

Nov. 27, 1951

J. R. CORNELIUS
ELECTRONIC COMPARATOR FOR ANALYZING FERROUS
AND NONFERROUS MATERIAL
Filed Jan. 5, 1950

2,576,173

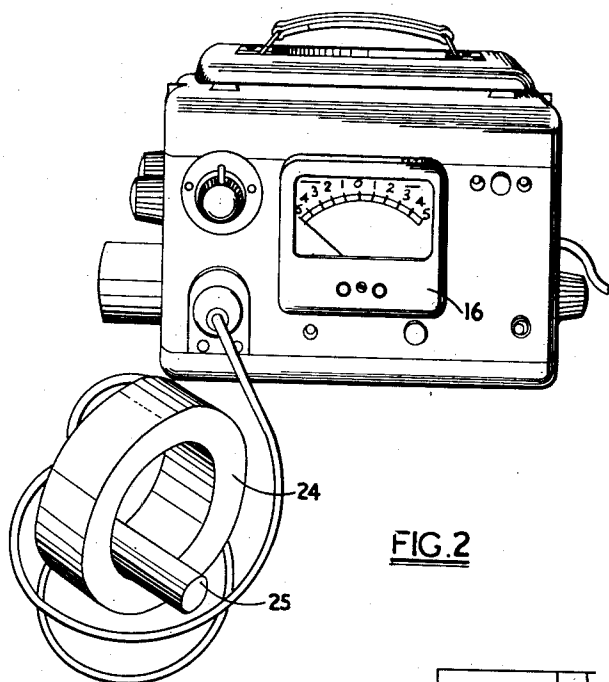


FIG. 2

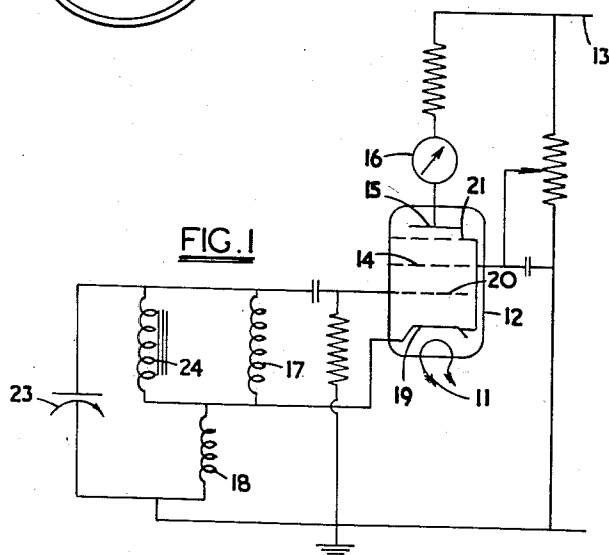


FIG. 1

INVENTOR.

JAMES R. CORNELIUS

BY

Mauchney & Mauchney
Attys.

UNITED STATES PATENT OFFICE

2,576,173

ELECTRONIC COMPARATOR FOR ANALYZING FERROUS AND NONFERROUS MATERIAL

James Richard Cornelius, Coventry, England

Application January 5, 1950, Serial No. 136,975
In Great Britain January 25, 1949

2 Claims. (Cl. 175—183)

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It is known to utilise electric circuits, dependent upon permeability, permittivity, inductance, capacitance or other characteristics of ferrous materials, to distinguish to a greater or less degree, by non-destructive methods, variations existing between materials of slightly varying, or even greatly varying, chemical analysis.

Usually such an apparatus includes an oscillatory circuit the frequency of which is varied from a standard figure due to a variation in the characteristic of a specimen to be compared, which specimen is placed in an inductance forming part of the oscillatory circuit, the frequency variation produced being indicated by a suitable system. Alternatively, use may be made of a simple system which indicates directly a change in inductance in an alternating system, the variation being translated into some visual indicating means by comparison with a standard specimen.

These known apparatus are, in practical use, limited to ferrous materials in which the permeability varies sufficiently to provoke a considerable change of frequency or inductance to operate an indicator.

The main object of the present invention is to provide apparatus with which it will be possible satisfactorily to compare at will either ferrous specimens or non-ferrous specimens, and also the conditions in which the various qualities of the different variations can occur.

For example, it has not previously been feasible to compare variations in the brasses known as 70/30 copper/zinc and 70/29/1 copper/zinc/tin (1% tin replacing 1% of the zinc), and also the hardness value of high speed steel, or the depth of case hardening provided in case hardening steels by saturation, or the depth of decarburisation in such steels after hardening, by means of a single apparatus.

For an understanding of the nature of the present invention, attention should be directed to the following description in which reference is made to the accompanying drawings. In these:

Figure 1 is a diagram of an apparatus according to the invention; and

Figure 2 is a perspective view of the apparatus with a specimen to be tested shown in position in the discriminating coil.

