied to a coin telephone set, a switch SW shown in FIG. 6 represents the hook switch of the telephone set, whereas a source switch in the case of a coin exchanger or a slot machine. Relay G may also be included in the collector circuit of transistor 45 shown in FIG. 2 and connected between source 8 and discriminator 4 to be energized when the inserted coin is of the predetermined type. Change-over device 9 comprises a control relay T, a relay TRS for switching the reference elements and contacts of these relays. Contacts C1 and C2 are operated when a coin is inserted and relays G, T and TRS are provided with contacts *g*1, *g*2 and *g*3; *t*1; and *trs*1, *trs*2, *trs*3 and *trs*4, respectively.

It is now supposed that reference elements 121 and 122 are adapted to determine 10 yen and 100 yen Japanese coins respectively. Accordingly, reference element 121 is designed to have an impedance equal to that of detection coil 11 when a 10 yen coin is brought thereto whereas reference element 122 has an impedance equal to that of the detection coil 11 and when a

100 yen coin is brought thereto. During operation, switch SW is closed as above described. Then relays TRS and T are operated successively to throw contact trs1 (which corresponds to transfer switch **19** shown in FIG. 5) toward reference element **121.** Under these conditions when a coin is inserted, contacts C1 and C2 open and close, respectively, due to the insertion of the coin. Contact C1 opens the circuit of relay TRS to release it with a time delay. However, when the inserted coin is a 10 yen coin, the bridge circuit **1** with element **121** connected through switch *trs*1 becomes balanced. Under this balanced state, the attenuation of the bridge circuit is increased as above described, so that the loop circuit including feed back conductor **5** does not oscillate. Accordingly, relay G connected to discriminator **4** will operate to close its contact *g*1 before release of relay TRS so as to continue the energization of relay TRS. Thus, contact trs1 remains continuously connected to reference element **121.** At this time, contacts C2, *g*3 and *trs*4 are all closed to produce an output signal at terminal T121 indicating the coin that has been inserted is the given coin, that is a 10 yen coin.

In the event the, coin inserted is not a 10 yen coin, the bridge circuit **1** with element **121** connected becomes unbalanced to cause the loop circuit to oscillate. Under these conditions, relay G will not be energized so that relay TRS will release with the time delay. Consequently, transfer contact *trs*1 is switched from reference element **121** to reference element **122.** Opening of contact *trs*3 commerces the time delay release of relay T. Where the inserted coin is a 100 yen coin, the bridge circuit now including reference element **122** becomes balanced to terminate the oscillation of the loop circuit. Consequently, relay G is energized by the output of discriminator **4** to close contact *g*2 to continue the energization of relay T. Under these conditions, contacts C2 and *g*3 are closed to provide a 100 yen coin discriminating signal at output terminal **T122.** If the coin inserted were a coin different from 10 or 100 yen coin or a counterfeit coin the bridge circuit **1** would not be balanced with either reference element **121** or **122** so that relay G will not be energized to prevent release of either relays TRS or T with time delays. Under these conditions, a signal is produced at output terminal NO indicating that the coin due to the release of relay T and return of contact t_1 to its normally closed position is not either 10 or 100 yen coin. In this embodiment, by the operation of relays TRS, T and G, it is possible to discriminate 10 yen, 100 yen and another coins as well as counterfeit coins, and signals discriminating these coins are produced at output terminals, T121, T122 and NO.

FIG. **7** shows another embodiment of this invention capable of discriminating three types of coins. In this embodiment, a third reference element **123** is added to the bridge circuit **1** and a relay TRS2 for switching the reference elements is added to change-over device **9.** Relay TRS shown in FIG. **6** is designated by a reference character TRS1 in FIG. **7.** Since the embodiment shown in FIG. **7** operates in the same manner as that shown in FIG. **6,** detailed description thereof will not be made. Where it is desired to discriminate more than four types of coins it is only necessary to add the required number of reference elements and relays for switching them for the desired number of types of coins to be discriminated.

Current coins have more or less different electromagnetic characteristics so that the impedance of the detection coil responsive to the insertion of the coins varies over a range for the same type of the coin. FIG. **8** shows the impedance distribution of the electromagnetic detection coil where each type of 5 yen, 10 yen and 100 yen coins are inserted in the magnetic field produced by the detection coil at a temperature of 20°C. In this figure, regions **D10, D100** and **D5** represent impedance distributions of the detection coil for 10 yen, 100 yen and 5 yen coins, respectively. Symbols X in respective regions show the center impedance manifested by respective types of the coins. As can be noted from FIG. **4** since an air gap is included in the passage of the magnetic flux passing through the coin **6,** the impedance of the electromagnetic detection coil varies greatly when the temperature in the casing of a coin telephone set or a slot machine embodying the invention varies. FIG. **9** is a graph showing the impedance variations of respective types of the cons at various temperatures. Impedance variations of the detection coil for 5 yen, 10 yen and 100 yen coins are plotted for temperatures of −20°C (plotted by small white, circles), 0°C (black circles), +20°C (symbols X), +40°C (white triangles), +60°C (black triangles) and +80°C (white squares), respectively. Thus, dotted lines **L10** show the impedance variation characteristic of the detection coil at respective temperatures, solid line **L100** and dot and dash lines L5 show corresponding impedance variation characteristics. Region **D100** (+20) in FIG. **9** represents the impedance distribution region of the electromagnetic detection coil for 100 yen coins at +20°C, while regions **D100** (−20) and **D100** (+80) represent the impedance distribution regions of the electromagnetic detection coil for 100 yen coins at −20°C and +80°C, respectively.

