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(71) Applicant: **ZELTRON - Instituto Zanussi per la Ricerca S.p.A.**
Via Principe di Udine 114
I-33030 Campoformido(IT)

(72) Inventor: **Monai, Giuliano**
Via Ippolito Nievo 8
I-33042 Buttrio (Udine)(IT)
Inventor: **Boscolo, Antonio**
Via Angelo Emo 33/2
I-34144 Trieste(IT)

(74) Representative: **Patentanwälte Grünecker, Kinkeldey, Stockmair & Partner**
Maximilianstrasse 58
D-8000 München 22(DE)

(54) Apparatus and method for testing incandescent lamps having a glass bulb.

(57) An apparatus for testing lamps having a glass bulb, permitting such lamps to be tested individually and/or when packed in a container such as a blister pack, comprising, in cooperation with a location whereat said lamps are positioned:
-a radio frequency generator,
-infrared detector means, and
-a processing and control unit.

In a method for testing lamps having a glass bulb, permitting such lamps to be tested individually and/or when packed in a container such as a blister-pack, the filaments of the lamps are exposed to the action of a radio-frequency electromagnetic field of an intensity capable of inducing in said filaments a luminosity in the infrared range next to the visible range, the positions provided for each lamp being scanned by infrared detector means.

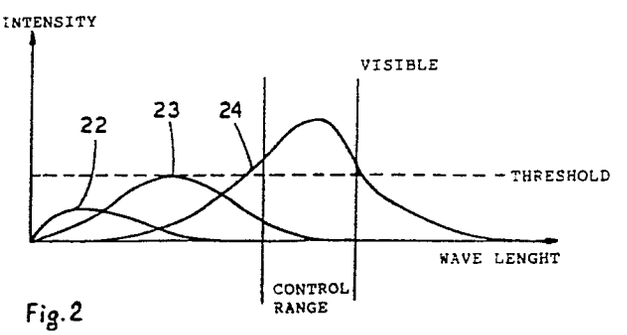

Fig.2

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APPARATUS AND METHOD FOR TESTING INCANDESCENT LAMPS HAVING A GLASS BULB

The present invention relates to apparatus for testing incandescent lamps having a glass bulb.

The invention also relates to a method for testing such lamps.

More particularly, the invention relates to the testing of low-voltage incandescent lamps, and is applicable to the testing of individual lamps, or to testing a plurality of such lamps disposed in a container such as in a blister pack.

In order to simplify the description, reference will be had in the following only to lamps disposed in blister packs.

In the process of manufacturing and automatically filling blister packeges for incandescent lamps, a considerable number of reject products is usually encountered due to the blister packs being incompletely filled and/or the glass bulbs of individual lamps being cracked or broken.

This problem, which occurs mainly in the case of lamps of larger dimensions, is actually solved by employing an operator for completing the not properly filled blister packs and for replacing damaged lamps.

This procedure is rather costly and time-consuming. With respect to light bulbs that are merely cracked this method is also rather inefficient, as the operator will not always be capable of recognizing minute cracks.

For resolving these problems, the inventors have studied, designed and tested a visual inspection system which operates without direct contact with the lamps.

This system is capable of automatically detecting the presence of incompletely filled blister packs or of blister packs containing at least one lamp having a damaged glass bulb or filament, to thereby permit such blister packs or individual lamps to be eliminated or replaced by the use of automatically operated equipment of a mechanical or pneumaticcally operated type.

The system according to the invention comprises means for processing signals generated by a telecamera operating in in infrared range for scanning the blister packs containing the lamps.

The absence of any lamp, or the presence of a lamp having a broken or cracked bulb and/or a broken filament, is detected by comparing the luminosity of the filament contained in an undamaged bulb to that of a filament which is exposed to atmosphere or broken.

This is accomplished by supplying the lamps with the energy necessary for heating their filaments without there being any direct contact with the lamps themselves.

This is accomplished by the use of a radio-frequency electromagnetic field which is suitably coupled to the lamps for transmitting to the filaments thereof a sufficient amount of energy for the intended purpose.

