Feb. 28, 1967 N. NICOLAUS 3,306,420

CONVEYOR APPARATUS

Filed Feb. 7, 1966 2 Sheets-Sheet 1

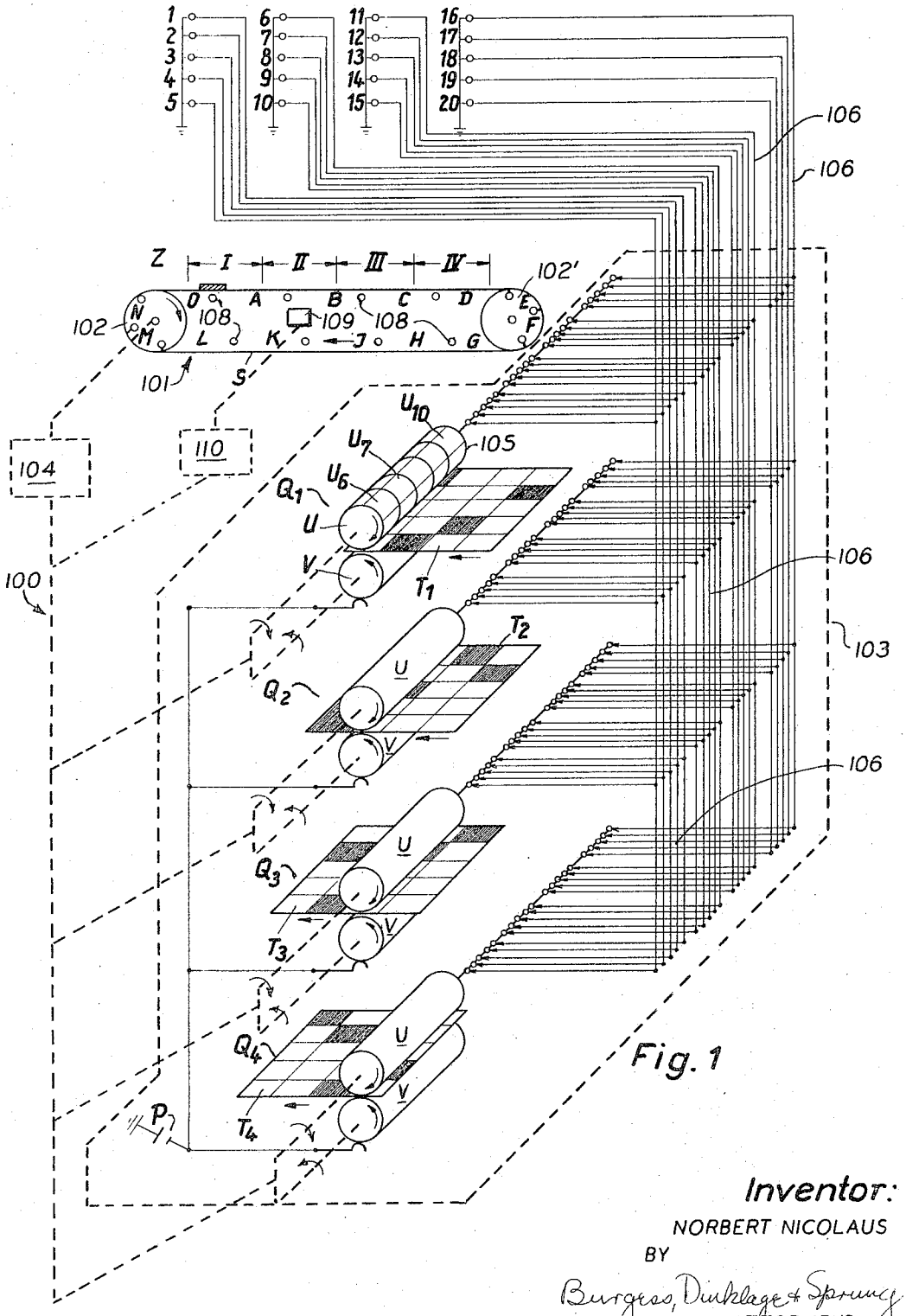


Fig. 1

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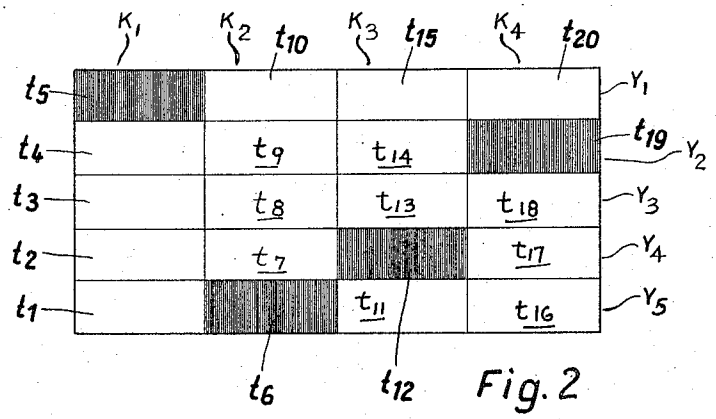


Fig. 2

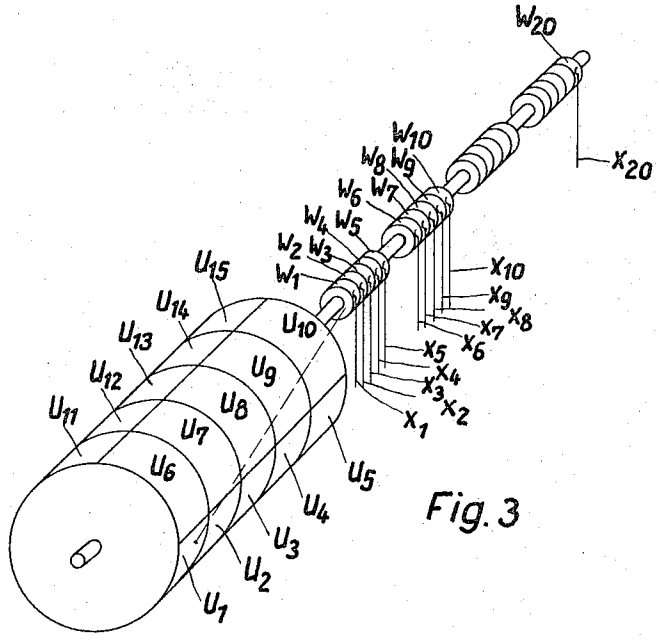


Fig. 3

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CONVEYOR APPARATUS

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This invention relates in general to conveyor equipment such as used in factories, etc., for moving articles along assembly lines. More particularly, the invention is directed to a conveyor apparatus having an article transport means disposed for movement to convey articles along a predetermined path to each of a plurality of work stations located at successive spaced intervals therealong, and work operation indicator devices located at each work station for identifying specific work operations to be performed thereat in accordance with information delivered by a data storage means.

To assure that the intended work operations will be correctly signified by the various indicators at the work stations, the data storage means is responsive to the movement of the transport means to deliver programmed work operation data in synchronism with the movement of a reference point on the transport means to successive work stations. The data storage means is operatively connected to the various indicators for activating them in accordance with the data delivery, which is preferably in electric signal form.

