Oct. 31, 1967 L. D. CRAWFORD 3,349,905

LENGTH SORTER

Filed Sept. 7, 1965

3 Sheets-Sheet 1

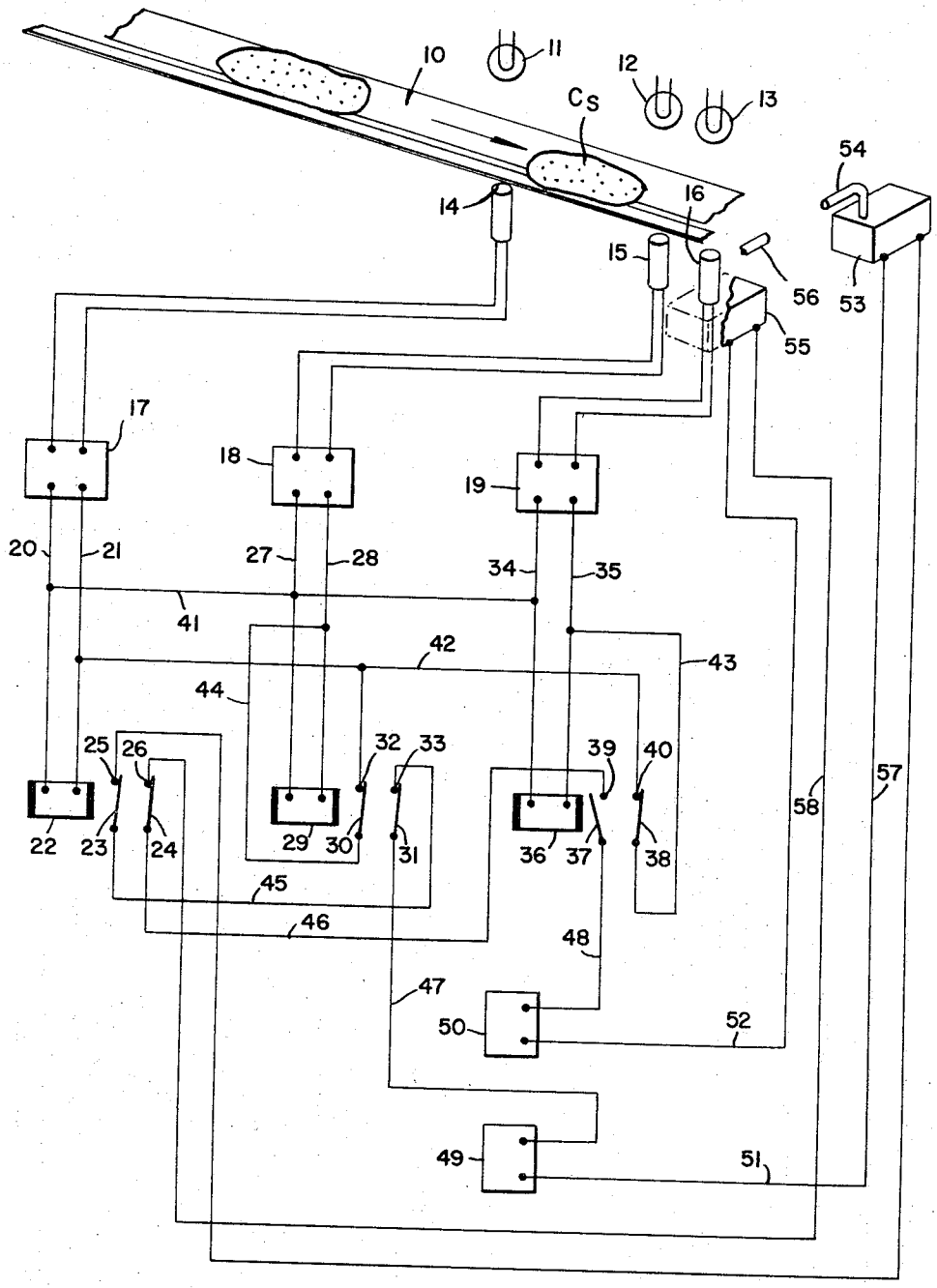


FIG_1

INVENTOR.
LYNN D. CRAWFORD

BY

Allen and Gurney

ATTORNEYS

Oct. 31, 1967 L. D. CRAWFORD 3,349,905

LENGTH SORTER

Filed Sept. 7, 1965 3 Sheets-Sheet 2

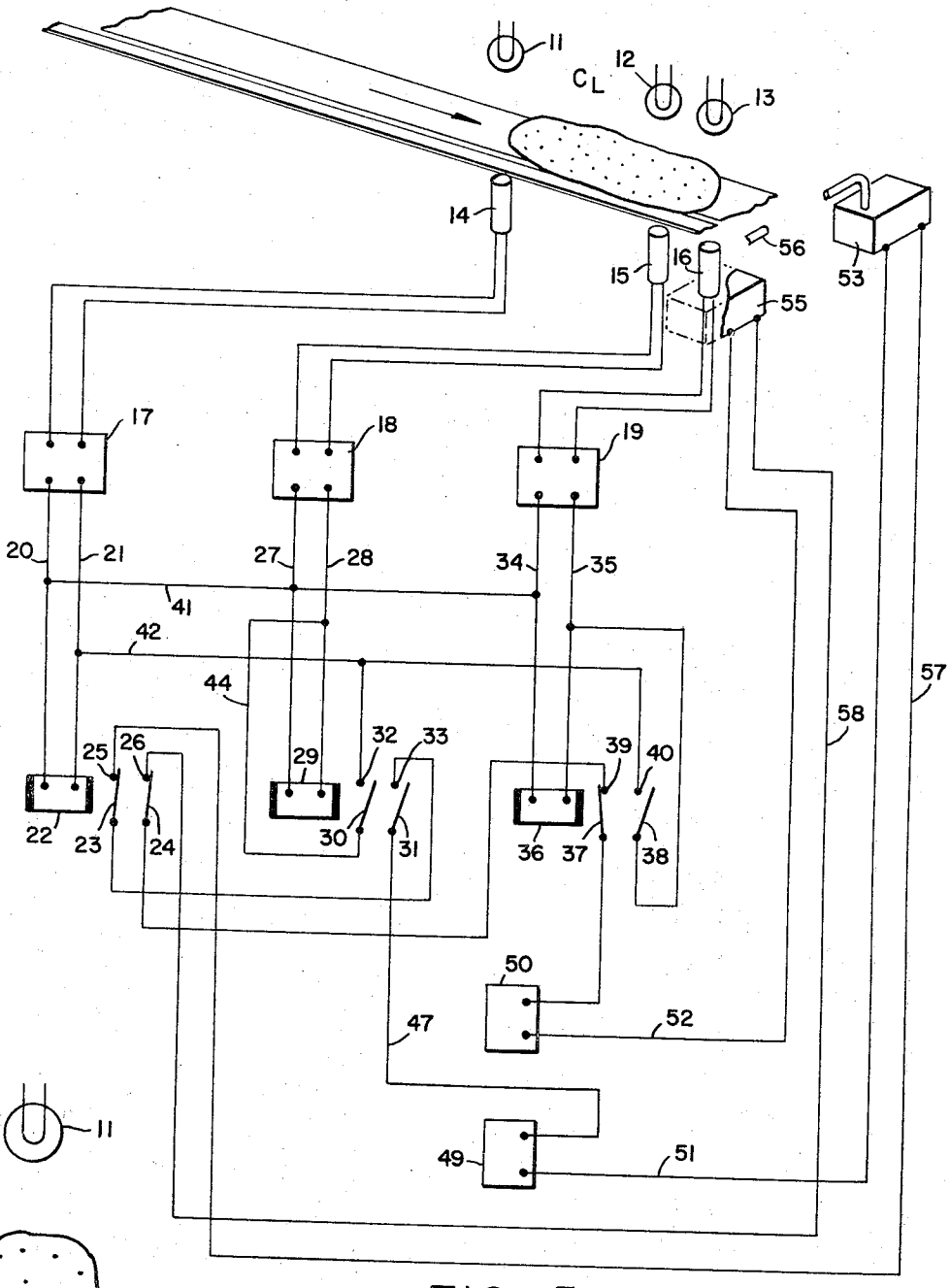


FIG_5

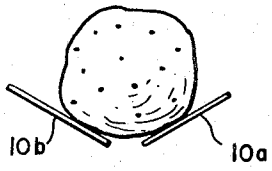




FIG_2

INVENTOR.
LYNN D. CRAWFORD

BY

Allen and Gromy

ATTORNEYS

Oct. 31, 1967 L. D. CRAWFORD 3,349,905

LENGTH SORTER

Filed Sept. 7, 1965 3 Sheets-Sheet 3

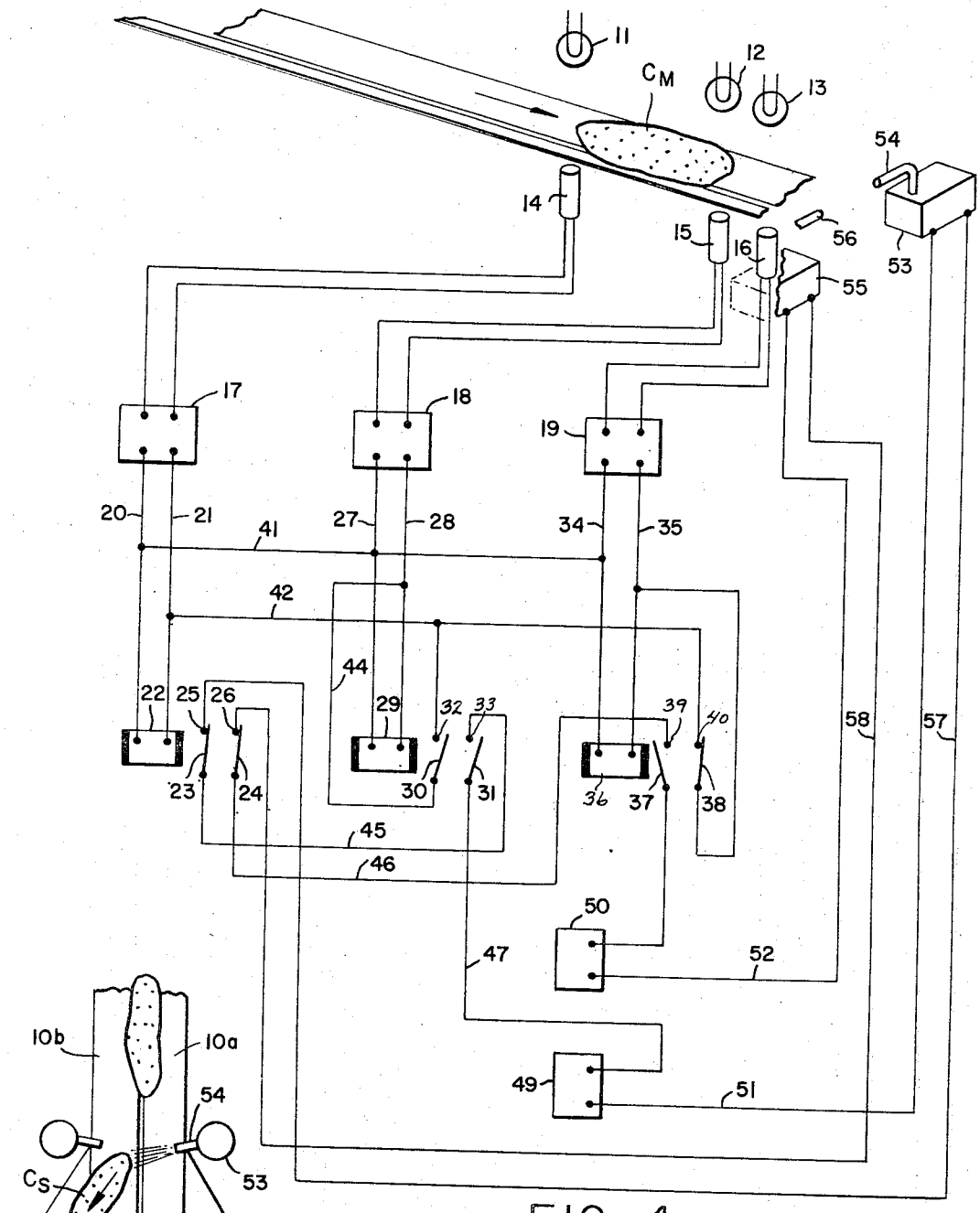


FIG_4

FIG_3

INVENTOR.
LYNN D. CRAWFORD

BY Allen and Chromy

ATTORNEYS

United States Patent Office 3,349,905 Patented Oct. 31, 1967

3,349,905

LENGTH SORTER

Lynn D. Crawford, San Jose, Calif., assignor of one-half to Genevieve I. Hanscom, Saratoga, Calif., and one-half to Genevieve I. Hanscom, Robert Magnuson, and Lois J. Duggan as trustees of the estate of Roy M. Magnuson

