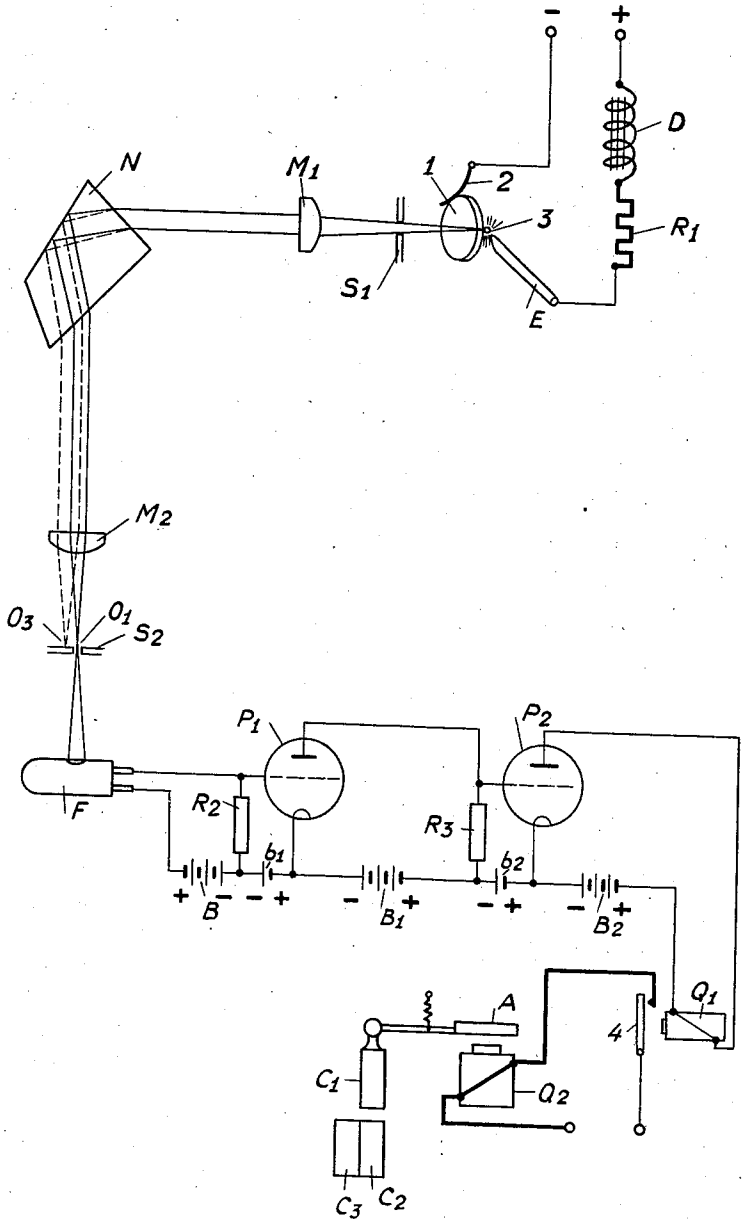
Nov. 30, 1937. H. L. PETTERSSON 2,100,977

TESTING METAL ARTICLES

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Fig.1.



