Sept. 29, 1953 J. FLAWS, JR., ET AL 2,653,711

DEFECTIVE LAMP DETECTING AND EJECTING MECHANISM

Filed June 30, 1951 2 Sheets-Sheet 1

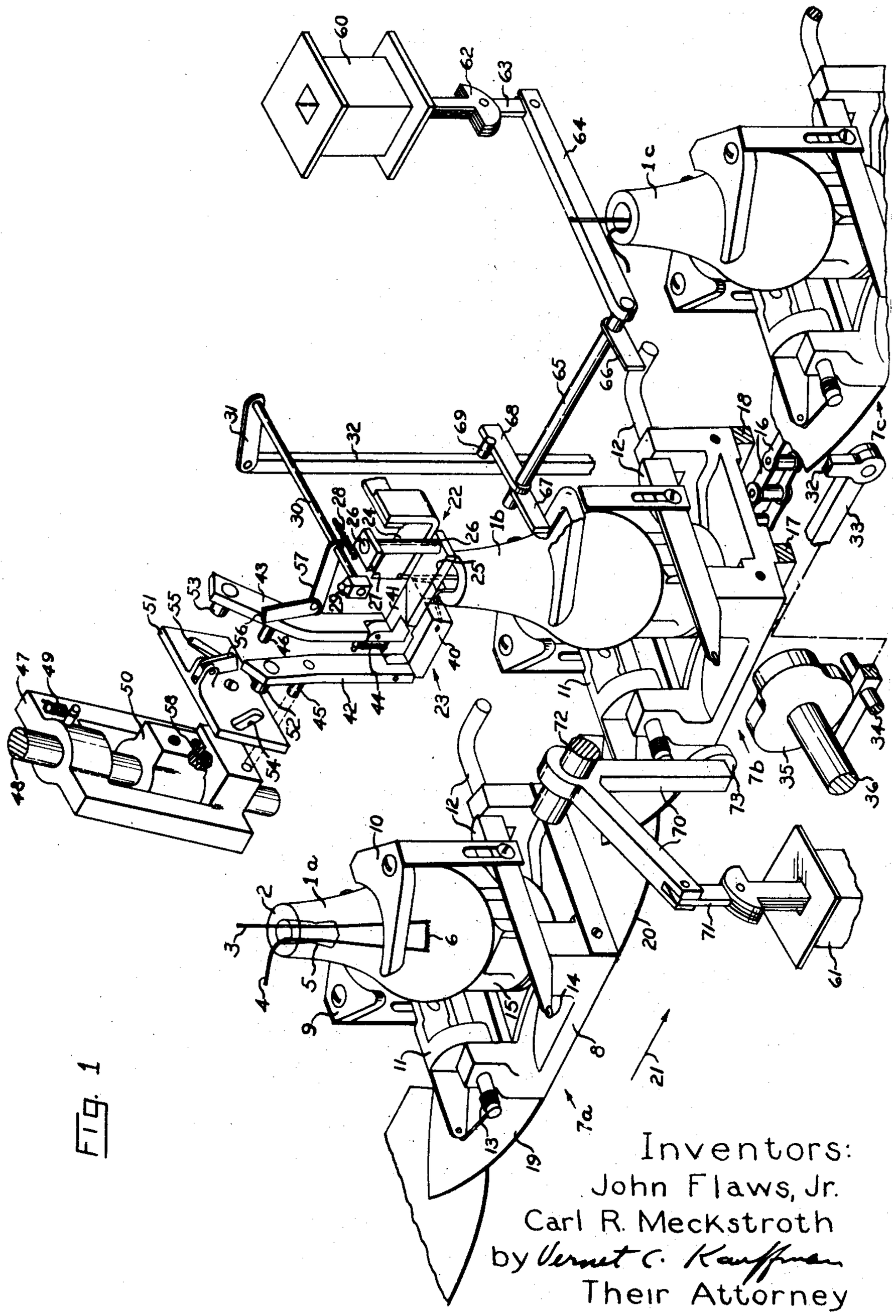