Filed Sept. 7, 1965, Ser. No. 485,451
1 Claim. (Cl. 209—82)

ABSTRACT OF THE DISCLOSURE

Apparatus for separating articles according to short, medium and long lengths. The articles are moved on a conveyor that is equipped with three spaced light sensitive cells which are aligned with spaced light sources. An article extending between the first and second light sensitive cells but not covering them is considered a short article. An article that extends from the first light sensitive cell and covers the second but not the third is considered a medium length article, and an article extending from the first cell and covering the light to a second and a third light sensitive cells is considered a long article. The first, second and third light sensitive cells are connected to the first, second and third relays respectively. Each of the relays is provided with two movable contactors which are interconnected in a predetermined manner to control the energization of two solenoid valves which control air jets positioned near the output of the conveyor. One of these valves is energized when a short article is scanned and directs an air jet against this short article to deflect it in a predetermined direction. The other air jet is controlled by the other solenoid valve which is energized by a signal corresponding to the long article and this solenoid valve releases an air jet against the long article to deflect it into another predetermined direction. The medium length articles are not deflected but are permitted to proceed in a normal path.

This invention relates to an apparatus for sorting products according to their lengths.

An object of this invention is to provide an improved length grader or sorter for products such as cucumbers, pickles or the like.

Another object of this invention is to provide an improved apparatus for grading or sorting products such as pickles, cucumbers or the like according to their lengths, said apparatus being constructed so that it may be efficiently and economically attached to a single file conveyor.

Still another object of this invention is to provide an improved length grader or sorter in which the article to be graded or sorted is passed along a conveyor into the grading or sorting zone in which there are positioned a plurality of light-sensitive cells and lights impinging on said cells, said cells being arranged and connected such that the sorting or grading operation is initiated immediately after the entire product is moved into the grading zone and the rear end of the article has cleared the light path to the first light-sensitive cell in said zone.