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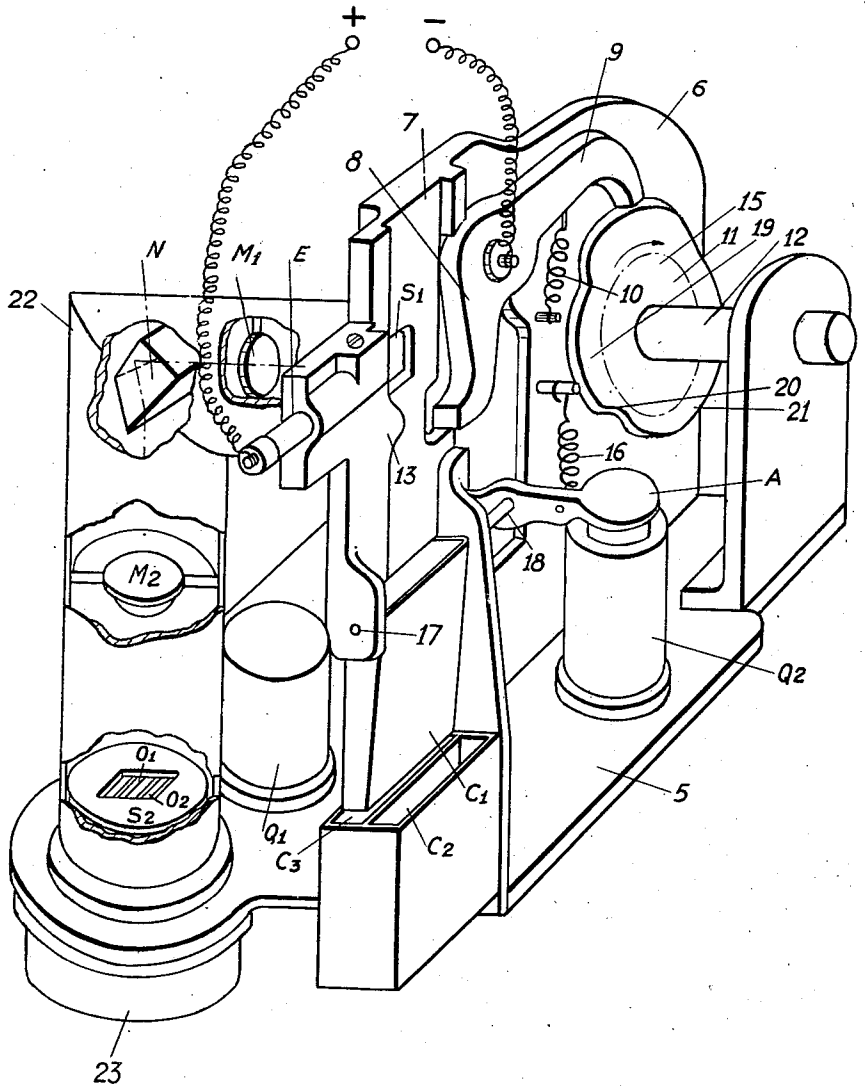
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Fig. 2.



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2,100,977

TESTING METAL ARTICLES

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14 Claims. (Cl. 194—100)

The present invention relates to a method of and means for testing metal articles, especially coins and tokens, to determine whether they are genuine or spurious or whether or not they are made of a particular known material.

The invention consists essentially in the provision of a spectrum corresponding to the metal or alloy of which the metal article, token or coin is made, and in utilizing certain predetermined ranges of wave lengths of this spectrum to influence a distributing relay. As it is known, a number of different methods can be used to produce such a spectrum. One simple method consists in establishing contact between an electrode of some suitable material and the coin or article to be tested, the electrode and coin being so disposed as to be included in the same electric circuit, and then separating the electrode and coin so that, under certain conditions, an arc is produced between the coin and the electrode. The light from the arc passes through a spectroscope containing a slit of suitable setting, through which slit only light waves within certain predetermined ranges of wave lengths can pass. The light which is in this way passed through the slit may influence a light-sensitive relay which in turn controls the disposition of the coin or otherwise indicates the result of the test.

The invention will now be more fully described with reference to the accompanying drawings, which illustrate by way of example, but which are by no means limitative, preferred manners of carrying out the invention.

Figure 1 is a diagrammatic view of a testing apparatus illustrating the principle and manner of operation of the method and means of the present invention.

Figure 2 is a perspective view of one mechanical embodiment of the invention.

In Figure 1 the reference numeral 1 indicates the coin or other article to be tested. Bearing against the coin there is a contact 2 connected to one of the poles of a current source. The opposite pole of the source is connected through a choke coil D and a series resistance R1 to an electrode E. If the electrode is moved toward the coin, or vice versa, so that the circuit D, R1, E, 1, 2 is closed, and thereupon is removed a slight distance, an arc 3 is produced between the electrode E and the coin 1. The light produced by the arc is screened by a slit device S1, so that only a narrow bundle of light containing rays of all possible wave lengths reaches a condensing lens M1. If the distance between the lens M1 and the arc 3 is equal to the focal distance of the lens, the rays coming from the lens will be parallel and meet a prism N, which can be of any suitable construction. The embodiment of the prism illustrated on the drawings is of the type suggested by Hilger and is so adjusted that the directions of the in-coming and outgoing rays are nearly perpendicular to one another. After passing through the prism the light is dispersed according to its wave lengths in such a way that the rays of the same wave length are still parallel, whereas rays of different wave lengths form angles to one another. The outgoing rays meet a condensing lens M2 which refracts the rays. Near the focus of the lens M2 is placed a slit S2 provided with one or more openings O1, O2 (compare the Figure 2) which are so chosen that they exactly correspond to the positions of one or several of the lines characteristic of the spectrum of genuine coins.

