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Sorting apparatus
Sortiervorrichtung
Appareil de triage

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References cited:

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Description

The present invention relates to a sorting apparatus of the type including a plurality of mobile carriages along a fixed route, at least one carriage of each group being provided with an advance motor and there also being provided on each carriage a rotating belt actuated by its own unloading motor and apt to receive an object to be sorted and to unload it along the route, the said advance and unloading motors picking up power supply from feed bars arranged along the route.

There are well known sorting apparatuses which include a plurality of carriages that move along one or more guide rails and on which there are arranged the objects to be sorted, which are then unloaded between collection devices positioned along the route.

One of these apparatuses is described for example in Italian patents no. 1.140.188 and no. 1.152.067 of the same applicant and includes a series of carriages, drawn by means of a chain or similar method, on each of which there is mounted a rotating belt actuated by its own motor which gets its energy supply, using sliding contacts, by a couple of feed bars which run in parallel to the guide rails.

All the apparatus functions are controlled by a central computer which monitors, moment by moment, the position of each carriage, thanks to signals generated by an encoder mounted on the wheel axis which sets the chain in motion. The commands for the activation of the motors which in turn activate the unloading belts for the transported objects are sent by the central computer to the various carriages by means of separated signal transport bars, these too arranged in parallel to the guide rails.

Hereafter, these bars which transport the signal will be indicated by the term "sectioned bars", while the term "continuous bars" or "feed bars" will indicate those bars from which the carriages pick up electric energy necessary for the supply of their motors and other devices on board.

The supply circuit of one of these well known apparatuses is given in diagram form in figure 1.

Here, 1 indicates the carriages, each of which has on board a rotating belt 2 which acts as a transport floor for the objects 3 and which is actuated by its own motor 4.

The motors 4 by way of sliding contacts 5 pick up the necessary supply from sectioned bars placed along the route, constituted by a plurality of conductors 6, each of a length less than the pitch of a carriage and separated from each other by insulating elements 7.

The functions of the system are managed by a central computer, for example a PLC, which controls a series of actionings or servo-amplifiers 9 which are earthed and each connected to a section of sectioned bar 6.

This solution, however, involves numerous inconveniences.

Each actioning must be able to transmit a current with an intensity greater than 15 Amp. This means that the connection to the supply bar must be made with cable of suitable dimensions.

When one considers that a normal system of this type often includes 200 or 300 carriages which sort towards what is often a similarly elevated number of collection stations, it is easy to understand how complex the apparatus is in constructional terms.

In addition to having to reposition a high number of earth actions, connecting each of them to the relevant part of the sectioned bar, problems then arise in relation to the control of electrical power in so far as the transmission of powers at such a high level through sliding contacts causes sparks. This cause the quick wearing out of the conductors.

To limit these inconveniences it is then necessary to very precisely control the activation of each section of bar, such that the transmission of power occurs only when the sliding contacts have passed the interruption zone between two consecutive bars.

The activation, in consequence, must be made with extreme precision with respect to the position of the machine, with restricted margins of error. This limits the performance, in so far as a reduced period of time is available for carrying out the unloading. When the collection stations are many and therefore of restricted dimensions, there are few milliseconds available (approx. 200) to give the rotating belt 2 the necessary acceleration for correct unloading of the object.

Other inconveniences of this solution derive from the fact that each time an actioning is burnt the corresponding output is lost. This can be recovered only by stopping the system for the necessary repair work.

Finally, the actionings must be exaggeratedly sized in relation to real need, to avoid over-heating and ensure a correct functioning even in the case, although not frequent, where several carriages unload consecutively at the same station.

These inconveniences have been resolved only in part in apparatuses known more recently, the supply layout of one of which is illustrated in figure 2.

In these apparatuses the actionings are mounted one per carriage and pick up the supply power by means of sliding contacts 10, from continuous bars 11.