FIG. 1

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Fig. 2

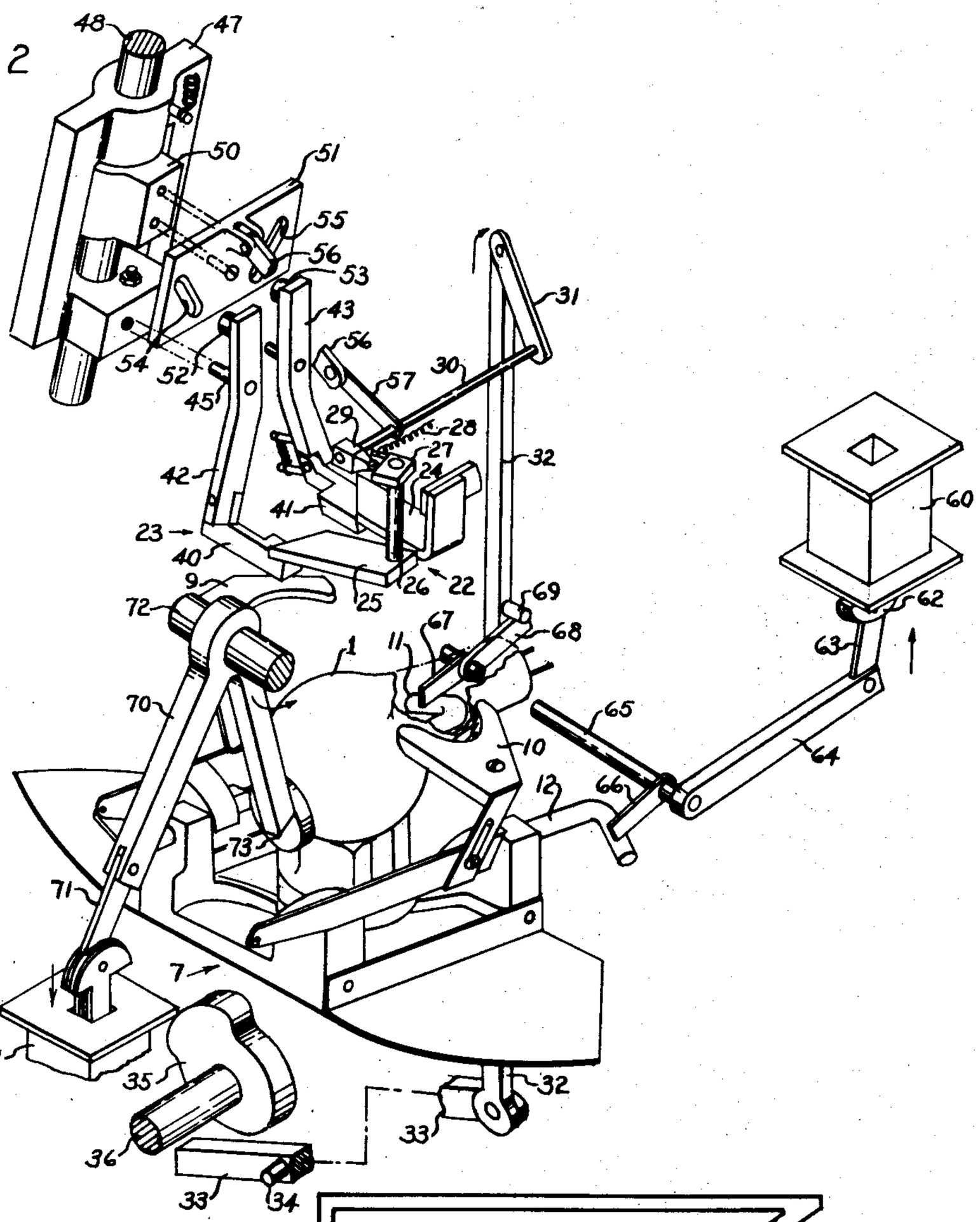
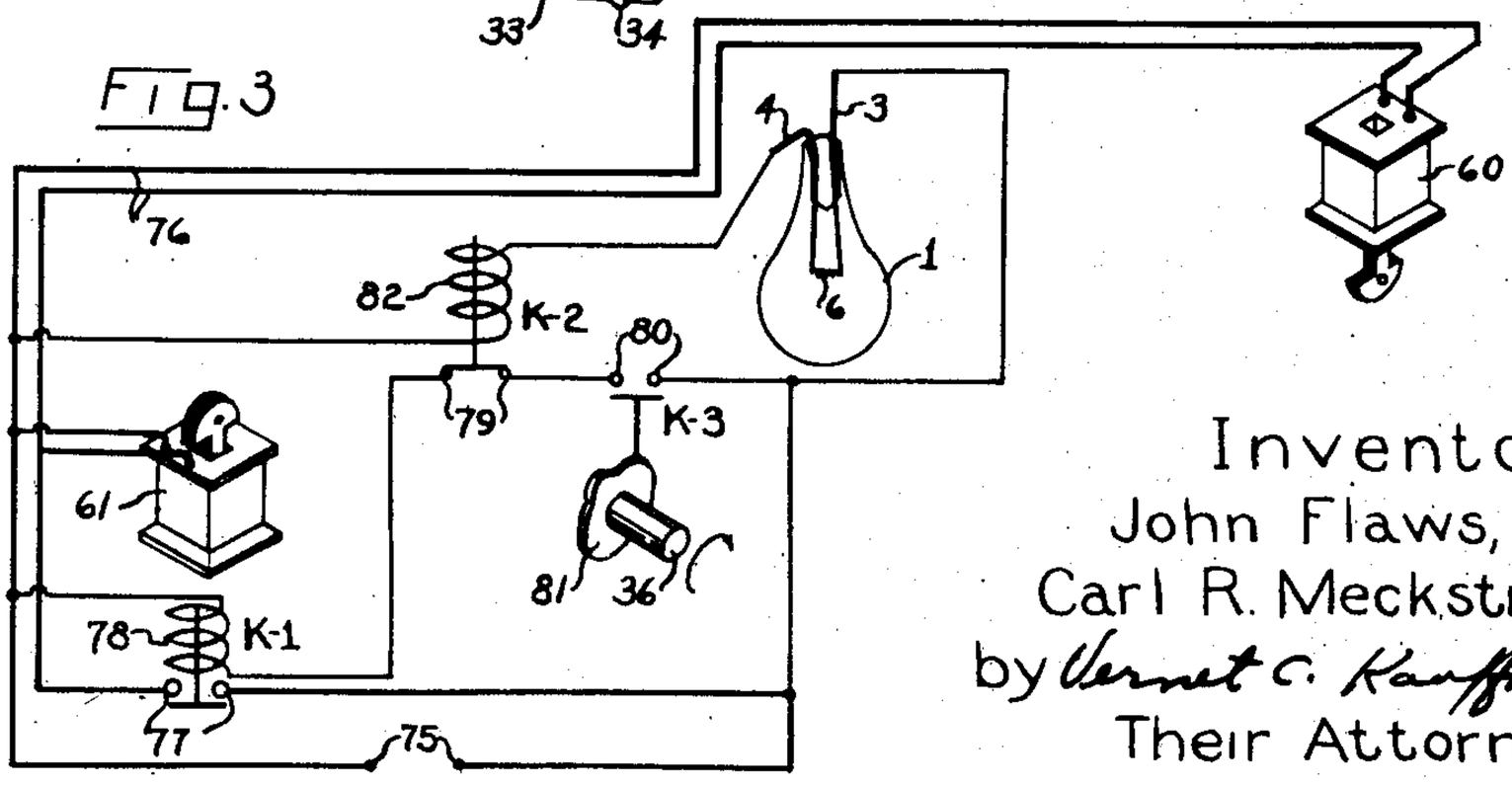


