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ELECTRIC IMPULSE STORING DEVICES AND PACKAGING MACHINES COMPRISING SUCH DEVICES

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Fig. 1

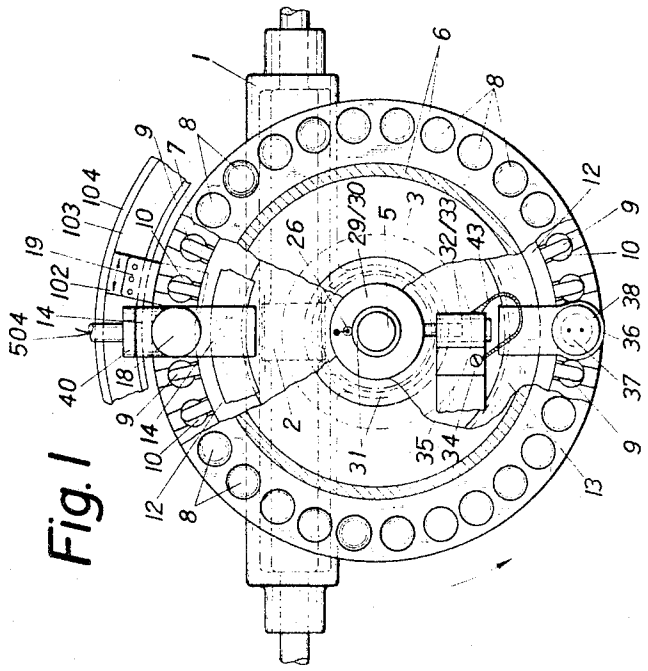
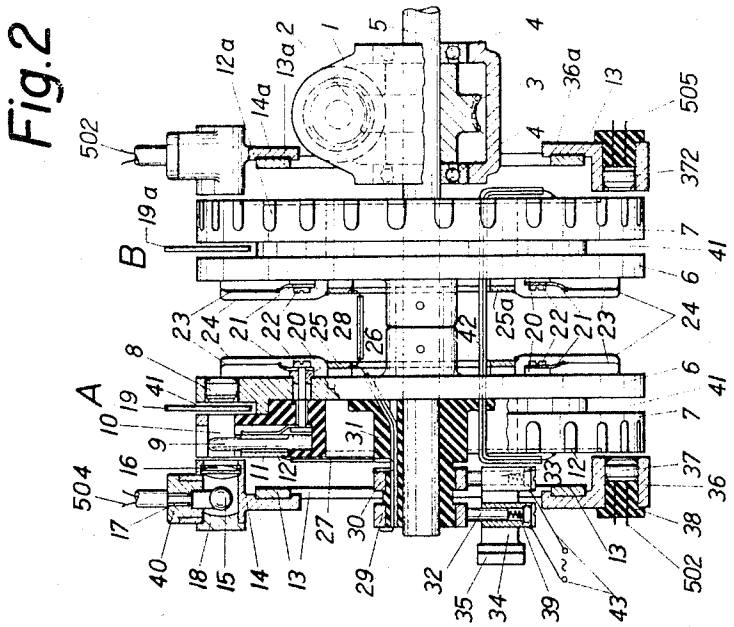


