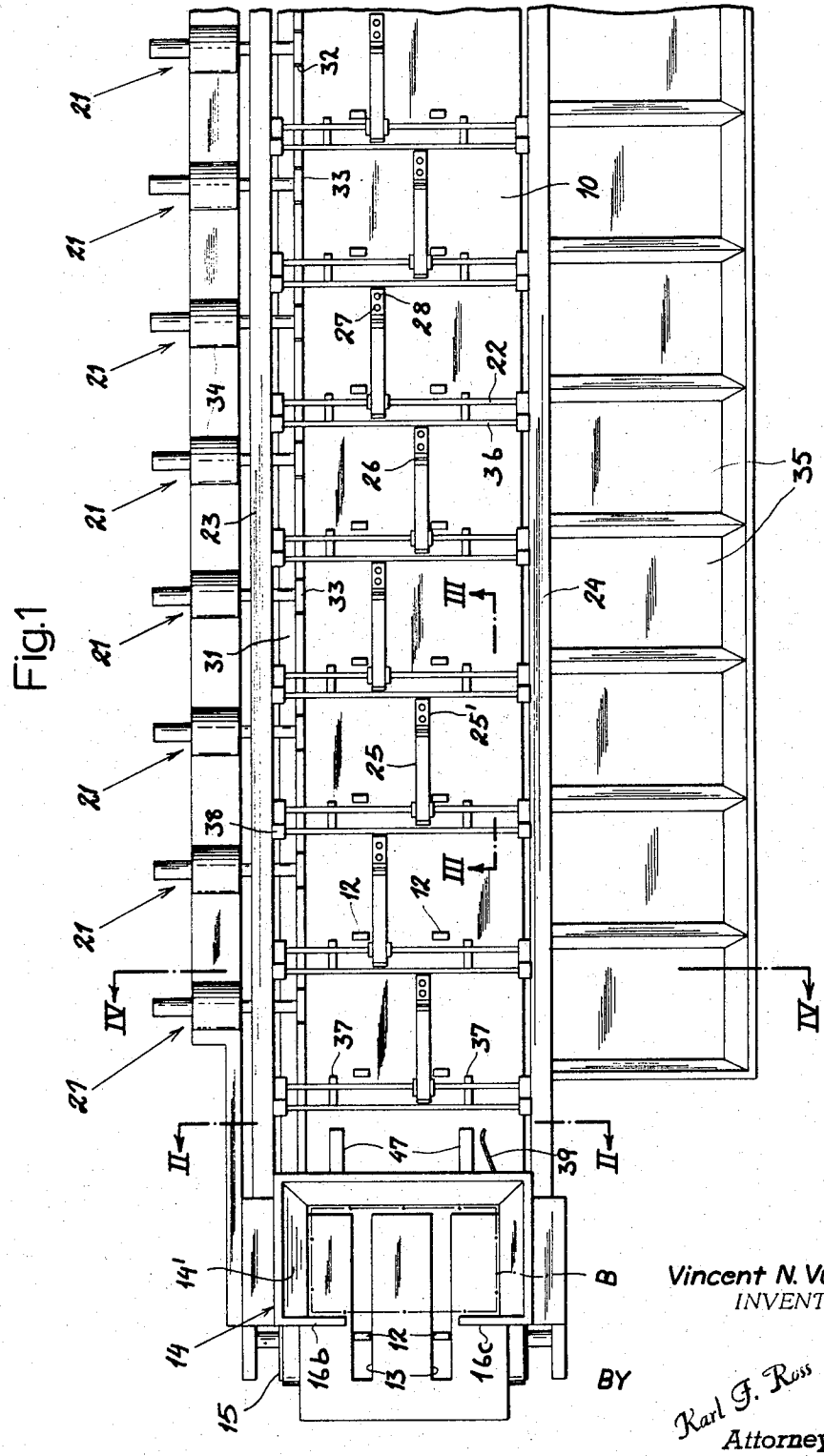
Dec. 3, 1968 V. N. VULCANO 3,414,126

BOOK-SORTING MACHINE

Filed May 23, 1966 3 Sheets-Sheet 1

Fig.1



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BOOK-SORTING MACHINE

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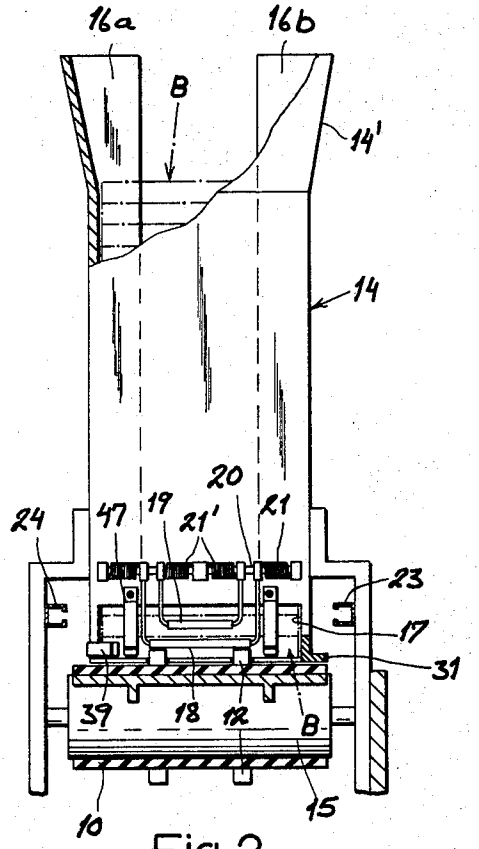