Of course the impedance of reference element comprising one arm of the bridge circuit varies with the ambient temperature. The impedance variation characteristic of the reference element is shown by a thick line S in FIG. **9.** Thick line S shows the impedance variation characteristic of a reference element for 100 yen coins and crosses the characteristic for 100 yen coins (measured at 20°C) at the center impedance thereof (shown by a symbol X).

For the sake of description, discrimination of 100 yen coins is assumed. In a temperature range of from −20°C to +80°C, the impedance viz. temperature characteristic of the electromagnetic detection coil is shown by **L100** and that of the reference element by S. From this it will be evident that these characteristics differ greatly. For this reason, in order to correctly determine the coin inserted at 80°C as a genuine one it is necessary to set a permissible range of the unbalanced voltage of the bridge circuit. Such permissible unbalanced voltage corresponds to the value at which the discriminator shown in FIG. **2** does not operate, that is the threshold voltage of the Zener **43.** In FIG. **9,** this permissible unbalanced voltage is shown by the area of a circle **P1** containing the distribution region **D100** (+80) of the electromagnetic detection coil for 100 yen coins at a point corresponding to +80°C (shown by a square) on line **L100** when the reference element is maintained at +80°C. Also in the case of −20°C, it is necessary to set a permissible range of the unbalanced voltage covered by a circle P2 having center at a point indicated by a small circle on line S, said circle P2 cov-

ering the distribution region D100 (−20) for 100 yen coins indicated by a small circle on line D100. However, since P1>P2, the permissible unbalanced voltage necessary and sufficient to discriminate genuine 100 yen coins in the entire range of −20°C to +80°C is represented by P1. Consequently, the permissible unbalanced voltage at −20°C is represented in FIG. 9 by a circle P3 which is equal to circle P1.

In this manner, it is possible to determine the inserted coin as the genuine 100 yen coin in a temperature range of from −20°C to +80°C by setting the permissible unbalanced voltage at a value determined by circle P1(=P3). However, where the permissible unbalanced voltage which is set as above described is made to be equal to the threshold value of discriminator 4, the discriminating apparatus operates to determine coins other than 100 yen coins as 100 yen coins.

More particularly, as shown in FIG. 10, the impedance distribution region of the electromagnetic coil for 5 yen coins at −20°C is represented by a dotted line region D5 (−20) which is partially included in the region of the permissible unbalanced voltage for 100 yen coins at −20°C, that is the region P3 of the threshold value of the discrimination 4. The portion of the region D5 (−20) included in the area of circle P3 is shown as shaded and amounts to 20 percent of region D5 (−20). This means that 20 percent of the 5 yen coins are determined as 100 yen coins.

Turning now to FIG. 11, the impedance distribution region of the detection coil for 10 yen coins at +80°C is represented by a dotted line region D10 (+80), the shading portion thereof being included in circle P1 representing the threshold value of discriminator 4 for 100 yen coins maintained at +80°C. This shaded portion occupies about 60 percent of region D10 (+80) which means that 60 percent of the 10 yen coins inserted at +80°C is determined as 100 yen coins.

In order to prevent such a miss-discrimination, it is necessary to design the reference element to have the same temperature characteristic as the electromagnetic detection coil. This can be accomplished by so constructing the reference element as to comprise a given coin and two sections of a coil of the same construction as the detection coil and disposed on the opposite sides of the coin. As shown in FIG. 8, even for given coins since the impedance characeteristic of the detection coil varies in a region of some area, the reference element should have an impedance at the center of this region. For this reason, for positioning a given coin in the reference element it is necessary to select a coin manifesting the center impedance out of a plurality of such given coins. Accordingly, where the novel discriminating apparatus is incorporated into a coin telephone set or a slot machine which are ordinarily manufactured on a mass production scale, it is advantageous to use a reference metal piece which manifests the same impedance value as the center value of the impedance distribution of the detection coil for the given coin instead of utilizing the same. The metal piece utilized in the reference element should have smaller impedance distribution region than the given coin, low cost, and should have such dimension and configuration that do not permit insertion of the metal piece into the coin telephone set or a slot machine instead of the given coin. The result of experiment shows that when a reference metal piece to be utilized in the reference element for discriminating 100 yen coins is made to have a diameter of 18mm and a thickness of 1.8mm from an alloy consisting of 64.0 to 68.0 parts of copper, less than 0.15 part of lead, less than 0.15 part of iron and the balance of zinc it is possible to cause the reference metal piece to have an impedance equal to the center value of the impedance distribution for 100 yen coins maintained at 20°C.