Fig. 2

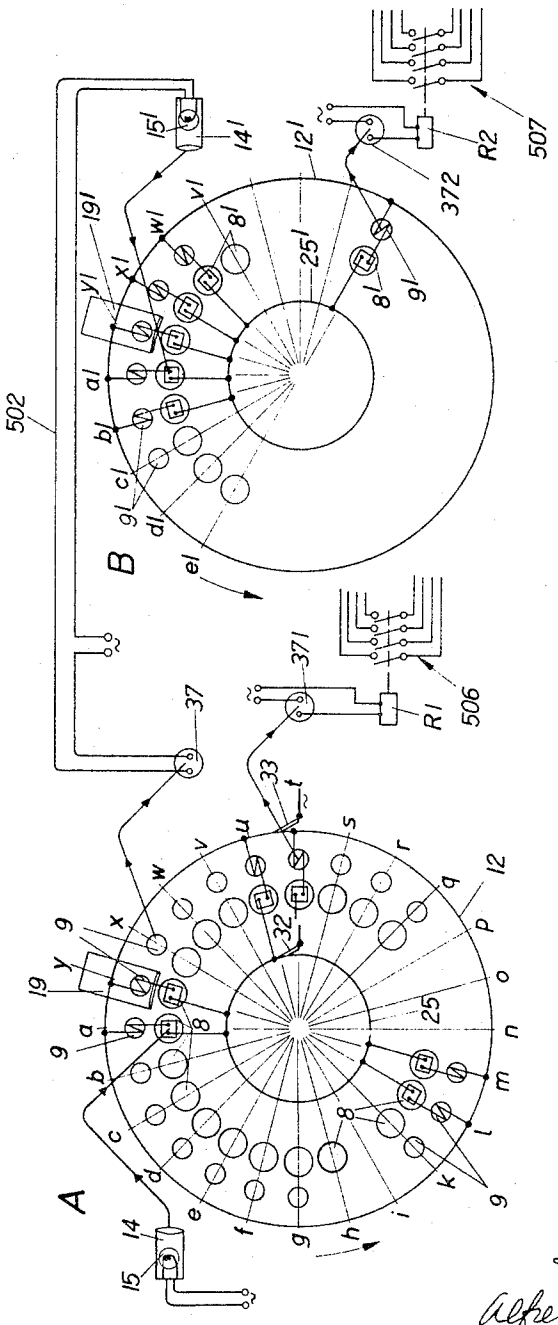


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ELECTRIC IMPULSE STORING DEVICES AND PACKAGING MACHINES COMPRISING SUCH DEVICES

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Fig. 3



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Fig. 4

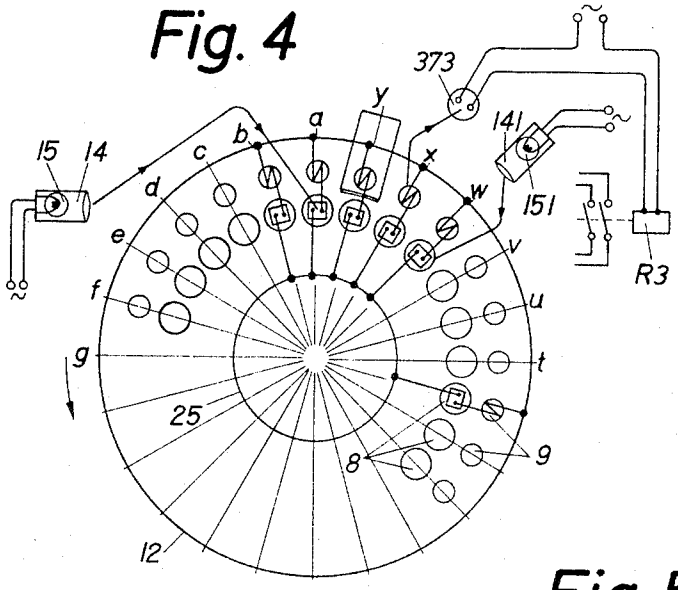
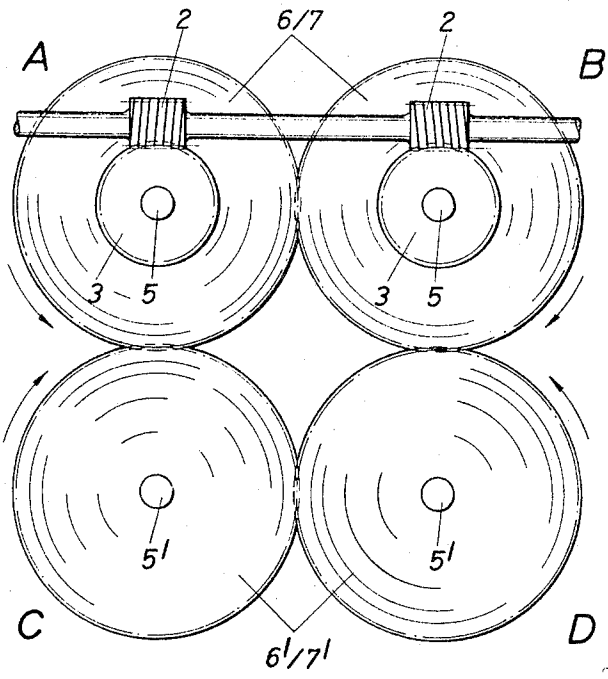