Fig. 2

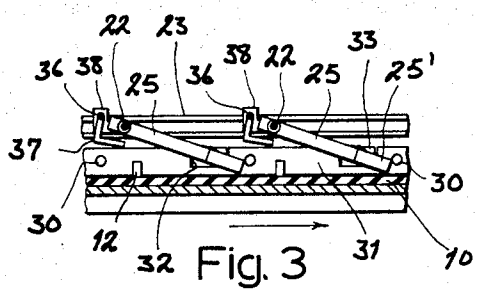


Fig. 3

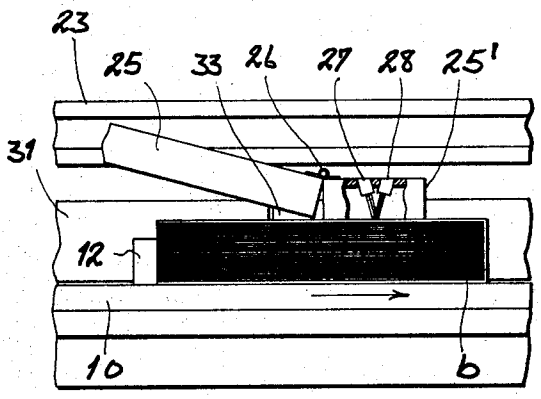


Fig. 5

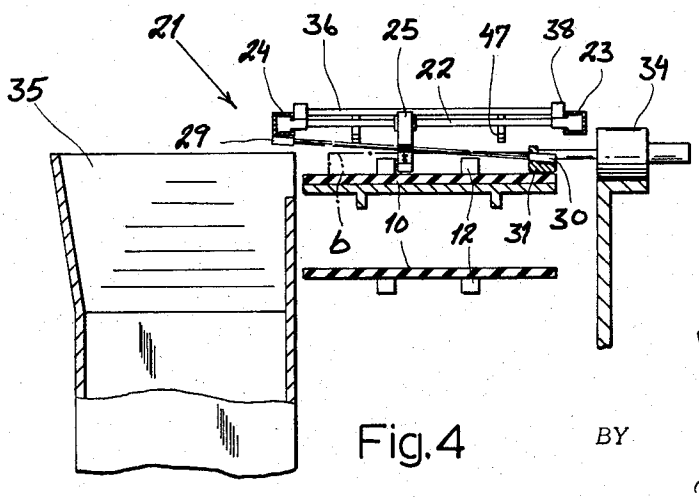


Fig. 4

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BOOK-SORTING MACHINE

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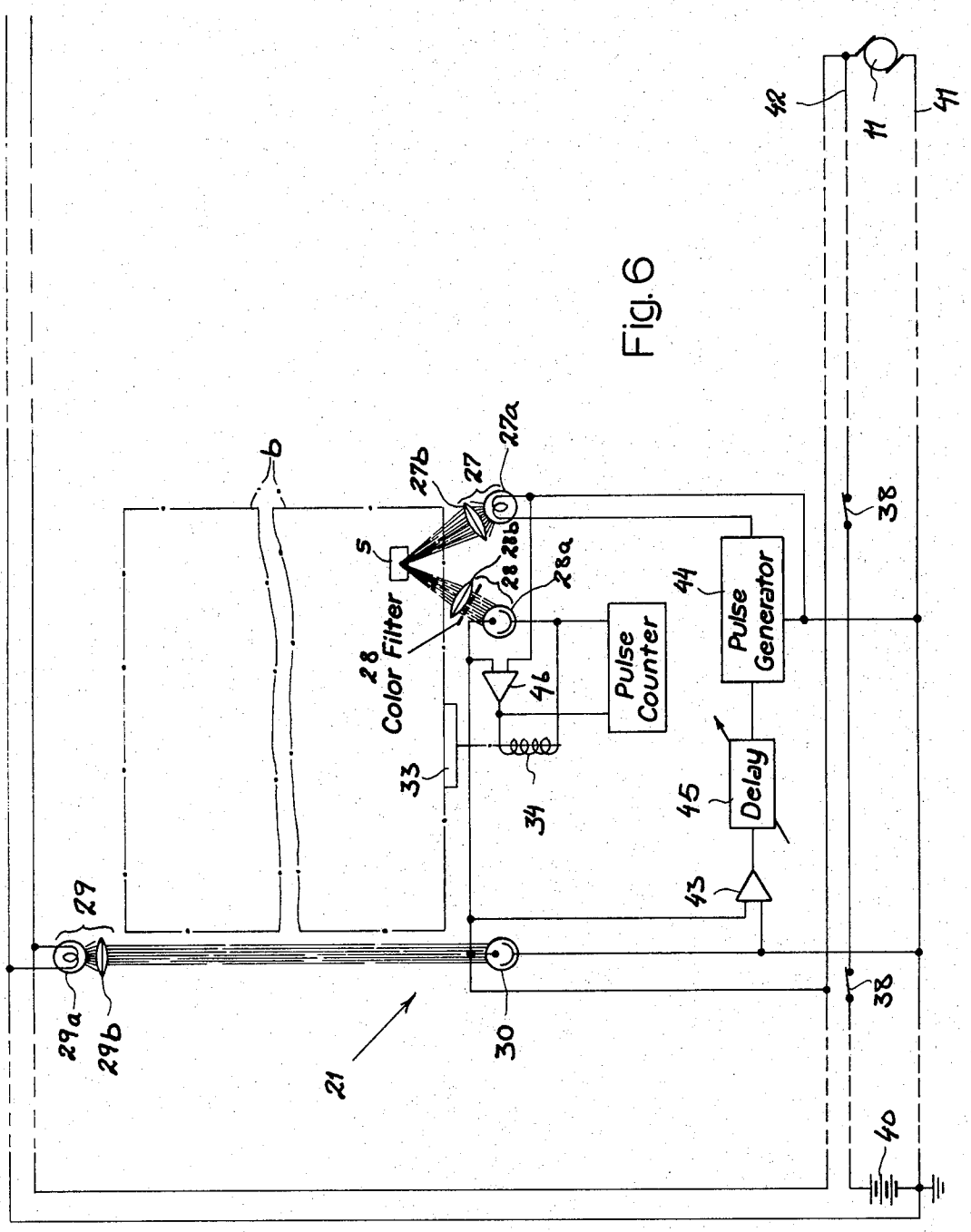


Fig. 6

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3,414,126

BOOK-SORTING MACHINE

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Filed May 23, 1966, Ser. No. 552,278
8 Claims. (Cl. 209—73)

ABSTRACT OF THE DISCLOSURE

Books stacked in a hopper are successively deposited on a conveyor and are photoelectrically scanned by a plurality of sorting stations along the conveyor path, recognition of a particular type of book by a corresponding sorting station resulting in the actuation of an associated ejector which discharges the book into an assigned receptacle.

My present invention relates to a machine for sorting books particularly (but not exclusively) paperbacks, which are received in random succession at a collection point and are to be distributed into different channels according to their titles.

A machine of this description is particularly useful to booksellers who periodically must return unsold copies to the respective publishers or wholesalers.

It is, therefore, an object of my present invention to provide a machine for the purpose described which will efficiently and dependably discriminate between different types of books, on the basis of distinctive markings on their covers, and will properly channel these books to their respective destinations.

