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APPARATUS FOR SORTING AND IDENTIFYING SOURCES OF WORKPIECES

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FIG. 1.

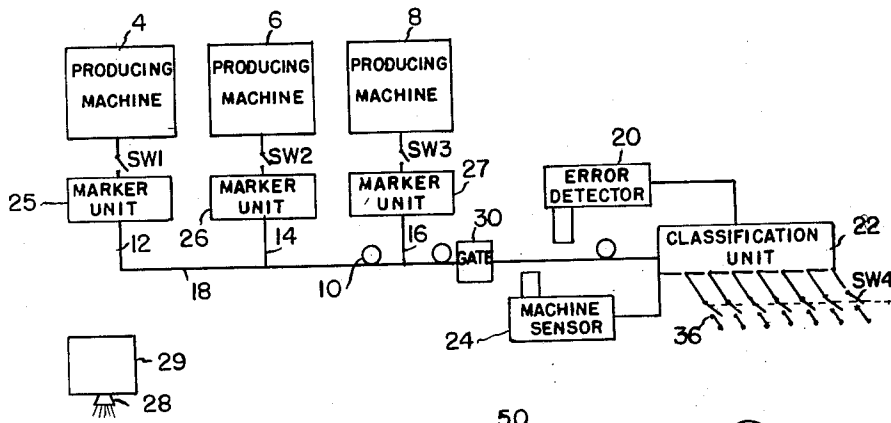


FIG. 2.

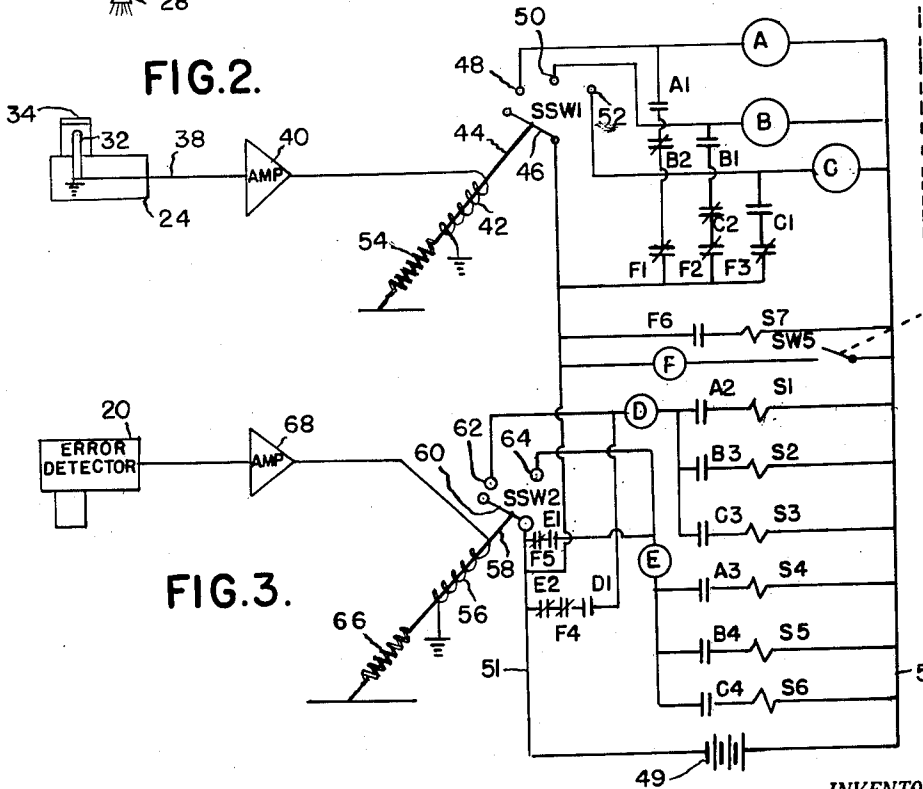


FIG. 3.

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APPARATUS FOR SORTING AND IDENTIFYING
SOURCES OF WORKPIECES

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The present invention relates to quality control apparatus and refers more particularly to apparatus for sorting articles from different sources according to predetermined characteristics thereof and identifying the sources of the articles.