Fig. 3



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DEFECTIVE LAMP DETECTING AND EJECTING MECHANISM

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Application June 30, 1951, Serial No. 234,594

5 Claims. (Cl. 209—81)

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This invention relates generally to machinery for manufacturing electric lamps and devices of a like nature comprising a filament or electrode enclosed within an envelope provided with external connectors in the form of projecting lead-in wires. The invention is particularly concerned with a new and improved mechanism for detecting defective ones among lamps periodically presented at a work station in suitable chuck holders, and the specific embodiment described herein is designed for operation in conjunction with an articulated conveyor system.

In the copending U. S. patent application No. 234,593, filed June 30, 1951, of John Flaws, Jr. et al. entitled "Automatic Lamp Base Threading Machine" and assigned to the same assignee as the present invention, there is shown a lamp conveyor system of the indexing type. The machine described therein may be advantageously operated in conjunction with an incandescent lamp sealing machine and a finishing machine, being provided with sealed but unbased bulb assemblies by the former and supplying them with bases properly threaded thereon to the latter. The conveyor system comprises an elongated oval track along which lamp holding chucks are periodically indexed by means of a roller chain driven through a Geneva drive mechanism. The basing is achieved at a suitable station of a conveyor system by a mechanism which automatically drops a base, open end down, over the neck of an upstanding bulb and with the eyelet hole of the base substantially in line with the top lead-in wire of the bulb. The base is restrained in proper vertical orientation over the bulb by means of a collar or tube and is agitated by jets of air in order to provide the top lead-in wire with repeated opportunities for entering the threading hole in the base.