If the coin 1 is a genuine one, one of said spectrum lines will pass through the opening O1 and meet a photo-cell F. Although the cell F may be of any suitable type, it may be preferable to employ a vacuum photo-cell having an anode and a cathode on which the light-sensitive material is provided. According to tests, such photo-cells, when they are not exposed to light, offer an infinitely great electrical resistance. When, however, rays fall on the sensitive material a certain electronic emission occurs which, by means of an anode voltage or a so called suction voltage, can produce an electrical signal current.

In the circuit arrangement shown in the Figure 1, it is assumed that the positive pole of a battery B is connected to the anode of the photo-cell F, whereas the cathode is connected to a grid of a common thermionic tube P1. The grid is connected through a leak resistance R2 with the negative pole of the battery B and through a grid battery *b1* with the cathode of the tube P1. The anode of the tube P1 is connected through a relatively large resistance R3 to the positive pole of an anode battery B1 and also to the grid of another thermionic tube P2. A grid battery *b2* gives to the grid of the tube P2 such a biasing voltage that normally an effective anode current passes through the anode circuit of the tube P2. This circuit contains a relay coil Q1 and an anode battery B2, series-connected with one another. The relay Q1 controls a contact 4 included in a circuit containing, for instance, the poles of a 220 volt lighting main and the solenoid of a power relay Q2. The relay Q2

controls in its turn an armature A which, when energized, moves a hopper C1 from a chute C2 for genuine coins to a chute C3 for bad coins. The current of the anode circuit normally holds the contact 4 of relay Q1 in closed position and thereby maintains the solenoid Q2 energized, so that the hopper C1 is held in communication with the chute C3 for bad coins.

When a genuine coin is tested, the arc 3 will contain certain characteristic spectrum lines for the genuine metal or alloy, which lines are allowed to pass through the opening O1 and to effect the photo-cell F. In this way a discharge current through the photo-cell F and the resistance R2 is obtained, which current causes a drop of voltage in the resistance R2 and a change in the grid voltage of the tube P1 in positive direction. If the grid-bias voltage is so chosen that the anode current, when the photo-cell is not exposed to light, is almost zero, the positive drop of voltage in the resistance R2 will cause an amplified anode current in the tube P1 which current passes through the resistance R3. The drop of voltage in the resistance R3 in turn produces a drop in both the anode voltage of the tube P1 and the grid voltage of the tube P2. The increased drop of voltage in the resistance R3 thus produces a sharp reduction, preferably down to zero, of that current, which normally flows through the solenoid of the relay Q1, so that the contact 4 is opened and the relay Q2 becomes deenergized. In this way the armature A is released and the hopper C1 is moved over to the chute C2 for genuine coins by means of a suitable spring.

If, on the other hand, the coin being tested is bad, the spectrum produced by the arc 3 will not contain any light within that range of wave lengths which is determined by the slit opening O1 but will contain light-waves of other wave lengths which, for instance, focus at a point O3 where the waves are screened and, thus, do not reach the photo-cell F. When the photo-cell is not exposed to light, it offers an infinitely great resistance and no current can pass through the resistance R2, for which reason the anode current of the tube P1 will become so weak that the anode current of the tube P2 is still operative and holds the relays Q1 and Q2 energized. Consequently, the hopper C1 will remain just opposite the repayment chute C3.

It is, of course, assumed that the photo-cell and the spectroscope as well as the arc are completely protected from any light coming from the outside.

Figure 2 has for its object to illustrate how the invention can be embodied in a practical, mechanical structure. On a foot-plate 5 there is mounted a vertical frame 6 of insulating material, for instance, of bakelite. The frame is provided with a vertical coin chute 7, into which projects one arm of a two-armed lever 8, 9 made of a conducting material. The arm 9 is continually urged by a spring 10 into engagement with a cam disc 11, the latter being mounted on a shaft 12 which is rotated in a clockwise direction, as indicated, by any suitable means, such as an electric motor when coins are tested. As will be understood from the following description, the test of each coin requires a complete revolution of cam disc 11, each test commencing when the disc is in a position approximately 90° further around in a clockwise direction than the position shown in Fig. 2.