In the past it has been known to provide classification units operating in conjunction with producing machines such as machines for producing gears to classify the articles produced by the machines according to predetermined characteristics such as helix angle in the case of gears. Such classification may be in terms of undersized, oversized or correct sized articles or just good and bad articles. The known classification units are normally capable of classifying many more articles in a given period of time than can be produced by a single producing machine in a similar length of time. Therefore to operate a classification unit efficiently it is desirable to provide means whereby a single classification unit may be used to sort articles from a plurality of producing machines. Such a classification unit should also be capable of identifying the source of each article so that the particular machine of said plurality of machines producing articles of particular characteristics may be readily determined.

Therefore it is one of the objects of the present invention to provide apparatus for sorting articles from different sources according to predetermined characteristics thereof and identifying the sources of the articles.

Another object is to provide in conjunction with a plurality of producing machines marker means capable of imparting a distinctive characteristic to articles produced by each machine, a single classification unit for classifying articles from all of said plurality of producing machines, and means associated with said classification unit to detect said distinctive characteristics whereby the source of a particular article may be determined.

Another object is to provide in conjunction with a plurality of producing machines marker means capable of imparting a distinctive characteristic to articles produced by each machine, a single classification unit for classifying articles from all of said plurality of producing machines, and error detector means operably associated with said classification unit to detect predetermined characteristics similar to all articles and machine sensor means operably associated with said first mentioned means and said classification unit to detect said distinctive characteristic whereby said articles may be classified both as to the predetermined characteristics thereof and the machine producing them.

Another object is to provide apparatus for sorting articles as set forth above wherein said marker means comprises devices for painting a portion of each article produced by each machine a separate color representative of each machine.

Another object is to provide apparatus for sorting articles as set forth above wherein said machine sensor comprises a device operable to produce a voltage the magnitude of which is dependent on the color of the marking on the article applied thereto by the marker units.

Another object is to provide apparatus for sorting articles as set forth above which is simple in construction, economical to manufacture and efficient in use.

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Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention, wherein:

FIGURE 1 is a diagrammatic representation of the article sorting apparatus of the invention.

FIGURE 2 is a diagrammatic representation of a marker unit of the article sorting apparatus of FIGURE 1.

FIGURE 3 is a partially diagrammatic and partially schematic diagram of the machine sensor and error detector of the article sorting apparatus illustrated in FIGURE 1 showing the particular electrical controls thereof.

With reference to the drawing a particular embodiment of the article sorting and identifying apparatus of the invention will now be described.

In FIGURE 1 there is shown article producing machines 4, 6 and 8 which function to produce similar articles 10 and to discharge them through chutes 12, 14 and 16 from whence they pass to the chute 18 for conveyance to a classification unit 22 past an error detector 20 and a machine sensor 24. Marker units 25, 26 and 27 are positioned adjacent chutes 12, 14 and 16 respectively and are operable on an article passing through the chute associated therewith to distinctively mark each article produced by the particular machines 4, 6 and 8. The machine sensor unit 24 is provided adjacent chute 18 to detect the distinctive characteristics of the articles produced by the marker units so that as each article passes the error detector 20 and proceeds to the classification unit 22 the machine which produced the article will be known. With the apparatus illustrated it is possible to classify articles produced by a plurality of producing machines both as to departures therein from characteristics common to each article and as to the machine producing each article.

More specifically machines 4, 6 and 8 may be for example gear producing machines for producing similar gears 10 and discharging the finished gears 10 through chutes 12, 14 and 16. As the finished gears 10 pass through the chutes 12, 14 and 16 a distinctive characteristic is given to the gears produced by each particular machine by means of marker units 25, 26 and 27. These marker units may be actuated by the gears passing over and mechanically operating switches SW1, SW2 and SW3 in chutes 12, 14 and 16 respectively.

The distinctive characteristic of the individual gears imparted thereto by marker units 25, 26 and 27 may vary considerably and may be for example different levels of radio activity, different magnetic characteristics, different temperatures, stamped markings, or color markings. In the embodiment of the invention illustrated in the drawings a mark of a distinctive color is applied to each gear by means of marker units 25, 26 and 27 comprising devices such as that indicated in FIGURE 2 wherein paint is caused to spray on the gears 10 from a nozzle 28 connected to a reservoir 29 on actuation of one of the switches SW1, SW2 and SW3 by a gear passing down chute 12, 14 or 16 respectively.