In order for the above mentioned basing machine to operate economically, it is highly desirable to provide some mechanism for detecting defective bulbs and for ejecting them from the conveyor system, prior to the basing operation. It will be understood that the cost of the base is a sizable proportion of the total cost of a finished lamp and that the basing of a defective lamp means the total loss of a good base. As an example, in the common sizes of household incandescent lamps, the cost of the base may be as much as 35% of the total cost of parts going into making the finished lamp, so that the basing of a defective lamp is wasteful to that extent.

The ejection of defective lamps from the conveyor may be performed by the mechanism described herein and which is adapted to be located at a work station of the conveyor preceding the basing station, and preferably just prior to it.

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Accordingly the general object of the present invention is to provide a new and improved mechanism for detecting defective ones among electrical devices periodically presented at a testing station in suitable holders.

A more particular object of the invention is to provide a new and improved defective lamp detecting and ejecting mechanism operating in conjunction with a lamp conveyor system of the indexing type as described in the above mentioned copending application entitled "Automatic Lamp Base Threading Machine."

The specific object of the present invention is to provide a new and improved mechanism for detecting, among lamps periodically presented at a testing station of an indexing type conveyor, those which are defective as a result of improper positioning of the lead-in wires or as a result of lack of continuity between the lead-in wires through the filament, and for ejecting such defective lamps from the conveyor.

In the "Automatic Lamp Base Threading Machine" of the Flaws et al. application, where operation in synchronism with a lamp finishing machine is desired, it is necessary that the bulb have a fixed orientation in its chuck holder by reference to the location of its side lead-in wire. The reason for this is that the side lead-in wire must occupy a fixed position in the finishing machine to permit cutting off and soldering by the automatic mechanisms provided for the purpose. The required orientation of the bulbs may be achieved, either manually by the operator where hand loading is used, or by an automatic device where the bulbs are fed into the holding chucks at random from a loading chute. A suitable orienting device is described in copending U. S. patent application No. 234,595, filed June 30, 1951, of Kenneth W. Reynolds entitled "Side Wire Locating Mechanism," and assigned to the same assignee as the present invention. That mechanism may be located at a work station of the conveyor system preceding the testing station of the present invention and preferably just prior to it. The function of the device of the present invention is then to detect and to eject from the conveyor system, bulbs which are defective in circuit continuity between their side and top lead-in wires, and bulbs which are improperly oriented in the holding chucks such that they could not properly be operated upon in the lamp finishing machine.

In accordance with the invention, there is provided a detecting and ejecting mechanism performing the above described function, and comprising contracting means arranged for suitable reciprocation out of the path of movement of the bulb when the conveyor is being indexed and adapted to achieve a certain electrical condition whenever a satisfactory bulb is indexed into the testing station. If the bulb is defective, the desired electrical condition is not achieved, an electrical relay system is put into operation and the bulb is ejected from the chuck holding it on the conveyor system.

For further objects and advantages and for a better understanding of the invention, attention is now directed to the following description and accompanying drawings. The features of the invention believed to be novel will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a pictorial view of a defective lamp detecting and ejecting mechanism constituting a preferred embodiment of the invention and shown in conjunction with a fragment of an articulated lamp conveyor system such as is used in the copending Flaws and Reynolds application entitled "Automatic Lamp Base Threading Machine."

Fig. 2 is a pictorial view of the same mechanism shown in course of ejecting a defective bulb from a holding chuck in the conveyor system.

Fig. 3 is a schematic diagram of the electrical relay system utilized in the preferred embodiment of the invention illustrated in Figs. 1 and 2.

The operation of the present mechanism may be understood by reference to Fig. 1 wherein there are shown electric lamp bulbs *1a*, *1b*, and *1c* at successive positions on an articulated conveyor system. The bulbs are of a pear shape having a constricted neck portion **2** out of which extend the top lead-in wire **3** and the side lead-in wire **4**. The inward projections of the lead-in wires through the press **5** within the bulb support the filament **6**, as illustrated in bulb *1a*.