FIGS. 12 and 13 show one example of the reference element embodying the invention. As shown in these figures, two sections 121 of a coil of the reference element are wound on pot shaped ferrite cores 83 and 84 and respective sets of the coil segment and the ferrite core are contained in casings 81 and 82, respectively, of polyacetal resin. Two sections of the coil are wound cummulatively and are connected in series between terminals 85 and 86. Casings 81 and 82 are formed with lateral flanges 87 and 88 projecting in the opposite directions. The reference element is mounted on a base 89 having vertical wall 90 at its left hand end as viewed in FIG. 12 which is used to fixedly secure the flange 87 of casing 81. A reference metal piece 91 is secured on the inner surface of casing 81. A ring 92 of polyacetal resin is secured to flange 87 by means of screws 93 to hold in position the reference metal piece 91. The right hand end of the base 89 as viewed in FIG. 12, is formed into a channel to form vertical guide walls 94 for the purpose to be described later. A slide plate 95 is mounted upon base 89 between guide walls 94. A vertical wall 96 is formed at the left hand end of slide plate 95 which is secured to flange 88 of casing 82 to support the same. A pair of guide slots 97 are formed through slide plate 95 to receive set screws 98 threaded into base 89. The mutual inductive coefficient of the coil sections contained in casings 81 and 82 can be varied by moving slide plate 95 in the direction indicated by an arrow A after loosening screws 98 thus enabling fine adjustment of the impedance of the reference element.

FIG. 14 is a graph showing temperature viz. impedance variation characteristics of a reference element including the reference metal piece described above, in which straight lines L10, L100 and L5 represent the temperature viz. impedance characteristics of the electromagnetic detection coil when 10 yen, 100 yen and 5 yen coins are inserted in the field of the detection coil, and a straight line S1 represents the temperature viz. impedance characteristic of a reference element for 100 yen coins containing a reference metal piece manifesting an impedance equal to the center impedance of the detection coil when it receives a 100 yen coin at 20°C. Comparing two characteristics L100 and S for 100 yen coins, different from the case shown in FIG. 9 curve S1 is located closer to curve L100. For this reason, in a temperature range from +20°C to 80°C, the permissible unbalanced voltage of the bridge circuit sufficient to determine the inserted 100 yen coins as the genuine 100 yen coins, or the threshold value of the discriminator 4 may be set in an area bounded by a circle P4 shown in FIG. 14, thus permitting decrease in the permissible unbalance voltage. By setting the permissible unbalance voltage in circle P4 in this manner, the possibility of misdiscriminating 5 yen coins at −20°C as 100 yen coins as has been described in connection with FIG. 10 and 10 yen coins at +80°C as 100 yen coins as has been described in connection with FIG. 11, can be efficiently obviated. While above description has been made in terms of 100 yen coins it will be understood that coins other than 100

yen coins can also be discriminated by utilizing reference metal pieces made of metals having the same impedance characteristics as those of the coins to be discriminated.

While the invention has been shown and described in terms of preferred embodiments thereof it should be understood that many changes and modifications will be ovious to one skilled in the art within the true spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. Coin discriminating apparatus comprising a bridge circuit including an electromagnetic detection coil, a reference element and a pair of proportionality arm elements; a bandpass filter connected to the output of said bridge circuit; an amplifier for amplifying the output of said bandpass filter; a discriminator connected to the output of said amplifier; and a feedback loop for positively feeding back the output of said amplifier to said bridge circuit to measure the attenuation characteristics of coins subjected to the action of the electromagnetic detection coil, the feed back loop being constructed such that upon a given coin to be discriminated favorably being subjected to the magnetic field created by said electromagnetic detection coil the feedback loop is maintained in one operating condition, and upon coins to be discriminated against being subjected to the electromagnetic coil, the feedback loop converts to a different operating condition, said discriminator being responsive to the operating condition of the feed back loop.

2. The coin discriminating apparatus according to claim **1** wherein said bridge circuit comprises an electromagnetic detection coil for discriminating coins, a reference element connected to one end of said electromagnetic detection coil, said reference element manifesting an impedance equivalent to the impedance manifested by said electromagnetic detection coil when a given coin to be discriminated favorably is brought into the magnetic field created by said electromagnetic detection coil, a first proportionality arm element connected to the other end of said electromagnetic detection coil and a second proportionality arm element connected between the other end of said reference element and the other end of said first proportionality arm element, said bridge circuit being constructed to assume a balanced condition only when a given coin to be discriminated favorably is brought to said electromagnetic detection coil to thereby maintain the feedback loop in a non-oscillatory condition, and said bridge circuit assumes an unbalanced condition upon a coin to be discriminated against being brought to said electromagnetic detection coil whereby the feed back loop is maintained in an oscillatory condition.