The articles 10 after having been distinctively marked proceed along chute 18 to gate 30 at which point they are caused to stop by gate 30, which may be an electrically actuated mechanical gate, to await their turn in passing by the machine sensor 24, error detector 20 and through the classifier unit 22 as will later be discussed. Gate 30 may be automatically operated on the completion of the classification of a particular gear as will later be discussed in more detail. Gates such as gate 30 are well known in the art and since the details of gate 30 form no part of the present invention they will not be considered in detail.

The machine sensor 24 must be capable of differentiating between the distinctive characteristics applied to the

gears 10 by the individual marker units 25, 26 and 27. Thus the type of machine sensor 24 to be used will be determined by the type of distinctive marking applied to the gears 10. When a paint of a distinctive color is applied on the gears 10 the machine sensor 24 may take the form shown at the upper left in FIGURE 3 wherein a light sensitive tube 32 is placed in proximity to the chute 18 (shown in FIGURE 1) and receives light through the colored lenses 34 operable to filter the light according to the lens color. The light filtered through lenses 34 is effective to cause the light sensitive tube 32 to produce a different electrical signal for each distinctive color. It will be understood of course that other machine sensors capable of producing different electrical signals due to sensing of the distinctive marks applied to the articles 10 by the marker units 25, 26 and 27 must be used with marker units which impart distinctive characteristics to gears 10 other than colored marks as discussed above.

The error detector 20 and classification unit 22 for gears 10 are completely set forth in copending applications Serial No. 466,118, filed November 1, 1954, now Patent No. 2,983,375, and Serial No. 795,005, filed February 25, 1959, which are assigned to the same assignee as the present application. Therefore since the details of the error detector and classification unit form no part of the present invention they will not be considered in detail herein. It will be understood however that the error detector is an apparatus operable to inspect finished articles such as gears and to create an electrical signal in accordance with the inspected characteristics of said article. For example a different electrical signal may be produced for good and bad articles inspected by the error detector.

The classification unit 22 is such that on receiving a particular combination of voltages from the machine sensor and error detector it will cause the article producing such voltages to pass out of the classifier through a predetermined one of chutes 36. A series of chutes 36 are provided for each machine feeding articles to the classifier, there being one chute in each series for each condition of the gears inspected by the error detector 20. Thus with three machines 4, 6 and 8 feeding gears 10 to classifier 22 and the error detector 20 detecting good and bad gears six chutes 36 are provided leading from the classifier 22. The operation of the error detector 20, machine sensor 24, gate 30, and classification unit 22, and their coordination will become more apparent as the operation of the article sorting and identifying apparatus of the invention is disclosed.

As previously indicated in the operation of the apparatus just described machines 4, 6 and 8 are operative to produce individual similar articles such as gears 10. As the gears 10 are discharged from machines 4, 6 and 8 through chutes 12, 14 and 16 respectively they are caused to mechanically close switches SW1, SW2 and SW3 activating marker units 25, 26 and 27 whereby paint of a distinctive color is applied thereto. The gears 10 then proceed along the chute 18 to the gate 30 which as will subsequently be disclosed periodically allows a single gear 10 to proceed past the machine sensor 24 and error detector 20, into the classification unit 22 and out through one of the chutes 36.

As the individual gears pass by the machine sensor 24 light reflected from the distinctive paint thereon passes through light filter 34 striking the light sensitive tube 32 to create an electrical signal on conductor 38, shown in FIGURE 3, which is related in magnitude to the distinctive color of paint on the gear. This signal is amplified in amplifier 40 and passed through coil 42. The amplified signal passing through coil 42 causes the core 44 thereof to move arm 46 of selector switch SSW1 into contact with one of the terminals 48, 50 and 52 in opposition to spring 54 which tends to move the core 44 into the position shown where arm 46 is not in contact with any of the terminals 48, 50 and 52. As will be obvious the arm

46 will successively contact each of the terminals 48, 50 and 52 in turn providing the signal developed by the light sensitive tube 32 and amplified in the amplifier 40 is of sufficient magnitude.