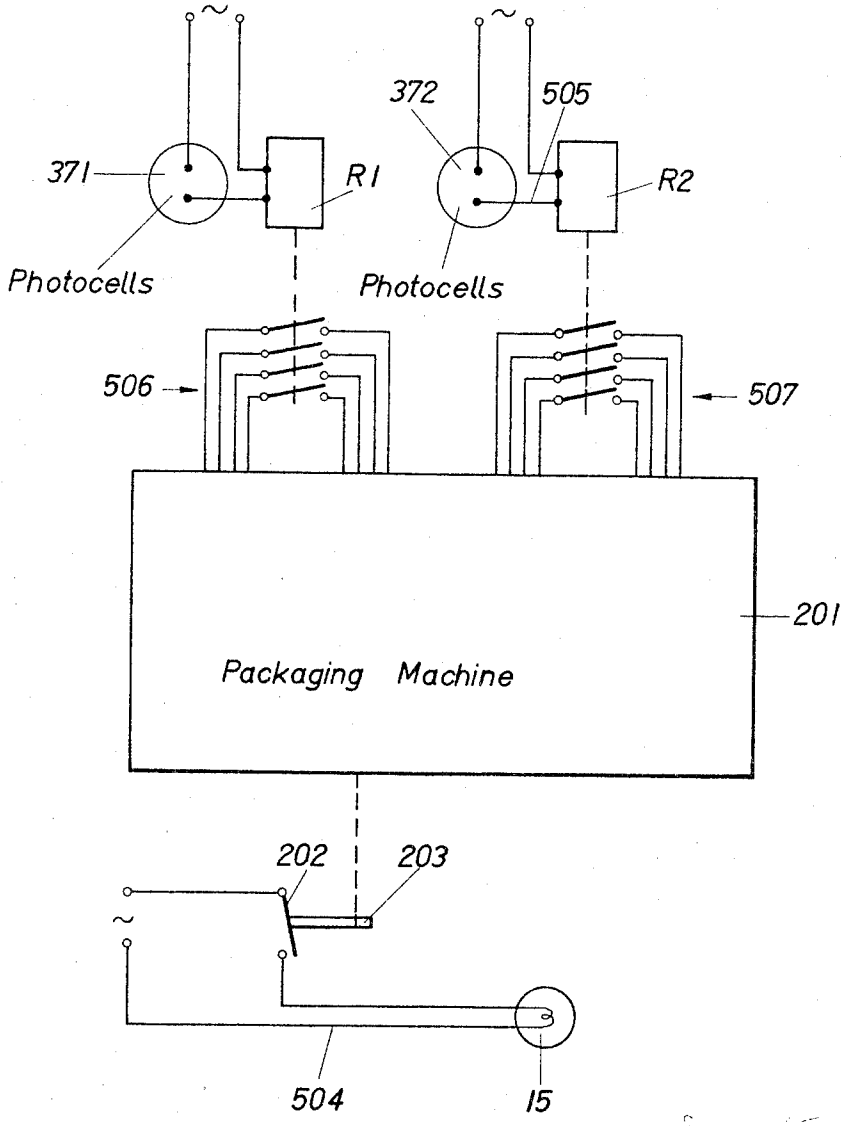
Fig. 5



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Fig. 6



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ELECTRIC IMPULSE STORING DEVICES AND PACKAGING MACHINES COMPRISING SUCH DEVICES

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8 Claims. (Cl. 250—205)

The invention relates to electric impulse storing devices and packaging machines comprising such devices.

In packaging machines, for example cigarette packaging machines, in which packages pass along a feed path from one handling station to another, it is desirable to provide means for sensing the presence of imperfectly formed packages or for sensing the absence of a package in an otherwise regular series thereof or for sensing a wrongly orientated package.

When such a condition is sensed, it is usually inconvenient to take immediate action; instead, it is desirable to delay any corrective action until the imperfect package has reached a predetermined position in the feed path, or until a conveyor space from which a package is missing is at a predetermined position of the feed path. The imperfect package is then ejected and possibly replaced by a substitute package, or a reserve package is placed in the conveyor space from which a package was missing.

The present invention consists in an electric impulse storing device comprising a rotatable member, means for rotating said member, a plurality of main photocells, an equal plurality of electric circuits, an equal plurality of electric main light sources, said main photocells and said main light sources being fixed to said rotatable member, in a circular configuration about the axis of rotation of said member, each of said main light sources being associated with one of said main photocells for illuminating the same, and being arranged in axial opposition to its associated photocell, each of said electric circuits including one of said main light sources and its associated main photocell for energizing a main light source when its associated photocell is illuminated, input means including a stationary electric auxiliary light source arranged to be energized in response to an electric impulse to be stored, said main light sources and said associated photocells being rotatable jointly with said rotatable member relatively to and past said auxiliary light source which is arranged for illuminating, when energized, an adjacent one of said plurality of photocells, a stationary auxiliary photocell arranged for being illuminated by any one of said main light sources when energized and when in a predetermined first position relative to said auxiliary photocell, an auxiliary electric circuit, which includes said auxiliary photocell, for creating a control effect in dependence on the illumination of said auxiliary photocell, means for intercepting light from any one of said main light sources to its associated main photocell when in a predetermined second position subsequent to said first position, and angularly displaceable mounting means for setting the angular spacing between said auxiliary light source and said auxiliary photocell to vary the time during which electric impulses are stored.