Another object of this invention is to provide an improved length grader in which there is provided a row of light-sensitive cells aligned with a conveyor or conveying a single file of the products to be graded, each of said cells being connected to an amplifier, the output of which is connected to a relay, the relays being interconnected to provide a circuit for controlling devices for deflecting the long and short products leaving the conveyor so that these products are routed to compartments or conveyors for these lengths, while the medium length products pass to another compartment or conveyor.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claim and drawing in which, briefly:

FIG. 1 is a schematic diagram showing a product of short length positioned in the grading zone of the apparatus and the relays employed in the apparatus being energized in accordance with the signals produced when the short length article is being scanned;

FIG. 2 is a detail view showing a section through the article conveyor and also showing the position of a light-sensitive cell and light source with respect to the article and conveyor in the scanning zone;

FIG. 3 is a detail plan view of the end of the conveyor showing an article being deflected from the conveyor to the ramp for short articles;

FIG. 4 is a schematic diagram showing an article of median length positioned in the article scanning zone and showing the relays of the apparatus energized in accordance with signals produced when such median length article is being processed; and

FIG. 5 is a schematic diagram similar to FIGS. 1 and 4 except that an article of longth length is positioned in the scanning zone and the relays of the apparatus are energized in accordance with signals produced when such an article is being processed.

Referring to the drawing in detail, reference numeral **10** designates a conveyor for conveying the articles to be graded in a single file to the scanning zone. The scanning zone is provided with an initial light source **11**, intermediate light source **12** and end light source **13**, and light-sensitive cells **14**, **15** and **16** which are positioned in a row such that the light from the light sources **11**, **12** and **13** pass downward through the opening between the conveyor belts **10***a* and **10***b* to the light-sensitive cells **14**, **15** and **16**, respectively, which are positioned below the conveyor as shown in FIG. 2. The cell **14** may be designated the initial cell, cell **15** the intermediate cell, and cell **16** the end cell. Also, a single light source may be employed and the light therefrom directed in beams to the responsive cells. Suitable light-columnating members may be positioned around the lamps **11**, **12** and **13** and also around the light-sensitive cells **14**, **15** and **16** to reduce the extraneous light entering the light-sensitive cells.

The light-sensitive cells **14**, **15** and **16** are connected to the inputs of amplifiers **17**, **18** and **19**, respectively, which are of conventional construction and may employ either vacuum tubes or transistors, as desired. The output of amplifier **17** is connected to lines **20** and **21** which are connected to the winding of relay **22**. The output of amplifier **18** is connected to lines **27** and **28** which are connected to the winding of relay **29**, and likewise, the output of amplifier **19** is connected to lines **34** and **35** which are connected to the winding of relay **36**.

Each of the relays is provided with two movable contactors or armatures. Thus, relay **22** is provided with movable contactors **23** and **24**, which are normally open, that is, they are normally out of contact with stationary contacts **25** and **26**, respectively. Relay **29** is provided with movable contactors **30** and **31** which are also normally open and out of contact with stationary contacts **32** and **33**, respectively. Relay **36** is provided with movable contactors **37** and **38** associated with contacts **39** and **40**, respectively. However, in the case of relay **36**, movable contactor **37** is normally closed with contact **39**, and movable contactor **38** is normally open with respect to contact **40**.

A line **41** is provided for connecting lines **20**, **27** and **34**, as shown. A line **42** is provided between lines **21**, con-

tact 32 and contact 40. Line 43 is provided between line 35 and movable contactor 38. Line 44 is provided between line 28 and movable contactor 30, and line 44 is provided between contact 33 and movable contactor 23. Line 46 is provided between movable contactor 24 and contact 39. Line 47 is provided between movable contactor 31 and one terminal of the source of current supply 49. Line 48 is provided between movable contactor 37 and one terminal of the source of current supply 50. The other terminal of current supply source 49 is connected by line 51 to one side of the solenoid valve 53 which controls the compressed air supply to nozzle 54. The other terminal of current supply source 50 is connected by line 52 to one side of the solenoid valve 55 which controls the source of compressed air supplied to nozzle 56. Line 57 connects the other side of solenoid valve 53 to contact 25 of relay 22, and line 58 connects the other side of solenoid valve 55 to contact 26 of relay 22. The apparatus shown in FIGS. 4 and 5 is connected the same as the apparatus shown in FIG. 1 except that the relays 22, 29 and 36 receiving different signals as a result of the scanning of articles of different lengths provide different connections in the output circuits thereof.