It is also an object of this invention to provide means in such machine for registering the number of books in each category recognized and sorted by the system.

A further object of this invention is to provide simple means for supplying the books in stacked condition to a conveyor which thereupon delivers them to a succession of sorting stations.

In accordance with this invention I provide along a conveyor a plurality of sorting stations each including a photoelectric detector which is positioned above the conveyor to ascertain the presence of a particular marking, individual to the respective station, on the cover of an oncoming book, this marking being preferably an element of the picture or lettering normally appearing thereon; a monitoring device at each sorting station determines the arrival of a book in testing position and actuates a circuit for triggering the detector which operates momentarily, at a predetermined instant with reference to the operation of the monitoring device, to energize an ejector for removing the book from the conveyor if its marking corresponds to that to which the detector is adjusted.

Advantageously, the detector is of a type sensitive to specific colors and, for this purpose, includes at least one photocell or equivalent photoelectric pick-up means which scans the book cover through the intermediary of a color filter interposed in the path of radiation from a suitable light source.

The motoring device of each sorting station, according to another feature of my invention, is also of the photoelectric type and includes a light source on one side of the conveyor and a confronting photocell or equivalent transducer on the other side thereof. I prefer to dispose the photocell at a stationary lateral guide rail toward which oncoming books are deflected upon being delivered to the conveyor, this guide rail also having a cutout at each station through which the head of an injection plunger may pass. The operation of this plunger, triggered by a response of the associated photoelectric detector to the presence of the assigned marking on the cover of a book, is also registered by a concurrently energized pulse

counter to indicate the number of books ejected at each station. In order to insure positive entrainment of the books up to the point of ejection, the conveyor may be fitted with a series of cleats aligned with one or more bottom slots in a hopper to which the stacked books are delivered by an operator and from which they emerge, preferably with their backs facing forward, by way of a front opening which may be guided by yieldable detent means designed to restrict the discharge through this opening to a single book at a time.

These and other features of my invention will become more fully apparent from the following detailed description of a preferred embodiment, reference being made to the accompanying drawing in which:

FIG. 1 is a top plan view of a sorting machine according to the invention;

FIG. 2 is a cross-sectional view taken on the line II—II of FIG. 1;

FIG. 3 is a sectional detail view taken on the line III—III of FIG. 1;

FIG. 4 is another cross-sectional view taken on the line IV—IV of FIG. 1;

FIG. 5 is an enlarged side view (parts broken away) of a detector assembly shown in the detail view of FIG. 3; and

FIG. 6 is a circuit diagram of the apparatus shown in FIGS. 1–5.

The sorting machine shown in the drawing comprises an endless conveyor **10** which is mounted in the usual manner on a pair of supporting rollers **15** (one shown in FIG. 4) driven by an electric motor **11** (FIG. 6). Conveyor **10** has the shape of a flat belt and is provided on its outer surface with longitudinally spaced pairs of cleats **12** which fits into longitudinal slots **13** on the bottom of a hopper **14** at the input end of the conveyor. Hopper **14** has the shape of a prismatic box with a flared top **14'**, conforming to the rectangular shape of a stack of books B adapted to be deposited in the hopper as indicated in dot-dash lines in FIGS. 1 and 2. To facilitate such deposition, the rear wall of the hopper is split into two spaced-apart portions **16***a*, **16***b* so that an operator may reach in and hold both the upper and the lower end of a stack of books which is being lowered into the hopper. An opening **17** in the front wall of the hopper given clearance to the cleats **12** and allows the stacked books to be individually entrained thereby past a pair of yieldable detents **18** and **19** overhanging that opening from the outside, these detents having the form of U-shaped wires which are swingably mounted on a rod **20** and are urged into a vertical blocking position by respective coil springs **21**, **21'**. The shorter, higher-level detent **19** may be more strongly biased than the lower-hanging detent **18** so as to yield only in the case of books having greater-than-ordinary thickness.

The books successively released from the hopper **14** and entrained by respective pairs of cleats **12**, with their backs facing in the direction of conveyor motion, are moved past a series of sorting stations **21** which are all substantially identical and of which one will be particularly described with reference to FIGS. 3 to 5.