The invention also consists in a packaging machine comprising such a device, and further comprising sensing means responsive to a condition in a feed path of said machine, which condition is to be compensated for at a later stage, means for feeding an electric impulse to said input means for operating the auxiliary electric light source in dependence on the actuation of said sensing means, and means connected to said auxiliary circuit to operate means in response to a change in the illumination of said auxiliary photocell for controlling the compensation of the said condition.

To make the invention clearly understood reference will now be made to the accompanying drawings which are given by way of example and in which:

FIG. 1 is an end view, partly in section and partly broken away, of an impulse storing device of the invention;

FIG. 2 is a side view of the device of FIG. 1, partly in section and partly broken away;

FIG. 3 is an electric circuit diagram of an impulse storing device similar to the device of FIGS. 1 and 2;

FIG. 4 is an electric circuit diagram representing a modification of part of the circuit diagram of FIG. 3;

FIG. 5 is a diagrammatic view illustrating the manner in which a number of impulse storing devices may be geared together; and

FIG. 6 is a block diagram illustrating the operative connection between the impulse storing device of FIG. 3 and a packaging machine.

The impulse storing device of FIGS. 1 and 2 comprises a first impulse storing and read-out unit A and a second impulse storing and read-out unit B. Each of the two units A and B comprises a flange **6** and a ring **7** secured to the flange **6**. The flanges **6** of the two units are fixed on a common shaft **5**. The shaft **5** carries a worm wheel **3** which meshes with a worm **2** provided on a drive shaft the worm **2** and worm wheel **3** being arranged in a casing **1**, the shaft **5** being journalled in ball bearings **4** mounted in the casing **1**.

The impulse storing and read-out units A and B are generally similar to each other, apart from one being a mirror image of the other. Therefore, only the first unit A will be described in detail.

The flange **6** of the first unit A is of metal and has thirty cylindrical bores extending therethrough, all of equal size, all at the same radius from the centre of the flange **6** and all equally spaced from each other. In each of the bores, a photoresistive cell **8** is arranged, these cells being hereinafter referred to as photocells and being preferably of such a nature as to have a high electric resistance when not illuminated but a low electric resistance when illuminated above a given threshold intensity.

The ring **7** which is of insulating material, is fixed to the flange **6** in face to face contact therewith, by thirty bolts **22** which are insulated from the flange **6** by bushes **20** of insulating material. The ring **7** has thirty bores **10** extending therethrough in line with the photocells **8** of the flange **6**. That face of the ring **7** which is remote from the flange **6** has an inset electrically conductive ring **12**. The bolts **22** are each connected to spring contacts **11** which in cooperation with the conductive ring **12** form sockets for thirty incandescent lamps **9**, of a type similar to telephone switchboard signal lamps, one of which extends into each of the bores **10** in the ring **7**.

One terminal of each of the photocells **8** is connected to a respective one of the bolts **22** by a solder lug **21** thereon and the other terminal of each of the photocells **8** is connected to a common conductive ring **25**. The ring **25** is connected by a wire **26** to a slip ring **29** mounted on an insulating bush **31** provided on the shaft **5**. The conductive ring **12** is connected by a wire **27** to another slip ring **30** mounted on the bush **31**. Carbon brushes **32** and **33** engage the slip rings **29** and **30**, the brushes being mounted in a holder **34** carried by a fixed part **35** of the frame of the device. The brushes are connected by flexible leads **43** to a source of electric current and are urged by springs **39** into positive engagement with the slip rings. By the described electrical connections, each photocell **8** is connected in series with the lamp **9** which

lies in axial line therewith, and all of these series combinations are connected, in parallel, to the source of electric current. Furthermore, in the absence of illumination of a photocell **8**, its associated lamp **9** does not receive sufficient electric current to operate, since the photocell **8** is of high resistance.