In general, the programmed work operation data can be supplied in any suitable form, such as on magnetic tapes, punch cards, etc., or any other conventional data storage medium. However, the invention contemplates the use of a two-dimensional data storage medium in the form of a card having a predetermined array of electrically conductive and non-conductive portions arranged so as to represent in digital form, successive sets of work operation data. Depending upon the interrelation between the work operations to be performed at the various stations upon articles conveyed thereto in succession, either a single data card or a plurality of data cards can be employed to control the activation of the indicators. By using a single data card to control the activation of indicators at each station, considerably greater flexibility in operation can be achieved, because the sequential pattern of work operations can be varied at any given station simply by substituting a differently encoded data card. In contrast, where a single data card is used to control indicator activation at all work stations, it must necessarily contain sufficient data for such purpose. Thus, should it be desired to change the pattern of work operations at only one station, replacement of a more complexly encoded card would be necessary, and the chances for the introduction of errors would be increased because the new card would have to be encoded to correctly repeat the data pertaining to the work stations where the work operation pattern remained unchanged, and also to correctly state revised data pertaining to the station at which the work operation pattern is to be changed. According to a preferred and simplified embodiment of the invention, the work operation indicator devices are electric lamps, with one lamp for each characteristic work operation contemplated being provided at each work station. For example, if five distinct types of work operations, not necessarily the same from station to station, are to be capable of indication at each of four work stations, then five lamps are provided at each station, making a total of 20 indicator lamps required for such conveyor apparatus installation. Preferably, each lamp is operable at the same voltage, so that a single electric power supply can be used to activate all of the lamps.

The data storage means includes an output translating means for converting the work operation data stored in the data cards into corresponding electric signals, preferably of sufficient voltage to directly energize the lamps. As provided by the preferred embodiment of the invention, the output translating means can be considered generally to be in the form of an array of switch contacts disposed to engage the various conductive and non-conductive regions of the data cards as they are shifted sequentially into contact with the switch contacts. The switch contact pairs and the data storage medium are disposed for relative movement in synchronism with the movement of the transport means to shift successive storage regions of the medium into operative engagement with the switch contact pairs as the transport means moves to successive work stations. With such an arrangement, corresponding indicator lamps will be energized as electrically conductive data storage regions are brought into contact with associated switch contacts.

While a variety of means equivalent to such switch contact pairs can be used, the invention contemplates the use of one or more pairs of data sensing rollers which perform the same function. These data sensing rollers are disposed to engage therebetween the data storage medium, and for such purpose one roller in each pair has a plurality of electrically conductive peripheral surface regions conductively isolated from one another and each connected to a corresponding indicator lamp. These surface regions are arranged in a circumferential and axial array corresponding in development to the rectangular array of data storage regions. The other roller in each pair has an electrically conductive peripheral surface connected to an electric source. The rollers in each pair are disposed for counter-rotation in synchronism with the movement of the transport means to engage successive data storage regions of the medium for energizing those indicator lamps corresponding to electrically conductive data storage regions positioned between the rollers.

Preferably the data output translating means has a plurality of data sensing roller pairs equal in number to the number of work stations, so that each roller pair can be used in conjunction with an associated data storage card to control the indication of work operations pertaining to a single corresponding work station.

Thus, the invention refers in particular to an apparatus wherein the conveyor transport means carries on individual portions objects which are to be treated in a different manner at the individual work stations, such objects being transported on conveyor sections which lie one behind the other in the direction of movement. Such objects can be either similar or different, as desired.

In accordance with the present invention, a plurality of work indicator or signal devices are provided at each work station, while there is also provided a plurality of stored data outputs corresponding to individual work stations.

It is therefore an object of the invention to provide a conveyor apparatus capable of carrying articles to successive work stations and incorporating means for indicating the nature of work operations to be performed on such articles arriving at various work stations.

Another object of the invention is to provide a conveyor apparatus as aforesaid wherein the work operations to be performed at the work stations are indicated thereat in accordance with previously stored data delivered in synchronism with the conveyor movement to successive work stations.

A further object of the invention is to provide a conveyor apparatus as aforesaid which is operable with data stored on a two-dimensional medium in the form of an array of electrically conductive and non-conductive regions thereon.

A further object of the invention is to provide a con-

veyor apparatus as aforesaid wherein the stored work operation data is delivered in the form electrical signals capable of directly operating the work indicator means.

Still another and further object of the invention is to provide a conveyor apparatus as aforesaid wherein the indicated work operation sequential pattern for any work station can be simply and expediently varied.