The sectioned bars 6, in consequence, receive only control signals coming from the PLC, and with this solution, thanks to the fact that the power to be transmitted is minimal, dangers due to sparks are avoided. There is in addition a greater amount of time available for accelerating the belt, which allows for more precise control of unloading functions.

On the other hand this solution involves a greater number of sliding contacts and therefore a greater complexity of connections, resulting in a cost which is significantly higher than the preceding solution.

For this reason there is felt to be in the sector a need to be able to use apparatuses of the above-described type, but which have limited production cost, are easy to maintain, and which allow the elimination or at least dras-
tic reduction of the number of harnesses, thereby possibly avoiding the need to make use of sectioned bars.

EP 0 343 612 relates to a sorting method and apparatus wherein the motor of belt units is actuated by a certain delay, as a function of the speed of the carriage. The preamble of claim 1 is based on this document. The preamble of claim 1 is also known from DE-A-3 836 193.

The present invention offers a sorting apparatus of the type above-described, in which

- the carriages are assembled in groups;
- each group of carriages includes a CPU which receives command signals and is connected to a plurality of actionings, one of the said actionings controlling the advance motor(s) for the carriage group and each of the others the unloading motor for one of the carriages.

The present invention will now be described in detail, though only as a non-limiting example, with special reference to the figures enclosed where:

- figure 3 shows in schematic form the connections in an apparatus according to the invention;
- figure 4 shows the electrics layout for the carriage control devices;
- figure 5 is a block diagram illustrating the management method for the apparatus.

In the system according to the invention, (figure 3) the carriages are gathered in groups, which in the following will be indicated with the term "shuttle", each one including a certain number of carriages, for example 7.

In each shuttle a carriage 12, which will indicate as the main carriage, is provided with an advance motor and has on board a multiservo box 13, including eight actionings arranged respectively for the control of the advance motor and the unloading devices on each shuttle carriage.

A CPU 14, which will be indicated as a MCPU (mobile CPU) is assembled on the main carriage and is connected by a BUS to the multiservo box.

On the CPU card a series of microswitches is present, or bridges, which can be set in various modes, to define an identification code for the card and thereby for the shuttle.

Appropriate harnesses 15 of the well known type connect the multiserve box with the motors that act the unloading devices for each carriage.

The actionings mounted on the carriage 12 pick up power through two couples of sliding contacts 16 by continuous supply bars 17 and 18, the first to a certain tension, for example at 70 Volts, and the second at 0 Volts.

The MCPU 14 on the other hand receives the signal through the couples of sliding contacts 19 one of which engages the supply bar 18 at 0 Volts and the other the sectioned bar 20.

The bar 20 is made up of a series of sections separated from each other by insulating elements 21.

The insulating elements 21 are greater in size than the sliding blocks 19, while the length of the bar sections 20 can vary within wide limits, though as a matter of preference there will be a length of approximately 8-9 times the length of a shuttle.

To each of the sections which make up the supply bar 20 there is connected a control unit or GROUND CPU (GCPU) 22, in its turn connected to the central computer 8.

Each GCPU, in consequence, having received commands from the computer 8, processes them and sends suitable signals along the section involved, to manage the shuttles which move along this section of the route.

The connection between the central computer 8 and the ground CPU 22 is of a standard type, for example a connection of the RS 422 type.

A characteristic of the invention is instead the particular type of connection between the ground CPUs and those mounted on each shuttle.

This connection is set out in the diagram in figure 4.

Each ground CPU transmits baseband (or using other communication techniques like frequency modulation, phase modulation, amplitude modulation, etc.), amplified signals by means of a power amplifier 23. These signals, along bars 18 and 20, are picked up by sliding contacts 19 and arrive at the MCPU 14.

As a consequence of the transmission from the ground to the carriage, by means of which the larger part of the information signals are exchanged, occurs in baseband with elevated energy levels, in order to have a high signal/disturbance ratio.

On the basis of the instructions received from the central computer 8, each GCPU 22 sends to the shuttles which are on its section of the route power control signals for the advance motor and signals on the basis of which the MCPU 14 activates the unloading devices of the individual carriages, according to the modalities which will be illustrated below.