3. The coin discriminating apparatus according to claim **2** wherein said discriminator comprises means for smoothing an AC signal from said amplifier for producing a DC voltage, means responsive to said DC voltage for determining a permissible balanced voltage level which is used to detect the balanced condition of said bridge circuit, and signal generating means responsive to the operation of said D.C. voltage responsive means for determining the permissible balanced voltage level for generating a coin discriminating signal.

4. The coin discriminating apparatus according to claim **2** wherein said reference element comprises a coil having the same rating as said electromagnetic detection coil and a reference metal piece having the same characteristic as said given coin to be discriminated favorably, said reference metal piece being positioned in the magnetic field of the coil of said reference element.

5. The coin discriminating apparatus according to claim **3** wherein said means for determining the permissible balanced voltage comprises a Zener diode.

6. The coin discriminating apparatus according to claim **4** wherein said reference element comprises a coil divided into two sections and having the same capacity as said electromagnetic detection coil, a pair of spaced apart magnetic cores, said two sections being wound upon said cores respectively to produce magnetic fields in the same direction, a reference metal piece manifesting the same impedance as the center value of the impedance distribution manifested by said electromagnetic detection coil when a given coin to be discriminated favorably is brought thereto, said reference metal piece being mounted close to the flux generating surface of one of said cores, a base for supporting one of said cores and a slide plate slidably mounted on said base and supporting the other of said cores.

7. Coin discriminating apparatus comprising a bridge circuit including an electromagnetic detection coil included in the first arm, of said bridge circuit, proportionality arm elements respectively included in the second and third arms, and a plurality of reference elements adapted to be selectively connected in the fourth arm of said bridge circuit; a bandpass filter connected to the output of said bridge circuit; an amplifier for amplifying the output of said bandpass filter; a discriminator connected to the output of said amplifier; a feed back loop for positively feeding back the output of said amplifier to said bridge circuit; and a change over device for selectively connecting one of said reference elements in said fourth arm when said discriminator detects the unbalanced condition of said bridge circuit upon a coin being brought to said electromagnetic detection coil.

8. The coin discriminating apparatus according to claim **7** wherein each one of said reference elements manifests an impedance equivalent to the impedance manifested by said electromagnetic detection coil upon a predetermined coin to be discriminated favorably being inserted in the magnetic field produced by said electromagnetic detection coil.

9. The coin discriminating apparatus according to claim **7** which further includes means for producing discriminating signals indicating whether the inserted coins correspond to predetermined types or not.

10. The coin discriminating apparatus according to claim **8** wherein each one of said reference elements comprises a coil having the same rating as said electromagnetic detection coil and a reference metal piece cooperating with said first mentioned coil and having the same characteristic as a particular coin to be discriminated favorably thereby.

11. The coin discriminating apparatus according to claim **10** wherein each one of said reference elements comprises a coil divided into two sections, a pair of spaced apart magnetic cores, said coil sections being wound upon said magnetic cores respectively to produce magnetic flux in the same direction, a reference metal piece manifesting the same impedance as the center value of the impedance distribution manifested by the coins of a predetermined type to be discrimi-

nated favorably by said one reference element, said reference metal piece being mounted on the flux generating surface of one of said cores and a base for supporting one of said cores, a slide plate slidably mounted on said base for supporting the other of said cores.

12. A coin discriminating apparatus comprising an electromagnetic detection coil divided into two sections, each section being supported within magnetically permeable, insulating housings secured on respective sides of a coin receptacle, a pair of spaced apart magnetic cores each mounted in a respective one of the housings with said two sections of said coil being wound upon said cores respectively to produce magnetic fields in the same direction such that upon a coin being deposited in the coin receptable, it is disposed in the flux path between the two cores and causes a characteristic impedance value to be manifested by said electromagnetic detection coil.

13. A coin discriminating apparatus comprising a reference element for inclusion in a measuring bridge with an electromagnetic detection coil, said reference element including a coil divided into two sections, a pair of spaced apart magnetic cores, said coil sections being wound upon said magnetic cores respectively to produce magnetic flux in the same direction, a reference metal piece manifesting the same impedance as the center value of the impedance distribution manifested by the electromagnetic detection coil in the presence of coins of a predetermined type to be discriminated favorably by said reference element, said reference metal piece being mounted on the flux generating surface of one of said cores, a base for supporting one of said cores and a slide plate slidably mounted on said base for supporting the other of said cores.

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