Other and further objects and advantages of the invention will become apparent from the following detailed description and accompanying drawings in which:

FIG. 1 is a schematic illustration of a conveyor apparatus according to a preferred embodiment of the invention.

FIG. 2 is a schematic illustration of a typical data storage card which can be used in the apparatus of FIG. 1.

FIG. 3 is a schematic illustration of a data output translating device which can be used in conjunction with the data storage card of FIG. 2 and in the conveyor apparatus of FIG. 1 to deliver work operation data in the form of electric signals suitable for direct work indicator operation.

As illustrated in FIG. 1, the conveyor apparatus **100** utilizes a transport means **101** which can be expediently, in the form of a continuous, recirculating article carrier line or belt S, disposed for movement along a predetermined path established by a pair of spaced pulleys **102** and **102'**, either one of which is connected to be driven in rotation by a motive means (not shown).

The operation of the invention can be best explained by considering the carrier belt S to be composed of a plurality of adjoining sections A through O, all equal in length to the length of a work station I through IV located at successive spaced intervals along the carrier belt S. Taking section A as a reference point, an article Z placed thereupon (shown at Station I in FIG. 1) will be carried to stations II, III and IV in succession as the carrier belt S moves in the direction indicated by the arrows on pulleys **102** and **102'**. If additional articles (not shown) are placed on sections O, N, M, etc., following section A and one another in the direction of belt S travel, such articles will also be carried to stations I–IV in succession so that various work operations can be performed upon them on arrival thereat.

To identify the characteristic work operations to be performed on articles arriving at stations I–IV, the inventon provides a plurality of electric indicator lamps **1–20**. Five lamps are provided for each station I–IV, lamps **1–5** being associated with station I, lamps **6–10** being associated with station II, lamps **11–15** being associated with station III, and lamps **16–20** being associated with station IV. Such an arrangement gives a capability of indicating up to five distinct work operations at each statoin I–IV, either singly or in combination, with the work operations signified by each group of lamps **1–5, 6–10, 11–15, 16–20** not necessarily being the same from station to station. Where additional work operation indicator capability is desired, additional lamps (not shown) can be added at the various stations I–IV.

The lamps **1–20** are illuminated to identify work operations to be performed at their respectively associated work stations I–IV in accordance with data delivered by a data storage means **103** which is responsive to the movement to the carrier belt S to deliver work operation data in synchronism with the movement of a selected reference station A–O thereof. Such synchronous data delivery can be accomplished by means of a transmission **104** operatively connected to the carrier belt S or to either of the pulleys **102** or **102'**, and operatively connected to the data storage means **103** to drive said data storage means in synchronism with the carrier belt S.

Illumination of lamps **1–20** is accomplished by connecting them to a data output translator **105** provided within the data storage means **103**, such connection being effected via individual data output lines **106**. The translator **105** is also connected to one terminal of an electric source P, which is represented as a D.C. source, but which may be either an A.C. or a D.C. source as required for direct operation of the lamps **1–20**. The other terminal of the electric source P is connected to a common ground as are the lamps **1–20**. The translator **105** operates in effect as a multi-pole, independent-throw switching device which connects and disconnects the ungrounded or "hot" sides of the lamps **1–20** to the ungrounded terminal of the electric source P in accordance with data delivered by cards **T1–T4**.

For each work station I–IV, there is provided a data storage medium in the form of cards **T1–T4** respectively, and as shown in FIG. 2, each card has a number of columns **K1** to **K4** equal to the number of work stations I–IV, and a number of rows **Y1** to **Y5** equal to the number of indicator lamps provided per station. Each card **T1–T4** is subdivided into a rectangular array of data storage regions *t***1** through *t***20**, which are either electrically conductive or non-conductive according to the encoding of work operations which they are arranged to represent.