In FIG. 1 there is shown a cucumber CS which is of short length positioned in the scanning zone. This article is of such length that when it is positioned in the scanning zone, the forward end of the article does not interrupt the light passing from lamp 12 to light-sensitive cell 15 as the rear end of this article clears the path between light source 11 and light-sensitive cell 14. Thus, when this article is positioned in the scanning zone as shown, the cells 14, 15 and 16 are energized by light from lamps 11, 12 and 13, respectively. As a result, all of the cells, 14, 15 and 16 produce output signals which are amplified by amplifiers 17, 18 and 19, respectively, and the outputs from these amplifiers are supplied to the windings of relays 22, 29 and 36, respectively. Relay 22 actuates its movable contactors 23 and 24 and causes them to close with contacts 25 and 26, respectively, and relay 29 causes the movable contactors 30 and 31 thereof to close the circuit with contacts 32 and 33, respectively, whereas, relay 36 causes the movable contactor 37 thereof to interrupt the circuit with contact 39 and it also causes its movable contactor 38 to close the circuit with contact 40.

Thus, the circuit to the solenoid valve 55 is interrupted at the relay 36 which has opened the connection between its movable contactor 37 and contact 39. The circuit to solenoid valve 53, on the other hand, is closed since the relay 22 has closed the circuit between movable contactor 23 and contact 25. Also, relay 29 has closed the circuit between movable contactor 31 and contact 33 so that the current supply source 49 is connected to solenoid valve 53 and the compressed air supply controlled by this valve is supplied to the nozzle 54. The air jet from nozzle 54 causes the short article CS to be deflected toward ramp 10*c* from the conveyor 10*a*–10*b*, as shown in FIG. 3.

It will be noted that one side of each of the relays 29 and 36 is connected by line 41 to one side of the relay 22 that is to line 20. Also, line 42 is provided between line 21 of relay 22 and stationary contacts 32 and 40 of relays 29 and 36, respectively, and movable contactor 30 of relay 29 is connected to line 28 going to relay 29 by line 44, and movable contactor 38 of relay 36 is connected by lines 43 and 35 to relay 36. These connections serve to lock relays 29 and 36 in their energized positions as long as relay 22 remains energized. Thus, relays 29 and 36 remain energized even after the article CS interrupts the light rays from light sources 12 and 13 going to light-sensitive cells 15 and 16, respectively, as long as the light beam passing from light source 11 to light-sensitive cell 15 is not interrupted. In this way relay 36 is kept from closing the circuit of movable contactor 37 with stationary contact 39 when the light beam passing from light source 13 to light-sensitive cell 16 is interrupted. Thus, the circuit to the solenoid valve 55 and current supply source 50 is kept open until the article CS is deflected by the air jet from nozzle 54 and another article is moved into the scanning zone so that the light beam passing from light source 11 to light-sensitive cell 14 is interrupted, at which time the winding of relay 22 is de-energized.