The bulbs are held in suitable chuck assemblies **7***a–c*, each comprising a rectangular shaped base **8** on which is pivotally mounted a pair of jaws **9** and **10**. These jaws are secured to cranks **11** and **12** which are spring biased with respect to the base by means of coiled springs **13** and **14**. The jaws are thus normally urged together to a substantially upright position in a manner to engage opposite sides of the bulb and to seat it firmly on the crowfoot shaped cup **15**. The lamp chucks are driven by a roller chain of which a portion is shown at **16**; the chucks are suitably fastened to links of the chain along their undersides and ride on a pair of guide rails **17** and **18**. The wedge-shaped guard plates **19** and **20**, which, as may be seen in the figure, are overlapped as between successive chucks, are provided for the purpose of preventing debris such as glass fragments from falling on the chain and interfering with its operation. The chucks of the conveyor system are indexed from the upper left to the lower right, as indicated by the arrow **21**; thus bulb *1a* is successively indexed from the position in which it is illustrated, into that occupied by bulb *1c*, being held stationary in each successive position for a definite time interval in accordance with the indexing cycle of the conveyor system.

It will be observed that the side lead-in wire **4** of lamp *1a* trails the bulb along its direction of movement. that is. it is located parallel to the path of movement of the bulb and pointing backwards. This illustrates the desired orientation of the bulb in its chuck holder and the preferred embodiment of the invention described herein will eject the bulb unless it is so oriented. In addition, if either lead-in wire is broken or badly bent over, or if the circuit to and including the filament is open, the mechanism will operate to eject the bulb from its holder.

The first operation of the mechanism provides a continuity test through the circuit including the lead-in wires and the filament. The test is achieved through the contacts **22** and **23**, the former being adapted to make connection to the top lead-in wire, and the latter to the side lead-in wire. The contacts **22** comprise a stationary contacting bar **24** which is insulatedly fixed in suitable manner to the frame of the machine, and a pivotable contacting bar **25** which is insulatedly fastened to the lower end of a vertical spindle **26**. Spindle **26** is journaled in suitable fashion on a standard fastened to the frame of the machine (not shown in the drawing), and carries at its upper end a crank **27**. Crank **27** is resiliently loaded by a spring **28** which tends to close the pivotable bar **25** onto the fixed bar **24**. Thus the contacts **22** are normally resiliently urged together, as during the period when a bulb is indexed into the testing station. During the intervals when the conveyor system is in movement, pivotable bar **25** is swung out through the operation of a short crank **29** whose rounded head engages the crank **27**. Crank **29** is fast on the end of a shaft **30**, which shaft is journaled in a suitable standard fastened to the frame of the machine (not shown in the drawing), and carries at its remote end a crank **31**. Crank **31** in turn may be pivoted by the long push rod **32** which is linked at its lower end to a rocker arm **33** pivoting on a rock shaft **34** and having its other end riding on a cam **35**.

Cam **35** is fast on a camshaft **36** which is geared by suitable means (not shown in the drawing) to the drive for the conveyor system in such a fashion that it makes one complete revolution during each indexing operation of the conveyor. The raised portion of the cam corresponds to that part of the index cycle during which the chucks are in movement, whereas the portion at a lower level corresponds to that part during which the chucks are stopped at their respective work stations. It will be seen from the figure, that when the conveyor is stationary, the lower level portion of the cam engages rocker arm **33**, push rod **32** is down, shaft **30** is rotated in a counter-clockwise direction, and the pivotable bar contact **25** is closed upon the top lead-in wire.

The contacts **23** which engage the side wire **4** of bulb *1b*, require a more complex motion comprising a vertical reciprocation and also a pivoting together to grip the lead wire. The vertical reciprocation is provided in order that these contacts may be raised out of the path of movement of the bulbs when the conveyor system is indexing. In addition, the vertical movement is desirable in the present embodiment in order to pull the lead wire down against the side of the bulb neck.

The side wire contacts **23** are constituted by a pair of cooperatively disposed contacting arms **40** and **41** which are pivotally mounted at the lower ends of a pair of scissor arms **42** and **43**. The contacting arms **40** and **41** carry suitably insulated contacts on their operating ends and are resiliently restrained in substantially horizontal

position by means of coil springs whereof 44 may be seen in the drawing. The scissor arms 42 and 43 are pivotally mounted by pins 45 and 46 onto a primary crosshead 47 which is slidably mounted on a guide rod 48. Guide rod 48 is fastened by a suitable bracket (not shown in the drawing) to the frame of the machine and is inclined slightly off the vertical in order to facilitate pulling down the side lead-in wire by the contacting arms. It will be realized that the parts including the scissor arms which are attached to the crosshead are shown pulled apart, or exploded, for greater clarity.