At the side of the ring **7** remote from the flange **6**, a stationary annular guide rail **13** is provided. A lamp housing **14** is mounted on the guide rail **13** so as to be movable in a circular path. The lamp housing **14** contains an electric lamp **15** at the same radius from the axis of the shaft **5** as the bores **10** and the photocells **8**. A reflector **18** serves for directing light from the lamp **15** to a lens **16** and thence out of the lamp housing **14**. The lamp **15** is supported in the lamp housing **14** by a closure plug **40** having conductive members **17** for engaging terminals of the lamp **15**. The conductive members **17** are connected to a flexible cable **504**.

A housing **36** is also mounted on the guide rail **13** for displacement therearound. The housing **36** carries a photocell **37** having electric leads **502**, the photocell **37** being held in the housing **36** by a plug **38** of insulating material.

The flange **6** is recessed at its periphery so that annular gap **41** extends between the array of photocells **8** and the array of bores **10**. A mask **19** (see FIG. 1) extends into the gap **41**, the mask being fixed to a slide **102** movable in a track **103** of a stationary guide rail **104**, the guide rail **104** being fixed to the frame of the device and extending in a circle around the flange **6**.

The impulse storing and read-out unit B, as mentioned hereinbefore, is generally similar to the unit A, but no slip rings and brushes are provided for feeding electric current to the photocells **8** and lamps **9** therein, the conductive rings **12***a* and **25***a* of the unit B being simply connected to the conductive rings **12** and **25** of the unit A by wires **42** and **28**. The lamp housing **14***a* of unit B has a flexible cable **502** (equivalent to the cable **504** of unit A) and the photocell housing **36***a* contains a photocell **372** having leads **505** (equivalent to the photocell **37** and leads **502** of unit A).

The number of impulses which can be stored depends on the number of photocells **8** in the flanges **6**. In each of the flanges **6** in FIGS. 1 and 2 there are thirty photocells **8**. For simplification, in the circuit diagram of FIGS. 3 and 4 there are provided only twenty-four photocells **8** for each of the flanges, but it will be understood that the maximum number of pohtocells which can be used is limited only by the maximum allowable diameter of the flanges which carry the photocells, and by the size of the photocells.

In the circuit diagram of FIG. 3, for simplification, the brushes **32** and **33** are shown diagrammatically as operating directly on the rings **25** and **12** and although there are twenty-four series combinations of photocells **8** and lamps **9** for each of the units A and B, only some of these have been shown in FIG. 3. Also for clarity, the photocells **8** have been shown at a different radius than their associated lamps **9**. In reality, the photocells **8** and lamps **9** are arranged in axial line as shown in FIGS. 1 and 2. For unit A angular positions *a* to *y* have been shown for the twenty-four series combinations each of a photocell **8** and a lamp **9** and for unit B similar angular positions *a*1 to *y*1 have been shown. The discs and flanges carrying the lamps **9** and photocells **8** rotate, of course, in the direction shown by the arrow, and the angular positions *a* to *y* and *a*1 to *y*1 will be referred to in the following description for identifying the angular extent to which a given lamp-photocell combination has progressed in a single revolution of the shaft **5**.

In the application of the device to a packaging machine, for the storing of impulses derived from means sensing missing packages or faulty or otherwise undesirable packages, with the read-out impulse controlling the ejection of the faulty package or the introduction of a substitute package at a predetermined later stage or controlling some other equivalent function, then preferably the flanges **6** and rings **7** are rotated by the shaft **5** with an intermittent motion, in angular steps each of which is equal to the angular distance between two adjacent photocells **8**, for each packing operation of the machine. Of course, it is alternatively possible for the flanges **6** and rings **7** to be rotated continuously.

Now, as already mentioned, the lamps **9** do not receive sufficient current to light, unless their associated photocells **8** are illuminated. From an examination of FIG. 2 it will be seen that if the lamp **15** is energised, then, whenever a series combination of a lamp **9** and a photocell **8** moves into axial line with the lamp **15**, light from the lamp **15** is directed onto the relevant photocell **8**, through the transparent envelope of the lamp **9**, with the result that the resistance of the photocell **8** becomes so low that the associated lamp **9** receives sufficient current to light. The lamp **9** then illuminates the photocell **8** and thus the resistance of the photocell **8** does not again become high when the photocell **8** moves out of the line of action of the lamp **15** as a result of rotation of the flange **6** and ring **7**. Consequently, once a lamp **9** has been placed in operation in this way, it continues to operate, regardless of the state of lamp **15**. When subsequently the lamp **9** and photocell **8** passes the mask **19** (see FIG. 1) light from the lamp **9** is intercepted by said mask, the resistance of the photocell **8** increases so that the lamp **9** is extinguished. By rotating the mask **19** along the track **103**, the position at which a lighted lamp **9** is extinguished can be altered.