The electronic comparator of the invention, as shown in the drawings, includes an oscillatory circuit employing a pentode 12, two inductances 17, 18 serving to maintain oscillations within the circuit, the inductances being in series with one another and connected, respectively, between a grid and the cathode, and the cathode and earth,

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in the case of a pentode, a large variable capacitance 23 which is connected across the two extreme ends of the two inductances, forming therewith a variable frequency adjusting means for the circuit, and a discriminating inductance 24, adapted to receive a specimen to be examined, shunted across the cathode and grid section of the pentode, the discriminating inductance serving to block the circuit oscillations, dependently upon the characteristics of the specimen, at some particular value of the variable capacitance.

In the drawings, 11 illustrates connections for supplying alternating current for heating the filament of the pentode 12, and 13 is a connection leading to a source of D. C. potential, this source being connected to the screen grid 14 and to the anode 15. An appropriate alternating current meter 16 or the like is disposed in series with the connection to the anode.

The two series-connected inductances, which are nominally equal to one another, are indicated at 17 and 18, the inductance 17 being connected between the cathode 19 and the control grid 20, and the other inductance 18 being connected between the cathode 19 and earth. The frequency to which the inspection is desired to operate determines the value of the combined inductance. The cathode 19 is also connected to the suppressor grid 21.

The large variable capacitance is indicated at 23, this being one of several thousands of micro-micro-farads in value and preferably completely variable from zero to its full value. It is shown as being connected across the two inductances 17 and 18.

The discriminating inductance 24 is connected across the inductance 17, i. e., that associated with the cathode and grid section of the pentode.

The method of operating this apparatus is as follows:

In the first instance the various parts of the apparatus are assumed to be supplied with the correct potential suitable for each element. The parts comprising the oscillatory circuit, namely, the two inductances 17, 18, the cathode 19, the grid 20, the large variable capacitance 23 and the discriminating inductance 24, are arranged to oscillate at a frequency of between 50 and 10,000 cycles per second—such as is normally employed when inspecting ferrous or non-ferrous specimens.

The discriminating inductance 24 will slightly increase the operating frequency, but it will also, at some particular value, completely block the circuit oscillations—i. e., cause the circuit to stop

oscillating. This condition will arise at a combination of the inductive value of the circuit and the value of the capacitance 23, and the latter value can be assessed at the instant when the oscillations cease—due to the modified value of the inductance 24 arising from the insertion of a specimen 25 therein.

For example, when the inductance 24 is free of a specimen, the apparatus may be adjusted to oscillate over a range of capacitance variation from 0 to 8,000 mmf. When a specimen 25 of known dimensions and condition, for example, a 70/30 copper/zinc specimen, is placed in the inductance 24, it may be that the oscillations will cease at 6,000 mmf. On the other hand, when that specimen is replaced by one of identical dimensions, but of 70/29/1 copper/zinc/tin, it may be that the circuit oscillations will cease at 5,500 mmf.

As will be well understood, the alternating current meter 16 can be arranged accurately to indicate the instant at which the oscillations are blocked as the capacitance 23 is being adjusted. Instead of using a meter, as shown, for this purpose, a connection may be taken from the anode 15 to a cathode ray oscilloscope, an oscillograph or the like.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. An electronic comparator including an oscillatory circuit employing a pentode, two inductances serving to maintain oscillations within the circuit, the inductances being in series with one another and connected, respectively, between a grid and the cathode, and the cathode and earth, of the pentode, a large variable capacitance which is connected across the two extreme ends of said two inductances, forming therewith a

variable frequency adjusting means for the circuit, and a discriminating inductance, adapted to receive a specimen to be examined, shunted across said cathode and grid of the pentode, the discriminating inductance serving to block the circuit oscillations, dependently upon the characteristics of the specimen, at some particular value of the variable capacitance.

2. An electronic comparator including an oscillatory circuit employing a pentode, two inductances serving to maintain oscillations within the circuit, said pentode having a cathode, a control grid, a screen grid, a suppressor grid and an anode, said inductances being in series with one another and connected, respectively, between said control grid and said cathode, and said cathode and earth, a large variable capacitance which is connected cross the two extreme ends of said two inductances, forming therewith a variable frequency adjusting means for the circuit, and a discriminating inductance, adapted to receive a specimen to be examined, shunted across said cathode and control grid, the discriminating inductance serving to block the circuit oscillations, dependently upon the characteristics of the specimen, at some particular value of the variable capacitance.

JAMES RICHARD CORNELIUS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,815,717	Kranz	July 21, 1931
2,326,344	Elmendorf et al.	Aug. 10, 1943