A horizontal rod **22** extends spacedly across the upper surface of conveyor **10** and is mounted in a pair of stationary frame members **23**, **24** which are substantially coextensive with the two longitudinal conveyor edges. An arm **25** is swingably mounted on rod **22**, with its free end pointed away from that rod in the direction of conveyor motion (arrow, FIG. 3), and has an extremity **25'** hingedly connected therewith at **26** (FIG. 5). This extremity, which is recessed at the bottom as seen in FIG. 5, carries a light source **27** and a photocell **28** trained upon a common point in the plane of the lower surface of detector carrier **25'**. When a book *b* moves past

on the conveyor **10**, it raises the arm **25** from its normal downwardly sloping position, in which the extremity **25'** may actually or almost contact the surface of belt **10**, into a more nearly horizontal position in which the extremity **25'** rests flat on the cover of the book so that, at a given instant during passage, a certain spot characteristically identifying the book will move into the field of light source **27** and pickup head **28**. A short time prior thereto, the leading edge of the book *b* has interrupted the light path between another radiation source **29**, supported on frame member **24**, and a photocell **30** mounted on a rail **31** which extends underneath frame member **23** slightly inwardly of the edge of belt **10**. The rail **31** is formed with a series of cutouts **32**, one at each station, which each receive the head of a plunger **33** controlled by an ejection solenoid **34** individual to the particular station. When this solenoid is actuated, in a manner more fully described hereinafter, it pushes sharply against the confronting book *b* which is thereby thrust across the opposite conveyor edge into a bin **35**.

A shaft **36**, disposed close to the rod **22** and lying parallel thereto, swingably carries a pair of guard fingers **37** which lie just below the level of the supported end of swingable arm **25** and can be deflected upwardly by an object of inordinate height approaching the arm **25**. When the fingers **37** are thus tripped, the shift **36** is rotated counterclockwise (as viewed in FIG. 3) and actuates an associated sensitive switch **38** to cause an alarm, e.g. by arresting the entire machine; this prevents the occurrence of possible pile-ups in the event that, by accident, two or more books may not have been properly separated at the hopper outlet **17**.

In order to insure that the books *b* should move next to rail **31** when passing the several sorting stations, thereby effectively interrupting the light beam from source **29**, a resilient blade **39** (FIG. 1) deflects them toward the rail **31** as they leave the hopper **14**. Two leaf springs **47** slope down from the front wall of the hopper to hold down the book which is thus being deflected. Smooth passage of the books along rail **31** is insured by the fact that the heads of plungers **33**, when retracted, lie flush with the rail in their cutouts **32**.

Reference will now be made to FIG. 6 for a description of the time sequence of operations at any sorting station **21**.

As seen in FIG. 6, the monitoring light source **29** of each station comprises a lamp **29***a* and a focusing objective **29***b*, here shown as a simple lens, which normally directs a sharp beam of light upon the cathode of the confronting photocell **30**. Similarly, the detecting light source **27** comprises a lamp **27***a* and a lens **27***b* to focus a beam on a spot *s* of the cover picture of a passing book *b*; the associated photoelectric receiver **28** includes a photocell **28***a*, an objective **28***b* and a color filter **28***c* so that the cell **28***a* conducts only when, at the instant of energization of lamp **27***a*, the spot *s* is of a predetermined color passed by the filter **28***c*.

A power supply **40**, shown diagrammatically as a battery, energizes not only the aforedescribed circuit elements but also the drive motor **11** by way of a pair of bus bars **41**, **42**, the latter bus bar being connected to the positive terminal of battery **40** via all the protective switches **38** connected in series. The output of photocell **30** is connected across the input of an amplifier **43** which, upon interruption of the beam of the associated light source **29** by the leading edge of book *b*, actuates a pulse generator **44** with an adjustable lag determined by the setting of an interposed delay circuit **45**. The adjustability of this delay circuit, together with a shiftability of arm **25** (FIG. 1) on rod **22** and a limited displaceability of this rod together with shaft **36** along its supporting members **23** and **24**, enables the selection of any desired region of the book cover for scanning by the director **27**, **28**.

The pulse produced by generator **44** is fed to lamp **27***a* which lights up momentarily and, under the stated conditions of recognition, causes the photocell **28***a* to conduct for a brief instant and to trigger an amplifier **46** which in turn briefly energizes the solenoid **34**. Plunger **33** operates in the aforedescribed manner to push the book *b* off the conveyor, thereby restoring the light path between source **29** and receiver **30**.