Primary crosshead 47 is normally urged upwards by means of a coil spring 49 which is attached at its upper end to a convenient portion of the bracket supporting guide rod 48. The primary crosshead is in the form of a hollow rectangle whereof the transverse portions are bored for a sliding fit on the guide rod 48. A collar 50 is located between the vertical portions of the primary crosshead for sliding on the guide rod and has fastened to it a plate or secondary crosshead 51.

The scissor arms 42 and 43 carry at their upper ends a pair of transverse pins 52 and 53. The inward projections of these pins ride freely in slanted slots 54 and 55 which are milled in the front face of the secondary crosshead 51. By this arrangement, the lower ends of the scissor arms are pivoted in or out consequent upon relative motion between the primary and secondary crossheads 47 and 51 respectively.

The secondary crosshead 51 is driven through the system comprising cam 35, push rod 32 and the horizontal shaft 30 by means of the connecting link 56 and the crank 57 which is fast on shaft 30.

When the conveyor system is moving, the raised portion of the cam 35 engages rocker arm 33 and raises push rod 32 so that the secondary crosshead 51 is displaced upwards with respect to the primary crosshead 47, and moreover both crossheads are raised together as a unit on the slide rod to a slight extent. The final result is to pivot the lower ends of the scissor arms apart and to raise them to a level wherein the contacting arms 40 and 41 are clear of the path of the bulbs. This condition is illustrated in Fig. 2, although it will be realized that it was brought about therein through the operation of the ejecting solenoid 60 and not through the operation of cam 35.

After the conveyor system has stopped and a lamp is indexed into the station, cam 35 engages the rocker arm through its lower level portion so that the push rod 32 drops and the contacts 22 engage the top wire through the pivoting of bar 25. As for the side wire contacting mechanism, its first operation is a downward sliding of the secondary crosshead 51 with respect to the primary crosshead 47. This occurs because the primary crosshead is resiliently restrained by spring 49 and will not move downwards until collar 50 strikes the stop pin 58 on the lower transverse portion. Meanwhile, pins 52 and 53 riding in the slanted slots have caused scissor arms 42 and 43 to swivel so that contact arms 40 and 41 come together to grip the side wire. Thereafter the primary crosshead is carried downwards along with the secondary crosshead and the contacting arms 40 and 41 pull the side wire 4 down tightly along the side of the neck of the bulb. The resulting configuration of the side lead-in wire, as shown in bulb 1c, facilitates the base threading operation at a succeeding station of the conveyor system.

The ejecting portions of the mechanism operate in the event that a closed circuit is not achieved between the side and the top lead-in wires. It will be realized that a discontinuity in the circuit may occur from causes such as a break in the lead-in wires or a ruptured filament, or again as a result of the improper location of the lead-in wires whereby the top contacts 22 and the side contacts 23 fail to engage their respective lead-in wires. In the event that no such defective conditions are encountered, the contacts will reelase the lead-in wires near the end of the index cycle when the raised portion of the cam engages the rocker arm, and a successive bulb on the conveyor system is brought into the station for a repetition of the sequence that has been described.

In the event that the bulb is found defective, an electrical relay system is brought into operation whereby a pair of solenoids 60 and 61 are energized to eject the bulb from its holding chuck. The function of solenoid 60 is to release the bulb in the chuck and the lead-in wires from the contacts of the mechanism. To this end, the armature 62 of the solenoid is connected through a link 63 and a crank 64 to a lateral shaft 65 extending along the side of the conveyor and journalled by suitable means on the frame of the machine. Shaft 65 carries a pair of arms 66 and 67 which pivot downwards when solenoid 60 is energized and engage the transverse portions of the cranks 11 and 12, thereby causing the holding jaws 9 and 10 to pivot away from the bulb, as may be seen in Fig. 2. At the same time, the turning of shaft 65 causes the intermediate arm 68 to engage a pin 69 on push rod 32 and to raise it up so that rocker arm 33 is lifted off the surface of cam 35 and occupies substantially the same position as it would when the raised portion of the cam engages it. As a result, pivotable bar 25 of the top contacts pivots open, thereby releasing the top lead-in wire, and the sliding crossheads 47 and 51 are pulled up, thereby causing scissor arms 42 and 43 to swivel open and the jaws 40 and 41 to release the side lead-in wire.