As the arm 46 of switch SSW1 comes in contact with the terminal 48 thereof, relay coil A is energized by means of the electrical energy source 49 through offset conductor 51, conductor 53 and switch SSW1. Energizing relay coil A causes relay contacts A1 which are actuated thereby and which are normally open as shown to close. A holding circuit through normally closed contacts F1 and B2 and now closed contacts A1 for relay coil A, should arm 46 proceed toward contact 50 due to a large signal produced by tube 32 and applied to coil 42, or should arm 46 be caused to return to the position shown due to the bias of spring 54, is thus provided on closing of relay contacts A1.

Contacts A2 and A3 also operated by relay coil A are associated with the error detector portion of the schematic diagram which will be discussed in more detail later. Contacts A2 and A3 are normally open as shown but will be closed on energization of relay coil A to allow subsequent energization of solenoids S1 and S4. Solenoids S1 and S4 are operable on being energized to cause gears to be diverted into one of a pair of chutes 36 on classification unit 22, which pair of chutes are associated with machine 4, depending on whether the gears are good or bad as determined by error detector 20.

If the arm 46 moves from contact 48 to engage contact 50 due to a larger signal passed through coil 42 from amplifier 40 due to a signal from light sensitive tube 32 produced by an article having a different distinctive color such as for example that applied by marker unit 26, relay coil B will be caused to be energized. On energization of relay coil B the normally closed contacts B2 in the holding circuit for relay coil A will open causing the relay coil A to be deenergized causing contacts A1, A2 and A3 to open. At the same time contacts B1 will be closed providing a holding circuit for relay coil B through normally closed contacts F2 and C2. Also it will be noted that the normally open contacts B3 and B4 in the error detector portion of the schematic portion of FIGURE 3 are closed on energization of relay coil B whereby the only solenoids S1-S6 which can be energized in the error detector circuit are solenoids S2 and S5. Solenoids S2 and S5 are operable to cause gears to be diverted into one of a pair of chutes 36 on classification unit 22 associated with machine 6 depending on whether the gear is good or bad as controlled by the error detector as subsequently will be described.

Likewise if the signal developed by the machine sensor 24 is of a greater magnitude representative of a gear 10 produced by machine 8 arm 46 will be caused to swing past both contacts 48 and 50 into engagement with contact 52 due to the action of coil 42 on core 44 in opposition to spring 54. On arm 46 engaging contact 52 a circuit from energy source 49 to relay coil C is completed whereby the relay coil C is energized.

The energization of relay coil C will cause normally open contacts C1 to close providing a holding circuit for energization of relay coil C through normally closed contacts F3. At the same time normally closed contacts C2 open breaking the holding circuit to relay coil B, thus deenergizing relay coil B. On deenergization of relay coil B contacts B3 and B4 are returned to their normal open position. Energization of relay coil C also causes contacts C3 and C4 which are normally open to close whereby solenoid S3 or solenoid S6 associated with the classification of gears produced by machine 8 may be energized as will subsequently be explained.

Thus it can be seen that the machine sensor 24 senses the different distinctive characteristic imparted to the gears 10 by the marker unit associated with each producing machine and by means of the electrical control circuit just described permits classification of the gears

10 only with gears from the same producing machine. The gears from each producing machine may then be classified according to the particular common characteristics thereof. That is to say the gears from a given machine may then be classified as to whether they are good gears or bad gears by means of the error detector 20.

The error detector 20 which as previously indicated may be as disclosed in commonly owned application, Serial No. 795,005, which develops an electrical signal of different magnitude depending on the presence or absence of particular measured characteristics such as helix angle of gears 10 produced by the producing machines.

As indicated in connection with the machine sensor 24 an electrical signal passing through coil 56 associated with error detector 20 shown in FIGURE 3 will cause core 58 to pivot arm 60 of selector switch SSW2 into successive engagement with contacts 62 and 64 of switch SSW2 in opposition to spring 66. Assuming that a smaller signal is produced by error detector 20 for gears 10 which have desired characteristics and are therefore good the arm 60 will be caused by this signal to engage contact 62 whereby the relay coil D is energized closing normally open contacts D1 to provide a holding circuit for relay coil D through normally closed contacts E2 and F4 whereby one of the three solenoids S1, S2 and S3 will be energized depending on which of the contacts A2, B3 or C3 have been closed due to the machine sensor 24 sensing a gear 10 from producing machine 4, 6 or 8 as previously described.