Lamp **15** is operated, in a manner which will subsequently be described with reference to FIG. 6, whenever an event occurs in the packing machine which requires some action to be taken at a predetermined later stage. On the occurrence of such an event, and the consequent operation of the lamp **15**, the photocell **8** which is in line with the lamp **15** at that instant is illuminated and its associated lamp **9** is thus placed into operation.

It will be seen from FIG. 3 that the photocell **37** of the unit A is connected in series with a source of electric current and with the lamp **15'** of the unit B. The lamp **15** is represented in FIG. 3 in a position for illuminating the lamp **8** at position *a* and the photocell **37** is shown as receiving illumination from a lamp **9** at position *x*. The lamp **15'** is shown in a position for illuminating a lamp **8'** of the unit B at position *a*1. Accordingly, for each operation of lamp **15** of unit A one of the lamps **9** of the unit A is caused to operate and on reaching the position *x* this operated lamp **9**, by illumination of the photocell **37**, causes operation of the lamp **15'** of unit B and consequent placing into operation of that lamp **9'** of unit B which at this instant is at position *a*1. Thus the lamp **9'** which arrives at position *a*1 at any instant, leaves the position *a*1 in the same state, that is to say alight or not alight, as the state of the lamp **9** which is at the position *x* of unit A at the same time.

The mask **19** of unit A is shown in FIG. 3 as at position *y*. The remaining positions *a* to *x* thus provide twenty-three impulse-storing possibilities for a single revolution of the flange **6** and ring **7** of unit A, assuming that the housing **36** of the photocell **37** (see FIGS. 1 and 2) is moved into the position *x* shown in FIG. 3. Similarly, unit B provides for the storage of up to twenty-three impulses, assuming that the housing **36***a* of the photocell **372** is moved into the position *x*1.

The photocell **372** of unit B is connected in series with a source of electric current and the winding of a relay R2 having a contact set **507**.

Another photocell **371** (see FIG. 3) is provided in unit A for illumination by the lamps **9** and is angularly displacably mounted in a manner similar to the photocell **37**, but is not shown in FIGS. 1 and 2. The photocell **371** is connected in series with a source of electric cur-

rent and a relay R1 having a contact set 506, as shown in FIG. 3.

Now, referring to FIG. 6, a packaging machine is indicated generally by reference numeral 201, this machine being of known construction and being shown simply as a block. A sensing device, represented for simplicity as a switch 202 and a feeler 203, is provided for sensing the presence of faulty or otherwise undesirable packages, or the absence of packages, in a feed path of the machine 201. This sensing device may be of any known construction, for example it may be a photoelectric device sensing incorrectly positioned packages or a device weighing packages during their feeding. In any case, the sensing device is so connected that when the sensing device responds to an undesired or missing package, the lamp 15 is energised through the cable 504. The switch 202 is in known manner slow to open so that the lamp 15 remains energised until it is fully aligned with a lamp 9.

As explained above, the energising impulse thus supplied to the lamp 15 causes that lamp 9 to operate which at the instant of operation of lamp 15 is in axial line with lamp 15. Consequently, the impulse is stored by the operated lamp 9 remaining alight during the rotation of the flange 6 and ring 7. When this operated lamp 9 reaches the position *x* (FIG. 3), or any intermediate position to which the photocell 37 may have been set, the photocell 37 is illuminated by the lamp 9 and consequently the lamp 15′ of unit B is energised for the period in which the relevant lamp 9 remains at position *x*. When, now, the flange 6 and ring 7 of unit A rotate into position *y*, the photocell 37 is no longer illuminated and the lamp 15′ of unit B is extinguished. Due to the presence of the mask 19 at position *y* of unit A, the light from the lamp 9 which has been a light up to this stage, is prevented from falling on the associated photocell 8. This photocell 8 accordingly again becomes highly resistive and insufficient current flows through the lamp 9 to keep it alight. Extinguishing of the lamp 9 at position *y* renders it ready for use again at position *a*.