The second solenoid 61 operates the hammer crank 7 to which it is connected by a link 71. Crank 70 is supported on a shaft 72 which is journalled in suitable fashion on the frame of the machine. It is located close to the side of the conveyor so that the rubber bumper 73 will strike the side of the bulb when the solenoid is energized. The operation of the parts may be seen more readily in Fig. 2 wherein solenoid 61 is shown energized so that the vertical leg of the hammer crank is tilted forward and the rubber bumper strikes the bulb and shoves it out the side of the holding chuck and off the conveyor. A suitable receptacle may be situated on the side of the conveyor opposite the ejecting solenoid 61 in order to receive defective bulbs ejected from the conveyor.

The relay system through which the solenoids 60 and 61 are controlled is schematically illustrated in Fig. 3. Both solenoids are connected in parallel for energization from a voltage source connected across the terminals 75. The solenoids are energized through the path comprising conductors 76 and the contacts 77 of a relay K–1. The coil 78 of relay K–1 is connected across terminals 75 in a circuit including the normally closed contacts 79 of a sensitive relay K–2 and the normally open contacts 80 of a switch K–3. This switch is operated by a cam 81 fast on a

shaft which is geared by suitable means to the drive of the conveyor system in such fashion that it makes one complete revolution during each indexing operation of the conveyor. This shaft may be the same shaft 36 as carries the cam 35 described with reference to Figs. 1 and 2. Cam 81 has a short raised portion which engages the armature of switch K–2 to close it for a brief interval of time near the end of each indexing cycle of the conveyor, that is, just before the bulb is indexed into the succeeding station. The coil 82 of sensitive relay K–3 is connected into the testing circuit, that is, into the circuit including the top contacts 22 and the side contacts 23, and which is completed through the lead-in wires and the filament of the bulb being tested. If greater sensitivity is required, instead of connecting relay K–2 directly in the testing circuit, a suitable amplifier may be substituted for it, in which case the relay is connected across the output terminals of the amplifier in the usual manner.

In the operation of the system, a bulb is indexed into the testing station while switch K–3 has its armature riding on the low portion of cam 81. If the testing circuit through the bulb is properly made, relay K–2 is energized and contacts 79 open so that the circuit for energizing coil 78 of relay K–1 cannot be completed and the bulb remains at the testing station until it is eventually indexed to the succeeding station. On the other hand, if the bulb is defective, the circuit for energizing sensitive relay K–2 is not completed and contacts 79 remain closed. As a result, when contacts 80 of switch K–3 are closed through the rotation of the cam, the circuit for energizing coil 78 of relay K–1 is completed. Contacts 77 thereupon close, solenoids 60 and 61 are energized, and the bulb is ejected from the conveyor.

While a specific embodiment has been shown and described, it will of course be understood that various modifications may be made without departing from the invention. Evidently the contacts may be adapted to different circuit conditions as in testing bulbs which have been based. Moreover the relay system may evidently be adjusted to respond only to a predetermined range of current values and to be inoperative if the current is either greater or lesser. The appended claims are intended to cover any such modifications coming within the true spirit and scope of the invention.

We claim:

1. In combination with a conveyor system of the indexing type carrying incandescent lamp bulbs in upstanding position on holding chucks, said bulbs normally containing a filament connected to top and side lead-in wires extending from the neck thereof, a pair of movable contacting means mounted at a testing station of said conveyor, a mechanical linkage actuated from the drive means of said conveyor, said linkage comprising means pivoting one of said contacting means into engagement with the top lead-in wire of a bulb located at said station and means lowering and thereafter pivoting the other of said contacting means into engagement with the side lead-in wire of said bulb, said other contacting means being normally raised vertically out of the path of movement of the bulbs on the conveyor, a relay system including said contacting means in circuit and connected for energization upon failure to encounter circuit continuity between said contacting means through said bulb, and means for ejecting said device from said conveyor, said means comprising a solenoid actuated by said relay system and operating to release said bulb in its holding chuck and to eject it therefrom.