When the median length article CM is positioned in the scanning zone, as shown in FIG. 4, just after the rear end of the article has cleared the path between the light source 11 and light-sensitive cell 14, the forward end of the article interrupts the light path between the light source 12 and light-sensitive cell 15, while the path between the light source 13 and light-sensitive cell 16 is not interrupted. Thus, the cells 14 and 16 are energized and the output thereof is supplied to the input of amplifiers 17 and 19, respectively. The windings of relays 22 and 36 are energized so that the circuits between movable contactors 23 and 24 and fixed contacts 25 and 26, respectively, are closed in relay 22, and the circuit between movable contactor 37 and fixed contact 39 of relay 36 is open, while the circuit between movable contact 38 and fixed contact 40 of this relay is closed. As previously described, one side of each of the relays 29 and 36 is connected by line 41 to one side of the relay 22 that is to line 20. Also, line 42 is provided between line 21 of relay 22 and stationary contacts 32 and 40 of relays 29 and 36, respectively. In the case of median length articles CM, light from light source 12 is interrupted and does not energize light-sensitive cell 15, consequently, relay 29 is not energized for articles of this length. However, the light from light source 13 passes to light-sensitive cell 16 and consequently relay 36 is energized, since the relay 36 is connected across lines 20 and 21 of relay 20 through lines 41 and 42, respectively. Inasmuch as movable contactor 38 and stationary contact 40 are closed, the winding of relay 36 will continue to be energized from lines 20 and 21 even after the median length article CM is moved to interrupt the light passing from light source 13 to light-sensitive cell 16. Thus, for median length articles CM, neither of the solenoid valves 53 or 55 is energized because the circuit to solenoid valve 53 is interrupted at the movable contactor 31 of relay 9, while the circuit to solenoid valve 55 is interrupted at movable contactor 37 of relay 36. Under these conditions, the median length article CM is caused to move straight from the belts 10*a* and 10*b* of the conveyor onto ramp 10*e* which is aligned with the end of the conveyor.

When the long length article CL is positioned in the scanning zone, as shown in FIG. 5, and just after the rear end of the article has cleared the path between the light source 11 and light-sensitive cell 14, the forward part of the article interrupts the light paths between the light sources 12 and 13 and the light-sensitive cells 15 and 16, respectively. Thus, in this case the cell 14 is energized and the output thereof is supplied to the input of amplifier 17. The winding of relay 22 is energized and as a result the movable contactors 23 and 24 thereof are brought into engagement with stationary contacts 25 and 26, respectively. Since relay 29 is not energized, the movable contactors 30 and 31 thereof are left open. Relay 36 also is not energized and the normally closed contactor 37 thereof is in contact with stationary contact 39 while normally open contactor 38 is open. Thus, the circuit between the source of current supply 50 and solenoid valve 55 is closed since contactor 37 of relay 36 is closed, and contactor 24 of relay 22 is closed. As a result, solenoid valve 55 is energized so that air pressure is supplied to nozzle 56. The long product CL is deflected by the air jet from nozzle 56 and caused to move to ramp 10*d*, as shown in FIG. 3.

While I have shown a preferred embodiment of the invention, it will be understood that the invention is capable of variation and modification from the form shown so that its scope should be limited only by the scope of the claim appended herewith.

What I claim is:

In apparatus for separating articles such as cucumbers or the like according to median lengths and abnormal lengths, the combination comprising an article conveyor for conveying a single file of spaced articles, an article scanning zone associated with said conveyor, said scanning zone having signal producing means comprising a plurality of spaced light sources including an initial light source and a light-sensitive cell aligned therewith, a first relay and means connecting said first relay to said cell, a second light sensitive cell aligned with a second one of said sources, a second relay and means conecting said second relay to said second cell, and a third light sensitive cell aligned with a third one of said sources, a third relay and means connecting said third relay to said third cell, said sources being spaced such that a shorter than median article does not interrupt any of the light passing from said sources to said cells when the length of this article is being classified, and an article of median length interrupts light passing from said second one of said sources to said second aligned cell, and a longer than median length article interrupts light from all except said first light source to said first cell when the lengths thereof are being classified, means connected to said relays for routing said articles in response to predetermined signals derived from said cells whereby the shorter and longer than median length articles are separated from the median length articles.

References Cited

UNITED STATES PATENTS

2,916,633	12/1959	Stone et al.	
2,982,403	5/1961	Harmon	209—111.7 X
3,038,604	6/1962	Muller	209—82
3,232,429	2/1966	Norwich	209—111.7

M. HENSON WOOD, JR., *Primary Examiner.*

J. N. ERLICH, R. A. SCHACHER, *Assistant Examiners.*