According to a preferred embodiment of the invention, a testing apparatus of the type defined above comprises:

-a telecamera or other detector means of suitable characteristics operating in the infrared range, or an equivalent device,

-a transmitter device comprising a suitable radiating system capable of transmitting radio-frequency energy to the lamps, and

-a processing, control and optionally display unit for programming and controlling the system and any optional systems for moving the blister packs or for automatically substituting blister packs and/or lamps.

The apparatus according to the invention may be programmed for processing different types of lamps within a range permitted by the energy emitted by the transmitter and by the image processing capacity.

According to the invention, apparatus for testing incandescent lamps having a glass bulb comprises means for moving said lamps relative to a testing station, and a processing and control unit for controlling said moving means. The apparatus is characterized by comprising a radiating system adapted to transmit radio-frequency electromagnetic energy produced by generator means to said lamps when positioned at said testing station, and detector means operating in the infrared range and adapted to detect the luminosity of said lamps at said testing station and to apply a corresponding signal to said processing an control unit, the latter being adapted to compare said signal to a reference signal and to generate a corresponding control signal in a per se known manner.

The invention is also directed to a method for testing incandescent lamps having a glass bulb by the use of the above described apparatus, said method being characterized in that said lamps, when positioned at said testing station, are subjected to the action of a radio-frequency electromagnetic field of an intensity normally capable of inducing luminosity in the infrared range adjacent the limit of the visible range in the filament of each lamp, the luminosity of said lamps being detected by detector means for comparison to a reference value.

An embodiment of the invention shall now be described by way of example with reference to the accompanying drawings, wherein:

fig. 1 shows a block diagram of a testing apparatus according to a preferred embodiment of the invention, and

fig. 2 shows a diagram of the operating range of the apparatus according to the invention.

As shown in fig. 1, lamps 10 are contained in containers 11 such as blister packs supported on conveyor means 12.

The lamps 10 contained in blister packs 11 may all be of the same type or of different types, and may be contained in individual blisters in a selected alignment or at indeterminate orientations.

The invention permits the lamps contained in blister packs 11, and more generally any individual lamp 10, to be tested without any energizing or sensing devices coming into actual contact with the lamps.

Conveyor means 12 is actuated by motor means 13. When a blister pack 11 arrives at a testing station, a proximity detector 17 signals a processing and control unit 19 adapted to control motor means 13.

When a blister pack 11 is positioned at the testing station, processing and control unit 19 activates a radio-frequency generator 15, preferably of the type having a controlled power output, which cooperates with a radiating system 14 for transmitting radio-frequency energy to the location occupied by blister 11. Processing and control unit 19 may be of any per se known type comprising for example at least one input/output unit, signal acquisition and processing means and a microprocessor of the type MVME 133 sold by Motorola Inc., and comprising a central processing unit CPU 68020.

The radiofrequency energy supplied to the location occupied by blister 11 excites the filaments of lamps 10.

As shown in fig. 2 the filaments of lamps 10 show a different response to the supply of energy of a given magnitude when broken (curve 22), when exposed to air (corve 23), i.e. when the glass bulb is cracked or broken, and whenn lamp 10 is undamaged (curve 24).

The inventors have ascertained that the difference in luminosity between a filament exposed to air (curve 23) and a filament in a vacuum (curve 24) is unequivocally discernible when the energy supplied to the lamp is of a magnitude whereat the temperature of the filament is just short of producing visible luminosity i.e. when the luminosity emitted by the filament is in the infrared range close to the limit of the visible range.

Infrared detector means 16, comprising for instance a telecamera responsive to radiation in the selected infrared range, or an array of photodiodes responsive to infrared radiation, is arranged to scan any location on blister pack 11 whereat a lamp 10 is, or should be, present.

In response to what is being detected, detector means 16 transmitts to an interface 18 a series of signals indicative of the intensity of the infrared radiation emitted from the respective positions provided on the area of blister pack 11.

The presence of one or more signals for any position, indicating that the luminosity at the respective position exceeds a determined reference threshold, signifies that the respective position is occupied by an undamaged lamp 10.

When the intensity of the emitted radiation, and thus the respective signal, remains below the determined threshold, it signifies that the respective position is not occupied by a lamp, or that the lamp occupying the position is deficient due to its bulb and/or filament being damaged.