If one of the normally closed switches **38** had opened prior to this operation, all the circuit elements referred to would have been de-energized and the system would have come to a halt.

If a book is not recognized by the detector of any station **21**, it will move on to the remote end of the conveyor and be dumped into another receptacle not shown.

While in many instances it will be sufficient to have a single color-responsive detector at each station to discriminate between the different types of books to be sorted, it is of course possible to utilize a combination of serially connected photocells, each with its own color filter, so that the system will respond only to a particular grouping of spots of predetermined coloration at specified locations of the book cover; this would minimize the possible ambiguities arising when a large number of books with partly similar cover sheets are to be handled by the machine.

It will be understood that the invention is equally applicable to the sorting of substantially any stack of relatively flat object or objects having at least one flat surface. These surfaces can then be sorted in accordance with the color, configuration or markings thereon in the manner previously described. Of particular interest are record albums or jackets, generally containing the records, and indeed such record albums can be considered to be "books" for the purposes of the instant application. Record jackets have distinct color patterning and require no modifications of the apparatus described except to compensate in the stacking device for the greater size of the units. Such modifications in the system of the instant invention will, of course, be readily apparent to those skilled in the art and are intended to be included within the spirit and scope of the appended claims.

I claim:

1. A book-sorting machine comprising a conveyor; input means adjacent said conveyor for delivering successive books thereto with covers facing up and distinctive markings on said covers; and a plurality of sorting stations disposed along said conveyor beyond said input means, each of said stations including photoelectric detector means above said conveyor positioned to ascertain the presence of a particular marking individual to the respective station, monitoring means for determining the arrival of a book at the station and circuit means responsive to said monitoring means for triggering a momentary operation of said detector means at a predetermined instant with reference to the operation of said monitoring means, and ejector means controlled by said detector means for removing from said conveyor a book scanned by said detector means, said monitoring means comprising a light source on one side and a confronting photoelectric receiver on the other side of said conveyor, the latter being provided with a stationary lateral guide rail supporting said photoelectric receiver, said input means including resilient deflector means urging oncoming books into contact with said guide rail.

2. A machine as defined in claim **1** wherein said guide rail is formed with a cutout at each station, said ejector means including a plunger aligned with said cutout and provided with a head normally withdrawn into a position flush with said rail.

3. A machine as defined in claim **1** wherein said detector means comprises a color-filter means interposed iu the light path between said source and said receiver.

4. A machine as defined in claim **1** wherein each of said stations is provided with counting means controlled by

said circuit means for registering the number of operations of the associated ejector means.

5. A book-sorting machine comprising a conveyor; input means adjacent said conveyor for delivering successive books thereto with covers facing up and distinctive markings on said covers; and a plurality of sorting stations disposed along said conveyor beyond said input means, each of said stations including photoelectric detector means above said conveyor positioned to ascertain the presence of a particular marking individual to the respective station, monitoring means for determining the arrival of a book at the station and circuit means responsive to said monitoring means for triggering a momentary operation of said detector means at a predetermined instant with reference to the operation of said monitoring means, ejector means controlled by said detector means for removing from said conveyor a book scanned by said detector means, a support extending across said conveyor, an arm mounted on said support for swinging movement in a vertical plane, said arm having a free extremity pointing away from said support in the direction of conveyor movement, and mounting means holding said detector means in position on said extremity, the latter being engageable with the upper surface of a passing book lifting said arm from a normal downwardly inclined position.

6. A machine as defined in claim 5, further comprising a guard element positioned in the vicinity of said arm for engagement by an improperly positioned book on said conveyor, and alarm means responsive to a tripping of said guard element by a passing book for indicating improper functioning.

7. A machine as defined in claim 5 wherein said input means comprises a hopper above said conveyor with a bottom having at least one slot extending in the direction of conveyor motion and a front opening just above said bottom, said conveyor being provided with upstanding cleats aligned with said slot for entraining the lowest book of a stack placed in said hopper.

8. A machine as defined in claim 7 wherein said hopper is provided with detent means yieldably overhanging said front opening from the outside for restricting the discharge therethrough to a single book at a time.

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