Thus it will be seen that solenoid S1 will be energized only when a good gear from producing machine 4 passes the machine sensor 24 and error detector 20 and solenoid S2 is energized when a good gear from producing machine 6 is transferred to classification unit 22. Likewise solenoid S3 is energized on transfer of a good gear from producing machine 8 to classification unit 22.

A larger electrical signal is then produced by error detector 20, amplified in amplifier 68 and fed to coil 56 on the error detector 20 sensing a gear whose particular common characteristics are undesirable, whereupon arm 60 of switch SSW2 is caused to engage contact 64 to energize relay coil E. Energizing relay coil E causes the normally closed relay contact E2 to open breaking the holding circuit to relay coil D whereupon none of the solenoids S1, S2 and S3 associated with good gears 10 may be energized. At the same time normally open contacts E1 are caused to close providing a holding circuit for relay coil E. Thus at this time one of the solenoids S4, S5 and S6 may be energized depending on which of the machines produced the bad gear as sensed by machine sensor 24 as previously indicated.

Thus it will be seen that one of the solenoids S1-S6 and only one will be energized by signals produced from the machine sensor 24 and error detector 20 in response to a gear being transferred to the classification unit 22. The solenoids S1-S6 as fully explained in commonly owned application, Serial No. 466,118 control means in the classification unit to direct the gears 10 transferred thereto to a particular one of the classification chutes 36. Thus the solenoids S1-S6 will direct the gears 10 produced by each of the producing machines 4, 6 or 8 to a particular one of the chutes 36 depending on whether the gears are good or bad and which machine produced the gear.

As the gears 10 are discharged from the classification unit 22 through the chutes 36 after they have been classified they are caused to close one of the parts of switch S4 and therefore switch S5 which is connected to each part of switch S4. Switch S5 on being closed allows relay coil F to be energized by energy source 49. The energizing of relay coil F causes normally closed contacts F1-F5 to be opened whereby all energized relay coils A-E are caused to be deenergized placing the article sorting identifying apparatus of the invention in condition to

classify a subsequent gear passed from gate 30 to the classification unit 22.

On energization of relay F contacts F6 which are normally open are closed to energize solenoid S7 which in a manner well known in the art may provide the force to open gate 30 and allow a single gear 10 to be transferred to the classification unit 22.

Thus it will be seen that applicant has provided a method by which similar articles produced by a plurality of producing machines may be classified both as to producing machine from which they originate and as to particular common characteristics of said similar articles and has disclosed apparatus for performing such classification.

The drawings and the foregoing specification constitute a description of the method and apparatus for sorting and identifying sources of workpieces in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. Apparatus for sorting similar articles from different sources according to the source of said articles and selected characteristics common to all of said articles using a single classification unit, comprising a plurality of sources of said articles, marker means associated with said sources to impart a distinctive characteristic to articles from each source representative of said source, a classification unit, means for transferring individual articles from said plurality of sources past said marker means to said classification unit, sensor means operably associated with said classification unit for developing a signal representative of said distinctive characteristic of each individual article transferred to said classification unit, and error detector means also operably associated with said classification unit for developing a signal representative of the particular common characteristics of each of said individual articles, said classification unit being operable in response to said signals to classify said individual articles both as to source and said common characteristics.

2. Apparatus as claimed in claim 1 wherein said distinctive characteristic imparted to said articles comprises paint of a different color applied to the articles from each separate source.

3. Apparatus as claimed in claim 1 wherein said marker means comprises a reservoir of paint of a different color associated with each source, a spray nozzle in communication with each said reservoir and operable on activation to spray paint on a particular article being discharged from the source associated with said reservoir, and switch means operated by said particular article on discharge thereof from said source to activate said spray nozzle.

4. Apparatus as claimed in claim 2 wherein said sensor means is color sensitive and operable to develop a distinctive signal in response to the sensing thereby of each of said different colors applied to said articles.