The operation of the lamp 15′ of the unit B while the operated lamp 9 of unit A was at position *x*, has caused that lamp 9′ of unit B to operate, which was at position *a*1 at that time. When on further rotation of the flange 6 and ring 7 of unit B, this lamp 9′ reaches the angular position to which the photocell 372 has been set, the photocell 372 is illuminated, becomes less resistive, and allows sufficient current to flow from the current source to actuate relay R2. The contact set 507 of relay R2 is associated with the packing machine 201 (see FIG. 6) and in known manner controls an operation which makes good the deficiency or defect found by the sensing device comprising the switch 202 and the feeler 203. Such an operation may for example be an ejection of the undesired package at a given point in the feed path thereof or a replacement of an ejected package by a substitute package.

It will be appreciated that the time which elapses between operation of the sensing device 202, 203, and actuation of the relay R2 can be varied by varying the angular positions of the photocells 37 and 372 relative to the rings 7 of the units A and B respectively, the storage time given by the unit B being added to the storage time given by unit A. The storage time given by either unit depends on the time taken for a revolution of the shaft 5. If rotation is effected in angular steps, with one step for each packing operation in the packaging machine, then the storage time available will be dependent on the number of photocell-lamp combinations in each unit.

In some cases, it may be necessary to perform an operation in the packing machine at a time which bears a predetermined relation to the instant of operation of the sensing feeler 203, but which is prior to the operation effected by actuation of the relay R2. For this purpose the photocell 371 and relay R1 associated with unit A is provided (see FIG. 3). The contact set 506 of relay R1 is associated with the packaging machine 201 (see FIG. 6) and in known manner controls an operation therein. An example of such an operation would be the advance introduction into the feed path of a package intended to replace a package which has been found by the sensing feeler 203, to be undesirable and which will subsequently be ejected on actuation of relay R2.

The device has been described so far on the assumption that lamp 15 is normally not energised and is energised only when the feeler 203 is actauted. In such a case the lamps 9 of the unit A are normally not energised and a lamp 9 becomes energised only if the lamp 15 is alight when the photocell 8 associated with a given lamp 9 moves into axial register with the lamp 15. Similar considerations apply to unit B. This means that if one of the lamps 9 fails, an impulse cannot be stored by the photocell-lamp combination to which this inoperative lamp belongs, and the danger exists that a faulty package might thus be allowed to pass unejected. Also, if the lamp 15 should fail, no packages would be ejected.

For avoiding this danger the sensing feeler 203 and switch 202, may be so arranged that the lamp 15 is energised continuously and is temporarily extinguished only when a faulty or missing package is detected, Thus, the photocells 8 passing position *a* in FIG. 3 are all illuminated by the lamp 15 unless when a given photocell 8 is at position *a*, the lamp 15 is extinguished as a result of sensing of a faulty or missing package. Failure of the lamp 15 or 15′ or one or more of the lamps 9 or 9′ would in this case lead to the ejection of perfect packages, which is quickly noticed by the operating personnel and which is more satisfactory than the nonejection of undesirable packages or nonsensing of missing packages, which would be the consequence of lamp failure in the case where the lamp 15 is illuminated only when an undesirable or missing package is sensed. Of course, when the lamps 9 and 9′ are operated in this fail-safe mode, the relays R1 and R2 would have normally-closed contact sets.

When the lamps 9 are not operated in the fail-safe mode outlined above, provision may be made for testing the lamps 9 once during each revolution of the unit. The circuit diagram of FIG. 4 illustrates such a provision and it will be seen that a lamp 151 arranged in a housing 141 is provided for illuminating each photocell 8 as it reaches the position *w*. This causes the associated lamp 9 to operate, if it is not operating already as a result of operation of the lamp 15, and on movement of the photocell-lamp combination into the position *x* the state of the lamp 9 is sensed by a photocell 373 arranged at position *x*. If the lamp 9 at position *x* is alight, as must be the case if the lamp 9 is intact the photocell 373 will be illuminated and a relay R3 connected in series with the photocell 373 and a source of electric current will be energised. If the lamp 9 is faulty and is not alight at the position *x* the relay R3 lapses and causes the operation of alarm means (not shown). Of course, the provision of the lamp 151 at position *w* means that the photocell 37 (FIG. 3) which forms the link with unit B cannot be moved beyond position *v*. The available storage time is thereby reduced, but so also is the possibility of undesirable packages escaping undetected.