The translating means **105** includes one or more pairs of data sensing rollers **Q1–Q4** disposed to engage therebetween a data storage card **T1–T4** for scanning the data encoded therein by way of the arrangement of electrically conductive and non-conductive regions *t***1**–*t***20**. One roller U in each pair **Q1–Q4** is constructed with a plurality of electrically conductive peripheral surface regions **U1–U20** conductively isolated from one another and each connected to a corresponding indicator lamp **1–20**. From the details of a typical roller U shown in FIG. 3, it can be noted that the surface regions **U1–U20** are arranged in a circumferential and axial array corresponding in development to the rectangular array of data storage regions *t***1**–*t***20** illustrated in FIG. 2. The other roller V in each pair **Q1–Q4** has an electrically conductive peripheral surface which is connected to the electric source P.

Each of the roller pairs **Q1–Q4** is disposed for counter-rotation in synchronism with the movement of the carrier belt S so as to engage data storage regions of the cards **T1–T4** located along successive columns **K1–K4**. This will result in the energizing of indicator lamps **1–20** in accordance with the electrically conductive data storage regions positioned between the roller pairs **Q1–Q4**. For example, where the column **K1** of any card **T1–T4** contains an electrically conductive region *t***5**, feeding such card **T1–T4** into the roller pair **Q1** at the column **K1** end will result in lamp **5** being illuminated.

The detail connection of the surface regions **U1–U20** to lines **106** which are in turn connected to corresponding lamps **1–20** is best illustrated by FIG. 3. Each of the five axially disposed surface regions is electrically connected to a corresponding slip ring **W1–W5** fastened on the shaft **107** of roller U. Similarly, the next circumferentially displaced axial group of surface regions **U6–U10** are electrically connected to slip rings **W6–W10** respectively, as are surface regions **U11–U15** connected to slip rings **W11–W15** and likewise with the connection of surface regions **U16–U20** to slip rings **W16–W20**. On each slip ring **W1–W20** there slides a current collector, or transfer contact **X1–X20** respectively, which in turn is connected to a corresponding lamp **1–20** via a line **106**.

By providing a number of roller pairs **Q1–Q4** equal to the number of work stations I–IV, one card **T1–T4** can be used to control the indication of work operations for an individual article Z which arrives at each work station I–IV in succession. Since the number of articles being treated at any one time cannot exceed the number of work stations, assuming each belt section A–O carries only a single article to prevent confusion of work operation instructions, the choice of a number of roller pairs **Q1–Q4** equal to the number of work stations allows optimum utilization. By providing a number of conductive surface regions **U1–U20** equal to the total number of lamps **1–20**, a single card **T1–T4** can be used for each article.

For example, in any given roller pair **Q1–Q4**, the sur-

face regions U1–U5 are positioned to engage the column K1 of the data card T1–T4 corresponding to an article Z then positioned at station I. Whatever surface regions U1–U5 are in contact with an electrically conductive region *t*1–*t*5 of the data card T1–T4 will cause corresponding lamps 1–5 to be illuminated. Because the other surface regions U6–U20 which control lamps 6–20 respectively are out of contact with the data card T1–T4, no illumination of such lamps 6–20 can occur to confuse other work stations II–IV. When article Z is shifted to station II, the given roller pair (any one of Q1–Q4) will be rotated through approximately 90° (in the case of four work stations) to bring surface regions U6–U10 into contact with the column K2 of the same data card T1–T4, and thus the surface regions U6–U10 will be brought into contact with data storage regions *t*6–*t*10 for illumination of lamps 6–10 in accordance with which of the regions *t*6–*t*10 are electrically conductive, in a manner similar to that previously described in connection with article Z at station I. Here again, by reason of the fact that the other surface regions U1–U5 and U11–U20 are out of contact with the later card T1–T4, only the lamps 6–10 will be affected.

In a similar manner, the data card T1–T4 is shifted so as to bring its columns K3 and K4 into contact with the axial groups of surface regions U11–U15 and U16–U20 respectively in succession to control activation of lamp groups 11–15 and 16–20 respectively as article Z is shifted to station III and thence to station IV.