5. Apparatus as claimed in claim 2 wherein said sensor means comprises a light sensitive tube positioned to receive light reflected from said individual articles as the articles are transferred to said classification unit, said tube being operable to produce a signal variable in accordance with the light received thereby, and color sensitive light filter positioned between said light sensitive tube and said individual articles to permit different light reflected from said individual articles of different color to reach said light sensitive tube whereby a distinctive signal is produced by said light sensitive tube representative of the source of said individual articles.

6. Apparatus for sorting similar articles from different sources according to the source of said articles for further classification by a single classification unit, comprising a classification unit for sorting articles according to their source and common characteristics, a plurality of different article sources, marker means associated with each source for imparting a distinctive characteristic to

the articles representative of said source, and sensor means operably associated with the classification unit for detecting said distinctive characteristic of each individual article transferred to the classification unit from the different sources and for indicating the source of each article to the classification unit.

7. Apparatus for sorting similar articles from different sources according to the source of said articles for further classification by a single classification unit, comprising a classification unit for sorting articles according to their source and common characteristics, a plurality of different article sources, marker means associated with each of said sources for coloring each of said articles a distinctive color representative of said source, and sensor means operably associated with the classification unit for detecting said distinctive color of each individual article transferred to the classification unit from the different sources and for indicating the source of each article to the classification unit.

8. Apparatus for sorting similar articles from different sources according to the source of said articles for further classification by a single classification unit, comprising marker means associated with each of said sources for coloring each of said articles a distinctive color representative of said source, including a paint reservoir for storing paint of said distinctive color and a paint spray nozzle in communication with said reservoir operable on activation to spray an article discharged from the associated source with said distinctive color paint, and also including switch means associated with said source for activating said nozzle on discharge of an article from said associated source, and sensor means operably associated with the classification unit for detecting said distinctive color of each individual article transferred to the classification unit from the different sources and for indicating the source of each article to the classification unit, including a light sensitive tube positioned to receive light reflected from said individual articles as the articles are transferred to said classification unit, said tube being operable to produce a signal variable in accordance with light received thereby, and color sensitive light filters positioned between said light sensitive tube and said individual articles to permit different light reflected from said individual articles of different color to reach said light sensitive tube whereby a distinctive signal is produced by said light sensitive tube representative of the source of said individual articles.

9. A method for sorting similar articles from different sources according to the source of said articles for further classification by a single classification unit comprising the step of imparting a distinctive characteristic to the articles at the individual sources, mixing the articles from the different sources after imparting the distinctive characteristic thereto, transferring the mixed articles to the classification unit, sensing the distinctive characteristic of each article as it is transferred to the classification unit, and indicating to the classification unit the source of each article transferred thereto.

10. A method for sorting similar articles from different sources according to the source of said articles and selected characteristics common to all of said articles using a single classification unit, comprising imparting a distinctive characteristic to articles from each source representative of said source, transferring individual articles from said sources to said classification unit, sensing said distinctive characteristic of the individual articles, developing a signal representative of said distinctive characteristic of said individual articles operable to cause said classification unit to sort said articles according to the respective source thereof, and developing a signal representative of said common characteristics operable to cause said classification unit to further sort said articles according to particular common characteristics.

11. A method for sorting similar articles from different sources according to the source of said articles and selected characteristics common to all of said articles using a single classification unit, comprising imparting a distinctive characteristic to articles from each source representative of said source, transferring the articles from said sources to said classification unit, sensing the distinctive characteristic of the separate articles after they are transferred to the classification unit, developing a signal representative of the distinctive characteristic of the separate articles operable to cause said classification unit to sort said articles according to the respective source thereof, and developing a signal representative of said common characteristics operable to cause said classification unit to further sort said articles according to particular common characteristics.

12. A method for sorting similar articles from different sources according to the source of said articles and selected characteristics common to all of said articles using a single classification unit, comprising imparting a distinctive characteristic to articles from each source representative of said source, mixing the articles from the different sources after imparting the distinctive characteristic thereto, transferring the mixed articles from said sources to said classification unit, sensing said distinctive characteristic of separate articles as they are transferred to the classification unit, developing a signal representative of the distinctive characteristic of the separate articles operable to cause said classification unit to sort the articles according to the respective source thereof, and developing a signal representative of said common characteristics operable to cause said classification unit to further sort said articles according to particular common characteristics.

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