As already mentioned, the storage times of units A and B are effectively in series. If a shorter storage time is acceptable, then the unit B may be dispensed with, and relay R1 (FIG. 3) used for effecting the operations normally carried out by relay R2. If a greater storage time is required than is provided by units A and B described above, the number of photocell-lamp combinations in these units may be increased and the speed of rotation correspondingly reduced. As this would lead to the flanges 6 and rings 7 being of large diameter and cumbersome, it is preferred to provide further units similar to the unit B and all effectively arranged in series. To provide easy access for servicing, the units are then preferably arranged each on a separate shaft.

Such an arrangement is diagrammatically shown in

FIG. 5. In this arrangement, four units A, B, C and D are provided. The flanges 6 and rings 7 of the units A and B are mounted on shafts 5 which are driven by worm wheels 3 from worms 2 on a transverse drive shaft. Flanges 6' and rings 7' of the units C and D are mounted on shafts 5'. The flanges 6 and 6' and the rings 7 and 7' are externally toothed so as to function as spur gears, their interengagement ensuring that the shafts 5' of units C and D are driven in synchronism with the shafts 5 of the units A and B.

Many omissions, additions and modifications to the embodiments specifically described herein are possible without departing from the spirit and scope of the invention.

I claim:

1. An electric impulse storing device comprising a rotatable member, means for rotating said member, a plurality of main photocells, an equal plurality of electric circuits, an equal plurality of electric main light sources, said main photocells and said main light sources being fixed to said rotatable member, in a circular configuration about the axis of rotation of said member, each of said main light sources being associated with one of said main photocells for illuminating the same, and being arranged in axial opposition to its associated photocell, each of said electric circuits including one of said main light sources and its associated main photocell for energizing a main light source when its associated photocell is illuminated, input means including a stationary electric auxiliary light source arranged to be energized in response to an electric impulse to be stored, said main light sources and said associated photocells being rotatable jointly with said rotatable member relatively to and past said auxiliary light source which is arranged for illuminating. When energized, an adjacent one of said plurality of photocells, a stationary auxiliary photocell arranged for being illuminated by any one of said main light sources when energized and when in a predetermined first position relative to said auxiliary photocell, an auxiliary electric circuit, which includes said auxiliary photocell, for creating a control effect in dependence on the illumination of said auxiliary photocell, means for intercepting light from any one of said main light sources to its associated main photocell when in a predetermined second position subsequent to said first position, and angularly displaceable mounting means for setting the angular spacing between said auxiliary light source and said auxiliary photocell to vary the time during which electric impulses are stored.

2. A device as defined in claim 1, and comprising an additional electric light source, means mounting said additional electric light source at the same radius as the radius of said circular configuration and subsequent to said auxiliary photocell considered in the direction of rotation of said rotatable member, means permanently energizing said additional electric light source during operation of the impulse storing device, whereby successively each one of said plurality of photocells is illuminated by said additional light source during movement of said photocells past said additional light source, an additional photocell, means mounting said additional photocell, at the same radius as the radius of said circular configuration and subsequent to said additional electric light source, and signalling means responsive to an interruption of the illumination of said additional photocell for longer than a predetermined time.

3. An impulse storing arrangement comprising a first storing device as defined in claim 1, a second storing device as defined in claim 1, and means electrically connecting said auxiliary electric circuit of said first storing device to said input means of said second storing device.

4. An arrangement as claimed in claim 3, and comprising a common rotatable shaft, and means for rotating said shaft, said rotatable member of said first storing device and said rotatable member of said second storing device being mounted on said common shaft for joint rotation.

5. An impulse storing arrangement comprising a series of storing devices, each as defined in claim 1, a number of means electrically connecting the auxiliary electric circuit of each storing device (except for the last storing device of the series) to the input means of the succeeding storing device, a series of rotatable shafts, said rotatable member of each storing device being mounted on one of said shafts, and means for intergearing the rotatable members for synchronous rotation.

6. A packaging machine comprising an impulse storing device as defined in claim 1, and further comprising sensing means responsive to a condition in a feed path of said machine, which condition is to be compensated for at a later stage, means for feeding an electric impulse to said input means for operating the auxiliary electric light source in dependence on the actuation of said sensing means, and means connected to said auxiliary circuit to operate means in response to a change in the illumination of said auxiliary photocell for controlling the compensation of the said condition.

7. A packaging machine as defined in claim 6 wherein said feeding means are arranged for energizing said auxiliary light source on the occurrence of said condition, said controlling means being operable when said auxiliary photocell is illuminated.

8. A packaging machine as defined in claim 6, wherein said feeding means are arranged for extinguishing said auxiliary light source on the occurrence of said condition, said controlling means being operable when illumination of the auxiliary photocell is interrupted.

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