The informations supplied to interface 18 are transmitted to processing and control unit 19 and processed thereby for determining the state of each lamp 10 on the base of the above criteria.

Processing and control unit 19 may be reset, controlled and programmed in a per se known manner by using a keyboard 20, optionally in combination with display means.

In addition to controlling motor means 13, processing and control unit 19 may also generate control signals for activating a device 21 operable to automatically replace in blisetr pack 11 any lamps 10 having been found to be damaged.

According to a modification, detector means 16 may be designed to detect a determined value of luminosity varying for different types of lamps, so that, even when only one lamp is not excited, the respective value of luminosity is not attained, causing the detector means to report such inferior value.

The detector means may also be designed to detect the absence of excitation also in two or more lamps.

The described testing apparatus and method may obviously be modified in various manners without thereby leaving the scope of the invention.

Claims

1. Apparatus for testing incandescent lamps having a glass bulb, comprising means for moving said lamps relative to a testing station, and a processing and control unit for controlling said moving means, characterized by comprising a radiating system (14) adapted to transmit radio-frequency

electromagnetic energy produced by generator means (15) to said lamps (10) when positioned at said testing station, and detector means (16) operating in the infrared range and adapted to detect the luminosity of said lamps (10) at said testing station and to apply a corresponding signal to said processing and control unit (19), the latter being adapted to compare said signal to a reference signal and to generate a corresponding control signal in a per se known manner.

2. Testing apparatus according to claim 1, characterized in that said radio-frequency generator (15) has a variable and controlled power output.

3. Testing apparatus according to claim 1, characterized in that said infrared detector means (16) comprise a telecamera.

4. Testing apparatus according to claim 1, characterized in that said infrared detector means (16) is composed of photodiodes.

5. Testing apparatus according to claim 1, characterized in that said infrared detector means (16) is designed to detect the luminosity at individual locations occupied by said lamps (10).

6. Testing apparatus according to claim 1, characterized in that said infrared detector means (16) is designed to detect an average luminosity level.

7. Testing apparatus according to claim 1, characterized in that said processing and control unit (19) is adapted by means of said control signal to control in a per se known manner a device (21) for replacing any of said lamps (10).

8. A method for testing incandescent lamps having a glass bulb by the use of the testing apparatus according to any of claims 1 to 7, characterized in that said lamps (10), when positioned at said testing station, are subjected to the action of a radio-frequency electromagnetic field of an intensity normally capable of inducing luminosity in the infrared range adjacent the limit of the visible range in the filament of each lamp, the luminosity of said lamps being detected by said detector means (16) for comparison to a reference value.