The amplifier 23 is connected to the supply bar by means of an inductor 24 arranged in series.

The ground CPU also includes a tone detector which is inserted on the line connecting the amplifier 23 with the supply bars, in a point set between the impedance 24 and the bars themselves.

On the MCPU 14 there is a demodulator receiver 25 and a tones generator 26 connected, by means of a capacity 27, to the sliding contacts 19.

The generator 26 is of the type able to generate a high frequency signal, for example 200 KHz.

The functioning occurs as follows: on each MCPU a series of parameters is memorised on the basis of which the motor connected to the unloading belt is activated with a certain scale of acceleration and for a set time.

Each GCPU 22, on the basis of the instructions received from the central computer 8, processes a command which, appropriately treated is sent from the amplifier 23 along the respective section of bar 20.
This signal, which contains all the information necessary to manage the shuttles which are found to pass in relation to the area of the route controlled by the respective GCPUs, arrives at the receiver 25 where it is appropriately demodulated and sent from the CPUs of the individual shuttle to the respective carriages.

In a preferred embodiment of the invention, the signals sent by the amplifier 23 are eight byte signals; of these eight bytes the first four contain a message with the address of the shuttle to which the command is directed, the address of the carriage which must be activated, a control signal for the advance motor couple and a signal with the code of the operation to be carried out; in particular with a selection code for the unloading modality already memorised in the MCPu and that of the delay time "t" with which the unloading is to be activated.

The next four bytes contain the same complemented information, that is to say an analogous signal to the preceding one but in which all the 1 and 0 have been exchanged between them.

This allows the MCPu to carry out a check on the command received and, if positive, to send a confirmation signal to ground. In this way the MCPu compares the first four bytes with the four subsequent ones and, where they match, activates the tone generator 26 which then produces a high frequency signal for a duration of, for example, 5 milliseconds.

This signal crosses the capacity 27 and, by way of the sliding contacts 19 and the supply bars arrives at the GCPUs. Here the high impedance of the inductor 24 acts such that the signal passes to the tone detector 25 so that the GCPU has confirmation that the command sent has been received correctly.

In the absence of any confirmation signal after a certain time from the sending of the first signal, the GCPu sends a second command analogous to the preceding one, but in which the delay time is varied, reducing it by an interval of Δ"t", equal to the time spent between the sending of the first and second command.

Naturally this operation can be repeated more times, until the shuttle is positioned in relation to the section controlled by a specific GCPu.

The possibility of commanding an activation after t is provided by the fact that the sorter is of a synchronous type and therefore it is possible to provide in advance (for example 500 milliseconds) the operations which must be carried out. This characteristic is of fundamental importance for the two following reasons:

- the possibility of communicating with the capacity to retransmit the message if there are any errors in the transmission (having communicated in advance an action to be carried out after 200 milliseconds and in the absence of confirmation, it is possible to retransmit after 50 milliseconds the same action to be carried out after 150 milliseconds);
- the possibility of delaying the communication of commands which must, for statistical reasons, be carried out in the same instant (if, for example, 10
different actions must be carried out in instant t, the commands could be communicated in the following way:

ACTION 1: within 400 milliseconds;
ACTION 2: within 380 milliseconds;
ACTION 10: within 220 milliseconds.

The invention therefore makes it possible to take advantage of the predictability of the phenomena so as to drastically reduce the frequency band otherwise necessary and to create the prerequisites for an simple and practical application.

In figure 5 the block diagram is given in relation to the management procedure of the MCPU by the ground CPU. It will be clear, at this point, just what the advantages of this invention are.

Due to the fact that it exploits the same supply bars to send signals to the CPUs mounted on the carriages, the number of harnesses needed is drastically reduced.