Opposite the end of arm 8, the coin chute 7 is provided with a projecting part 13, directly above which the electrode E is mounted in the frame 6 in axially displaceable position, so that the inner end or point of the same projects somewhat into the coin chute 7. In the position shown in the figure, the arm 9 bears against the highest cam portion 15 so that any coin which might be in the chute can freely fall into the switchable coin chute C1, the so called hopper. The hopper C1 is pivotally mounted on the frame 6 by means of two pins 17 and 18, of which the latter carries the armature A of the electromagnet Q2. When armature A is in attracted position, the hopper C1 is held in a position above the repayment coin chute C3 for spurious coins, which position is shown in the figure, whereas, when the armature is not attracted, the spring 16 moves the armature A to its upper position so that the coin chute C1 feeds the coin in the chute C2 for genuine coins. After the shaft 12 has turned the cam disc approximately 90° farther than the position shown in the figure, the arm 9 lies in engagement with a portion 19 of the cam of somewhat smaller radius than portion 15 whereby the arm 8 is moved so much closer to the projecting part 13 that the next coin to fall through the chute 7 will be suspended between these two parts ready for test. As the testing begins, rotation of the disk 11 brings the recess 20 opposite the arm 9, and the arm 8 pushes the coin laterally until it bears against the inner end or point of the electrode E, whereupon a current is closed through the arm 8, the coin and the electrode E. Shortly thereafter, the arm 9 meets the portion 21 of the cam disc, and, due to the larger diameter of this portion, the arm 8 is moved away from projecting part 13 removing the coin somewhat from the point of the electrode. In this way the arc, which is required for the testing, is produced between the coin and the point of the electrode E. The arc lasts until the cam disc again approaches the position shown in the figure, at which time the arm 8 is moved so far from the projecting part 13 that the coin falls into the hopper C1 and from there into either the repayment chute C3 or the "continuation" chute C2, depending on the genuineness or spuriousness of the coin.

The slit S1 is mounted in frame 6 adjacent the bottom of the chute 7, while the lenses M1 and M2 and the slit device S2 are mounted on the walls inside an angular pipe 22. The prism N is mounted in the point or corner of the angular pipe. The bottom of the pipe enters into a box 23, which is mounted on the plate 5 and contains the photo-cell F. Preferably, the intermediate relay Q1 can also be mounted on the plate 5.

It is obvious that the invention is not limited to a method or apparatus in which only one slit opening O1 is used or in which only coins can be tested. Apparently, one can also use several ranges of wave lengths characteristic of the genuine metal or alloy, in which event other openings, such as O2, etc., are provided in addition to the opening O1. The light impulses which pass through these openings can affect either the same or different photo-cells.

It is also obvious that instead of an electric arc electric sparks may be produced by means of an alternating voltage of high amplitude which is impressed between the article being tested and the electrode.

It will be understood that the term "genuine

article" as used herein is intended to apply to one particular species of articles having a certain definite, known metallic composition, all other species being embraced within the term "spurious articles", and is not intended to designate genuine articles as a general class regardless of the material from which they are made.

Having now particularly described and ascertained the nature of my invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The method of distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials which comprises the steps of producing an electric discharge having a spectrum characteristic of the material of the article being tested, directing the spectrum of the discharge toward a light-sensitive device, preventing all but certain predetermined wave lengths peculiar to the spectrum of a genuine article from affecting said device, and utilizing the output of said light-sensitive device for indicating when a genuine article is being tested.

2. The method of distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials which comprises the steps of producing an electric discharge having a spectrum characteristic of the material of the article being tested, directing the spectrum of the discharge toward a light-sensitive device, preventing all but certain predetermined wave lengths peculiar to the spectrum of a genuine article from affecting said device, and utilizing the output of said light-sensitive device for controlling the disposition of the article being tested at the completion of the test.

3. The method of distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials which comprises the steps of producing an electric discharge having a spectrum characteristic of the material of the article being tested, directing the spectrum of the discharge toward a light-sensitive device, preventing all but certain predetermined wave lengths peculiar to the spectrum of a genuine article from affecting said device, and utilizing the current generated in said light-sensitive device for effecting delivery of a genuine article after being tested to a different destination than that to which spurious articles are delivered.

4. The method of distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials which comprises the steps of utilizing the article being tested as one electrode in the production of an electric discharge, dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, directing the spectrum thus produced toward a light-sensitive device, screening said device against all but certain predetermined wave lengths peculiar to the spectrum of a genuine article, and utilizing the output of said light-sensitive device for indicating when a genuine article is being tested.

5. The method of distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials which comprises the steps of utilizing the article being tested as one electrode in the production of an electric discharge, dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, directing the spectrum thus produced toward a light-sensitive device, screening said device against all but certain predetermined wave lengths peculiar to the spectrum of a genuine article, and delivering the article being tested to one or the other of two destinations dependent upon whether or not said light-sensitive device is affected by the spectrum thus produced.

6. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of means for producing a spectrum characteristic of the material of the article being tested, a light-sensitive device disposed in the path of said spectrum, means for preventing all but certain predetermined wave lengths peculiar to the spectrum of a genuine article from reaching said device, and means controlled by the output of said light-sensitive device for indicating when a genuine article is being tested.

7. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of means for producing an electric discharge having a spectrum characteristic of the material of the article being tested, a light-sensitive device disposed in the path of said spectrum, means for screening said device against all but certain predetermined wave lengths peculiar to the spectrum of a genuine article, and means controlled by the output of said light-sensitive device for indicating when a genuine article is being tested.

8. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of means for producing an electric discharge having a spectrum characteristic of the material of the article being tested, a light-sensitive device disposed in the path of said spectrum, a screen for said device having at least one slit formed therein at such position as to pass only certain predetermined wave lengths of the spectrum, a relay for controlling the disposition of the article being tested after completion of the test, and means responsive to the output of said light-sensitive device for controlling the operation of said relay.

9. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of means for producing an electric discharge including an electric circuit adapted to utilize the article being tested as one electrode thereof, means for dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, a light sensitive device disposed in the path of the spectrum thus produced, means for preventing all but certain predetermined wave lengths of the spectrum from affecting said device, and means responsive to the output of said light-sensitive device for controlling the delivery of the article being tested to one or the other of two destinations at completion of the test.

10. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the

combination of an electric circuit adapted to utilize the article being tested as one electrode thereof, a second electrode forming a permanent part of said circuit, means for producing an electric discharge between said article and said second electrode, means for dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, a light-sensitive device disposed in the path of the spectrum thus produced, a screen for said device having at least one slit formed therein at such position as to pass only certain predetermined wave lengths of the spectrum, a relay for controlling the disposition of the article being tested after completion of the test, and means responsive to the output of said light-sensitive device for controlling the operation of said relay.

11. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of an electric circuit adapted to utilize the article being tested as one electrode thereof, a second electrode forming a permanent part of said circuit, means for effecting relative movement between said article and said second electrode toward and away from one another so as to produce an electric discharge therebetween, means for dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, a light-sensitive device disposed in the path of the spectrum thus produced, a screen for said device having at least one slit formed therein at such position as to pass only certain predetermined wave lengths of the spectrum, a relay for controlling the disposition of the article being tested after completion of the test, and means responsive to the output of said light sensitive device for controlling the operation of said relay.

12. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of an electric circuit adapted to utilize the article being tested as one electrode thereof, a second electrode forming a permanent part of said circuit, means for producing an electric discharge between said article and said second electrode, means for dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, and means including a light-sensitive device for indicating the genuine or spurious character of the article being tested in accordance with the presence or absence of certain predetermined wave lengths in the spectrum thus produced.

13. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of means for producing an electric discharge including an electric circuit having an electrode and an electrically conductive member adjacent thereto but separated therefrom so as to normally break the circuit, means for delivering the article to be tested to a position between said electrode and member and in which it is supported by and in contact with the latter, and means for effecting relative movement between said electrode and member so as to first bring the article being tested and the electrode into contact with one another to close the circuit and then move the same apart so as to produce an electric discharge therebetween, means for dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, a light-sensitive device disposed in the path of the spectrum thus produced, a screen for said device having at least one slit formed therein at such position as to pass only certain predetermined wave lengths of the spectrum, means for moving said electrically conductive member out of supporting contact with the article being tested at completion of the test, and means controlled by the ouput of said light-sensitive device for delivering the article being tested to one or the other of two destinations at completion of the test in accordance with its genuine or spurious character.

14. An apparatus for distinguishing between genuine coins, tokens or like metallic articles having a definite, known composition and spurious articles of other materials comprising the combination of means for producing an electric discharge including an electric circuit having an electrode and an electrically conductive member adjacent thereto but separated therefrom so as to normally break the circuit, means for delivering the article to be tested to a position between said electrode and member and in which it is supported by and in contact with the latter, and means for effecting relative movement between said electrode and member so as to first bring the article being tested and the electrode into contact with one another to close the circuit and then move the same apart so as to produce an electric discharge therebetween, means for dispersing the light produced by the discharge to form a spectrum characteristic of the material of the article being tested, a light-sensitive device disposed in the path of the spectrum thus produced, a screen for said device having at least one slit formed therein at such position as to pass only certain predetermined wave lengths of the spectrum, means for moving said electrically conductive member out of supporting contact with the article being tested at completion of the test, and means including a distributing relay responsive to the current generated by said light-sensitive device for delivering the article being tested to one or the other of two destinations at completion of the test in accordance with its genuine or spurious character.

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