In the particular data card T1–T4 position illustrated in FIG. 1, the card T1 is controlling the indication of work operations by lamps 1–5 for an article Z at station I, and cards T2, T3 and T4 respectively are controlling the indication of work operations by lamp groups 6–10, 11–15, and 16–20 for articles (not shown) at stations II, III and IV.

In FIGS. 1 and 2, the electrically conductive data storage regions *t*1–*t*20 of cards T1–T4 are represented as blackened boxes. In the case of electrically conductive data storage regions such as *t*5, *t*6, *t*12, *t*19 shown in FIG. 2, it is understood that their electrical conductivity extends through the thickness dimension of the card T1–T4 so that whenever such a conductive region is sandwiched between the rollers U and V, said rollers U and V function to close a switch between the roller V and the corresponding surface region U5, U6, U12, U19 of roller U. Hence, each roller pair Q1–Q4 provides a plurality of switching contacts which are either open or closed in accordance with data stored in the card T1–T4 fed into them.

In connection with the representation of the data storage cards T1–T4 in FIGS. 1 and 2, it should be noted that while the regions *t*1–*t*20 are illustrated as being adjacent to one another, laterally and diagonally, such regions *t*1–*t*20 are actually insulated electrically from one another so that there is no conduction between any adjoining conductive regions, such as *t*6 and *t*12 in FIG. 2. This electrical isolation is essential because otherwise complete data encoding independence would not be available.

Accordingly, by making appropriate data storage regions electrically conductive, the invention is capable of indicating a plurality of work operations to be performed on a given article at any work station I–IV, and is not by any means restricted to single indicator lamps 1–20 operation.

As contemplated by the invention, the two dimensional data storage media used therein can be varied in detail. For example, electrically conductive and non-conductive regions on cards T1–T4 can be created by punching out sections thereof corresponding to intended electrically conductive regions, in the case of cards T1–T4 made of paper, cardboard, plastic, etc., or other electrically insulated material. Also, the regions which are to be made electrically conductive can be impregnated with a conductive ink which penetrates through the card T1–T4 thickness. The non-conductive regions are simply areas of the card T1–T4 which have not been rendered transversely conductive by treatment.

The feeding of the data cards T1–T4 into the roller pairs Q1–Q4 in synchronism with the movement of the carrier belt S can be accomplished in many ways, such as for example by providing projecting members 108 extending therefrom to engage a switch 109 each time the belt S is advanced a distance corresponding to a section A–O length. Such a switch 109 can be connected to control the operation of a stepping motor 110 which is coupled to the roller pairs Q1–Q4 so as to rotatably advance them by an angle corresponding to the arc length of the surface regions U1–U20 with each switch 109 actuation.

With such an arrangement, a transmission means 104 coupling the roller pairs Q1–Q4 of the translator 105 is not necessary and can be omitted. However, because of the nature of the roller pair Q1–Q4 engagement with the data cards T1–T4, either a stepwise advancement of said data cards T1–T4 thru the roller pairs Q1–Q4, or a continuous advancement therethrough in synchronism with the movement of the carrier belt S can be used.

While the invention has been described in terms of a specific type of data card T1–T4 and translator 105 data storage means 103, other types of storage and data processing devices can be substituted as desired, such as those used in electronic calculating and data processing installations.

The conveyor apparatus 100 of the invention is susceptible of a wide variety of applications throughout industry and in institutions. For example, the conveyor apparatus 100 can be used in the preparation of meals prescribed for individual patients in hospitals.

In such case, each data card can correspond to a single menu, and the meal can be assembled from soup placed on a tray at one work station, meat at another, vegetables at a third, etc., with the trays for each patient moving on a carrier belt S from one station to another, and the indicator lamps 1–20 being used to designate the type of soup, meat, vegetable, etc., to be placed on each tray.

As will be appreciated by the artisan, the invention is susceptible of numerous modifications, and variations, as will become apparent from the foregoing description of a preferred embodiment thereof. However, the invention is only intended to be limited by the following claims in which I have endeavored to claim all inherent novelty.