Claims

1. A sorting apparatus of the type including a plurality of mobile carriages (12) along a fixed route, at least one carriage of each group being provided with an advance motor and there also being provided on each carriage a rotating belt (2) actuated by its own unloading motor (4) and apt to receive an object (3) to be sorted and to unload it along the route, the said advance and unloading motors picking up power supply from feed bars (17, 18) arranged along the route, characterised by the fact that:

- the carriages are assembled in groups;
- each group of carriages includes a CPU (14) which receives command signals and is connected to a plurality of actionings, one of the said actionings controlling the advance motor(s) for the carriage group and each of the others the unloading motor for one of the carriages.

2. Apparatus according to the claim 1, where the transport bars for the unloading signals are sectioned bars (20), each part of the sectioned bar being controlled by a ground CPU (22), in its turn controlled by a central computer.

3. Apparatus according to claims 1 and 2, characterised by the fact that it provides, in relation to each ground CPU (22), a low frequency amplifier able to amplify the unloading command signal and, on the CPU on board of each group of carriages, a high frequency tone generator, connected to the said sectioned bars.
Patentansprüche

1. Sortiervorrichtung mit einer Mehrzahl beweglicher Wagen (12) entlang einem festen Weg, wobei mindestens ein Wagen jeder Gruppe mit einem Vorschubmotor versehen und an jedem Wagen ein umlaufendes Band (2) vorgesehen ist, das durch seinen eigenen Entlademotor (4) betätigt wird und geeignet ist, einen zu sortierenden Gegenstand aufzunehmen und ihn entlang dem Weg abzuladen, wobei die Vorschub- und Entlademotoren ihre Energieversorgung von Versorgungsleisten (17, 18) abnehmen, die entlang dem Weg angeordnet sind, dadurch gekennzeichnet, daß
- die Wagen in Gruppen zusammengefaßt sind;
- jede Gruppe von Wagen eine CPU (14) enthält, die Steuersignale erhält und verbunden ist mit einer Mehrzahl von Aktoren, von denen ein Aktor den Vorschubmotor bzw. die Vorschubmotoren für die Wagengruppe und jeder andere Aktor den Entlademotor für einen der Wagen steuert.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Transportleisten für die Entladesignale unterteilte Leisten (20) sind, wobei jeder Abschnitt der unterteilten Leiste durch eine Grund CPU (22) gesteuert wird, die ihrerseits durch einen Zentralcomputer gesteuert wird.

3. Vorrichtung nach den Ansprüchen 1 und 2, dadurch gekennzeichnet, daß sie mit Bezug auf jede Grund CPU (22) einen Niederfrequenzverstärker zum Verstärken des Entladespeisesignals und an der CPU an Bord jeder Wagengruppe einen Hochfrequenztongenerator enthält, der mit den unterteilten Stäben verbunden ist.

Revendications

1. Appareil de triage du type comprenant une pluralité de chariots (12) mobiles le long d’un itinéraire tracé, au moins un chariot de chaque groupe étant pourvu d’un moteur d’entraînement et étant aussi pourvu sur chaque chariot une bande rotative (2) actionnée par son propre moteur (4) de déchargement et apte à recevoir un objet (3) à trier et à décharger le long de l’itinéraire, lesdits moteurs d’entraînement et de déchargement prélevant de l’alimentation en puissance de barres d’alimentation (17, 18) disposées le long de l’itinéraire, caractérisé par le fait que:
- les chariots sont assemblés par groupes;
- chaque groupe de chariots comprend une unité centrale de traitement (14) qui reçoit des signaux de commande et est connecté à une pluralité de moyens d’actionnement, un desdits moyens d’actionnement contrôlant le(s)
Activation of belt according to modality 2 between 400 ms: $\Delta t_1 = 400$ ms - sec

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LOADING PROCESS

COMMUNICATION MODULE

WAITING FOR RETRY MEASURE $\Delta t$

Activation of belt according to modality 2 - $\Delta t$

($\Delta t_2 = 400$ ms - $\Delta t$)

RECEIVED ACK?

"EXECUTED"
Action removed from list of actions since it has been loaded by the receiver

RETRY

"EXECUTED"

FIG 5"