2. In combination, a conveyor system of the indexing type carrying incandescent lamp bulbs in upstanding position in holding chucks, said bulbs normally including a filament connected to top and side lead-in wires, said top lead-in wire extending vertically upwards and said side lead-in wire extending laterally in a fixed direction from the neck of the bulb, first contacting means mounted at a station of said conveyor and a mechanical linkage actuated from the drive means of the conveyor for advancing said first contacting means into engagement with the top lead-in wire, second contacting means mounted at said station and comprising a vertically reciprocable crosshead with pivotable contacting arms mounted thereon, and a mechanical linkage actuated from the drive means of the conveyor for drawing said crosshead down and pivoting said contacting arms together for gripping the side lead-in wire at a predetermined position corresponding to said fixed direction, a relay system including said contacting means in circuit and connected for energization upon failure to engage both said lead-in wires and to encounter circuit continuity between said contacting means through said bulb, and means for ejecting said device from said conveyor and comprising a solenoid controlled by said relay system and operating to release said bulb in its holding chuck and to eject it therefrom.

3. In combination, a conveyor system of the indexing type carrying incandescent lamp bulbs in upstanding position in holding chucks, said bulbs normally including a filament connected to top and side lead-in wires, said top lead-in wire extending vertically upwards and said side lead-in wire extending laterally in a fixed direction from the neck of the bulb, first contacting means mounted at a station of said conveyor comprising pivotable contacting bars and a mechanical linkage actuated from the drive means of the conveyor for pivoting said bars into engagement with said top lead-in wire, second contacting means mounted at said station and comprising a vertically reciprocable crosshead with pivotable contacting arms mounted thereon and a mechanical linkage actuated from the drive means of the conveyor for drawing said crosshead down and pivoting said contacting arms together for gripping said side lead-in wire, a relay system including said contacting means in circuit and connected for energization upon failure to encounter circuit continuity between said contacting means through said bulb, and means for ejecting said device from said conveyor comprising a solenoid having an armature controlled by said relay system, a mechanical linkage between said armature and the linkages of said contacting means for disabling said contacting means and releasing said lead-in wires, and another linkage for releasing said bulb in its holding chuck and ejecting it therefrom.

4. In combination, a conveyor system of the indexing type carrying incandescent lamp bulbs in upstanding position in holding chucks, said bulbs normally including a filament connected to top and side lead-in wires, said top lead-in wire extending vertically upwards and said side lead-in wire extending laterally in a fixed direction from the neck of the bulb, first contacting

means mounted at a station of said conveyor comprising pivotable contacting bars and a mechanical linkage actuated from the drive means of the conveyor for pivoting said bars into engagement with said top lead-in wire, second contacting means mounted at said station and comprising a resiliently restrained vertically reciprocable primary crosshead with pivotable contacting arms mounted thereon, a secondary crosshead sliding on said primary crosshead between stops and having slanted slots engaging portions of said arms for pivoting them together upon downward movement with respect to said primary crosshead, and a mechanical linkage actuated from the drive means of said conveyor for drawing said secondary crosshead down, thereby to pivot said arms together in order to grip and pull down said side lead-in wire, a relay system including said contacting means in circuit and connected for energization upon failure to encounter circuit continuity between said contacting means through said bulb, and means for ejecting said device from said conveyor and comprising a solenoid having an armature controlled by said relay system and operating to release said bulb in its holding chuck and to eject it therefrom.

5. In combination, a conveyor system of the indexing type carrying incandescent lamp bulbs in upstanding position in holding chucks, said bulbs normally including a filament connected to top and side lead-in wires, said top lead-in wire extending vertically upwards and said side lead-in wire extending laterally in a fixed direction from the neck of the bulb, first contacting means mounted at a station of said conveyor comprising pivotable contacting bars and mechanical linkage actuated from the drive means of the conveyor for pivoting said bars into engagement

with said top lead-in wire, second contacting means mounted at said station and comprising a resiliently restrained vertically reciprocable primary crosshead with pivotable contacting arms mounted thereon, a secondary crosshead sliding on said primary crosshead between stops and having slanted slots engaging portions of said arms for pivoting them together upon downward movement with respect to said primary crosshead, and a mechanical linkage actuated from the drive means of said conveyor for drawing said secondary crosshead down, thereby to pivot said arms together in order to grip and pull down said side lead-in wire, a relay system including said contacting means in circuit and connected for energization upon failure to encounter circuit continuity between said contacting means through said bulb, and means for ejecting said device from said conveyor and comprising a first solenoid having an armature controlled by said relay system, a mechanical linkage between said armature and the linkages of said contacting means for disabling said contacting means in order to release said lead-in wires, a further linkage for releasing said bulb in its holding chuck, and a second solenoid including a bumper for striking said bulb to eject it from the conveyor.

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