What is claimed is:

1. A conveyor apparatus which comprises an article transport means disposed for movement along a predetermined path to convey articles to each of a plurality of work stations located at successive spaced intervals therealong, a work operation indicator means disposed at each of said work stations to identify characteristic work operations to be performed on said articles upon arrival at said work stations, and a work operation data storage means responsive to the movement of said transport means and operatively connected to each of said indicator means to activate same in response to work operation data delivered by said data storage means, said data delivery being in synchronism with the movement of the transport means to successive work stations, whereby when articles conveyed by the transport means arrive at said work stations, work operations to be performed on such articles are identified by the indicator means thereat in accordance with stored data delivered by the data storage means.

2. The conveyor apparatus according to claim 1 wherein each of said work operation indicator means includes a plurality of electric lamps, each lamp when illuminated representing a characteristic work operation to be performed on an article arriving at its associated work station, said lamp being operatively connected to said data storage means for illumination by an electric source

in accordance with data delivered by the data storage means.

3. The conveyor apparatus according to claim 2 wherein said data storage means includes a data output translating means and an electric source for converting stored work operation data into corresponding electrical signals for delivery to said indicator lamps to illuminate same in accordance with said data.

4. The conveyor apparatus according to claim 3 wherein said data storage means is disposed to receive work operation data presented by a two-dimensional data storage medium having an array of electrically conductive and non-conductive data storage regions arranged to represent work operations to be performed at said work stations.

5. The conveyor apparatus according to claim 3 wherein said data output translating means includes a plurality of electric switch contact pairs disposed to engage a two-dimensional data storage medium having an array of electrically conductive and non-conductive data storage regions arranged to represent work operations to be performed at said work stations, said plurality of switch contact pairs and said data storage medium being disposed for relative movement in synchronism with the movement of the transport means to shift successive data storage regions of said medium into operative engagement with said switch contact pairs as said transport means moves to successive work stations, each of said switch contact pairs being connected to said electric source and to a corresponding indicator lamp to energize same when in engagement with an electrically conductive data storage region of said medium.

6. The conveyor apparatus according to claim 3 wherein said data output translating means includes at least one pair of data sensing rollers disposed to engage therebetween a two-dimensional data storage medium having a rectangular array of electrically conductive and non-conductive data storage regions arranged to represent work operations to be performed at said work stations, one roller in each pair having a plurality of electrically conductive peripheral surface regions conductively isolated from one another and each connected to a corresponding indicator lamp and arranged in a circumferential and axial array corresponding in development to said

rectangular array of data storage regions, and the other roller in each pair having an electrically conductive peripheral surface connected to said electric source, said roller pair being disposed for counter-rotation in synchronism with the movement of the transport means to engage successive data storage regions of said medium for energizing indicator lamps corresponding to electrically conductive data storage regions positioned between said rollers for engagement therewith.

7. The conveyor apparatus according to claim 6 wherein said data output translating means has a plurality of data sensing roller pairs equal in number to the number of work stations, each of said roller pairs being disposed to engage therebetween a two-dimensional data storage medium having a rectangular array of electrically conductive and non-conductive data storage regions arranged to represent work operations to be performed at a single corresponding work station.

8. The conveyor apparatus according to claim 6 wherein said data output translating means has a plurality of data sensing roller pairs equal in number to the number of work stations, each of said roller pairs being disposed to engage therebetween a two-dimensional data storage medium having a rectangular array of electrically conductive and non-conductive data storage regions arranged to represent work operations to be performed upon a single article at all corresponding work stations in sequence.

9. The conveyor apparatus according to claim 6 wherein the roller in each pair having a plurality of electrically conductive peripheral surface regions, has a number of such surface regions equal to the total number of indicator lamps provided at all work stations, whereby each roller pair can control the activation of indicator lamp at each work station, one station at a time in sequence.

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