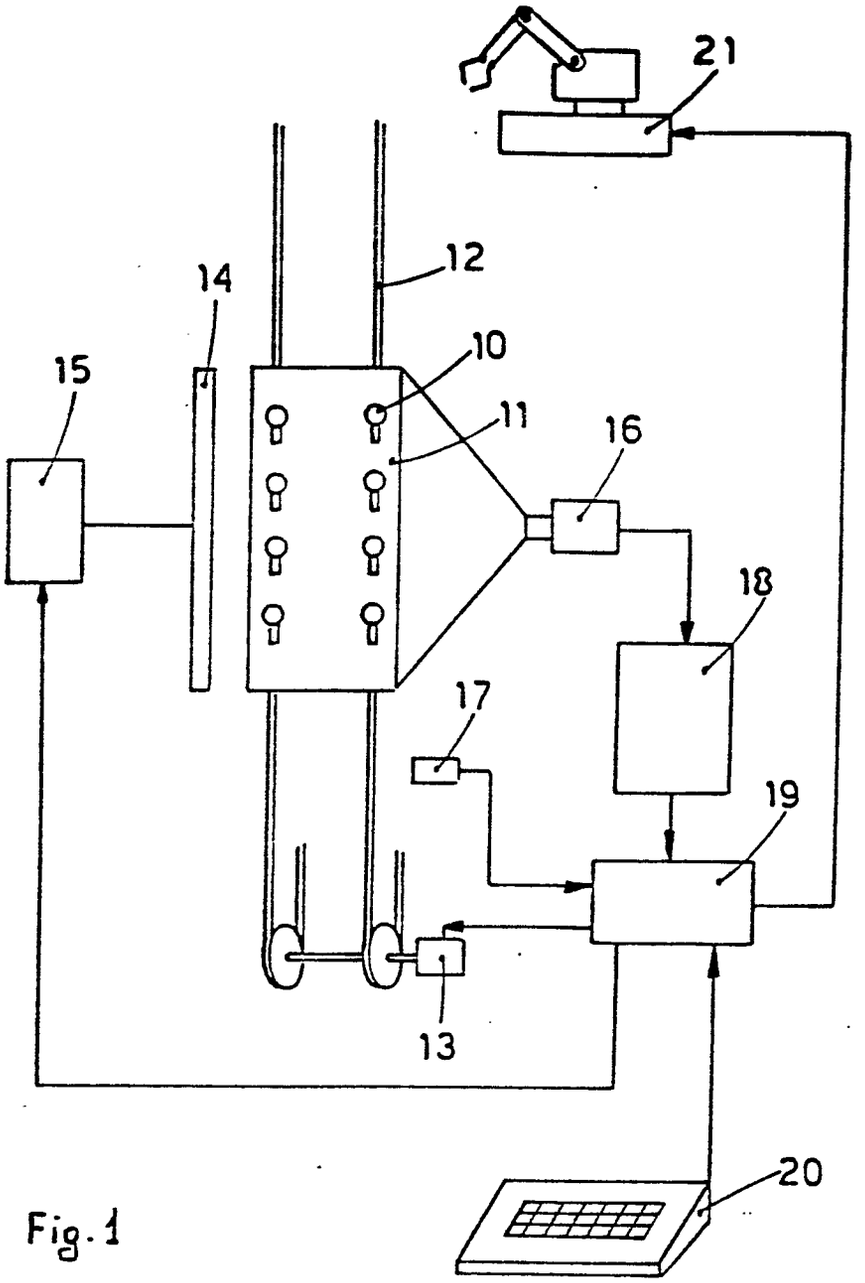
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Fig.1

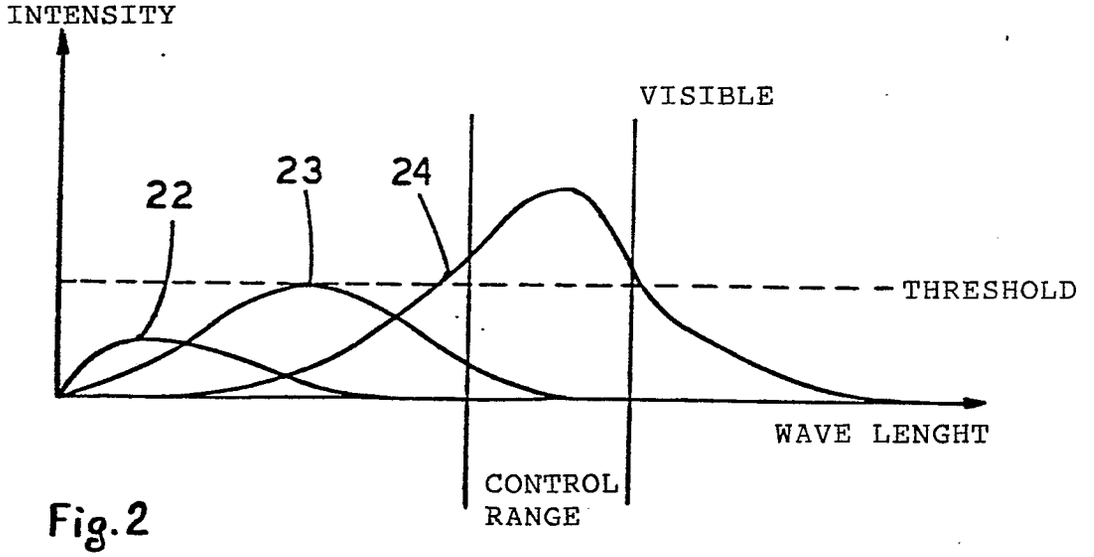
INTENSITY
VISIBLE
22
23
24
THRESHOLD
WAVE LENGHT
CONTROL
RANGE

Fig.2