July 14, 1970 J. C. TURNER 3,520,406

ARTICLE SORTING SYSTEM CONTROLLED BY RADIO FREQUENCY ENERGY SIGNALS

Filed May 13, 1968

FIG. 1

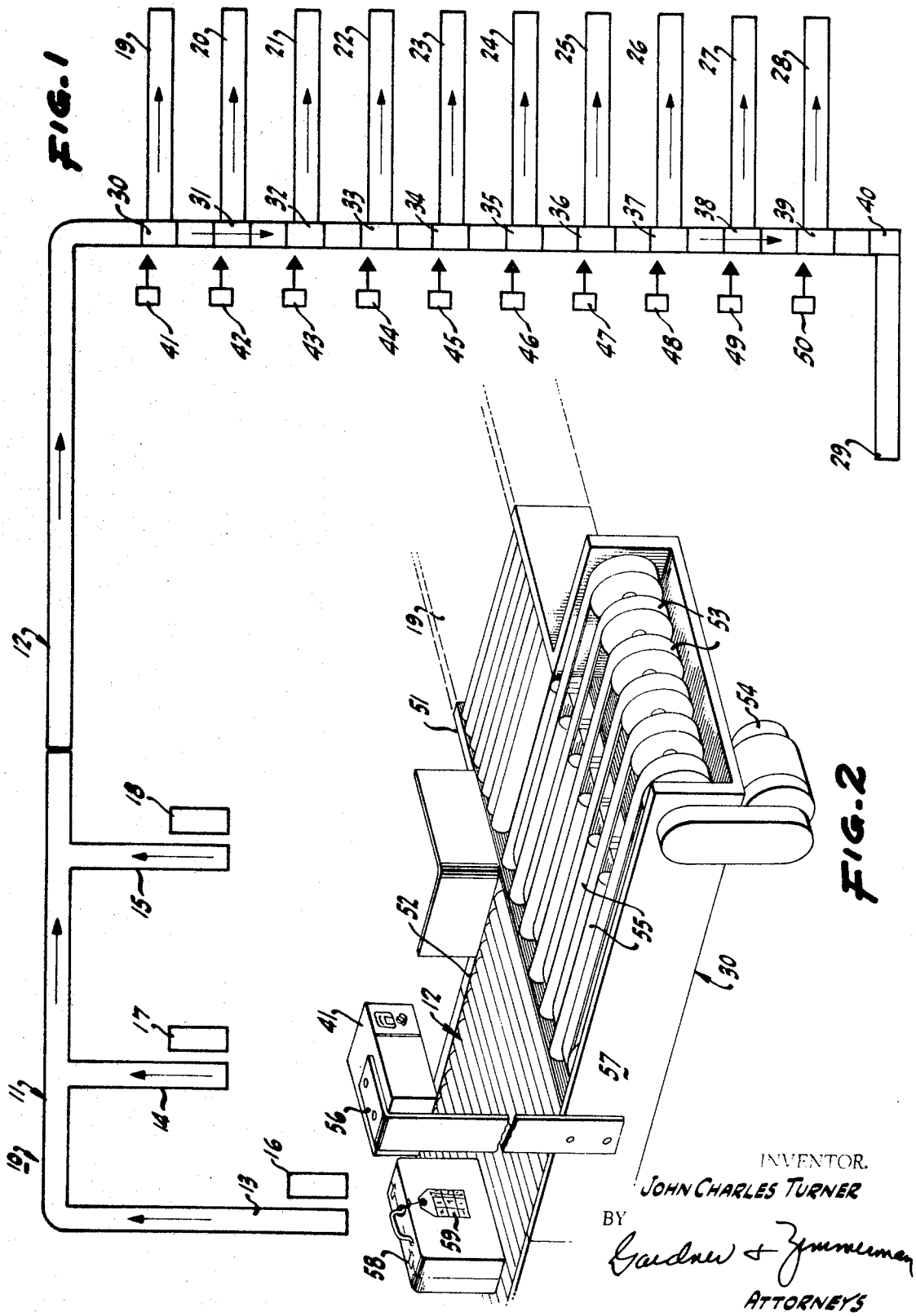

FIG. 2

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United States Patent Office 3,520,406 Patented July 14, 1970

3,520,406

ARTICLE SORTING SYSTEM CONTROLLED BY RADIO FREQUENCY ENERGY SIGNALS

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Filed May 13, 1968, Ser. No. 728,521
Int. Cl. B07c 5/34
U.S. Cl. 209—111.5 2 Claims

ABSTRACT OF THE DISCLOSURE

An article-handling system for processing passenger baggage at airline terminals. A particular form of the system includes a conveyor having both a collection section along which baggage is accumulated and a distribution section providing a plurality of distribution branches or stations respectively corresponding to particular flight destinations and into which baggage is selectively diverted in accordance with the destinations thereof. A plurality of diverters disposed in respective association with the distribution branches are operative selectively to effect diversion thereinto of individual pieces of baggage being advanced along the conveyor. Each piece of baggage carries a tag equipped with a self-identifying responder providing control indicia corresponding to the destination indicated by the tag; and a plurality of interrogation units respectively associated with the diverters are operative to transmit interrogation signals for interception by the responders. Whenever control indicia of a predetermined character answers an interrogation signal, the interrogation unit responsive thereto operates the associated diverter to segregate or divert the piece of baggage carrying such answering responder into the appropriate branch.

This invention relates to an article-handling system in which intermingled articles are distributed in accordance with certain predetermined characteristics so as to collect or group those articles having like characteristics. The invention relates more particularly to a system of this type in which the articles themselves by means of self-identification determine and control such distribution and collection thereof. The system has utility in a variety of environments, and a specific instance thereof is baggage handling and especially the collection and distribution of baggage in airline terminals.

Considering the processing of airline baggage as typifying a use of the invention, it may be noted that the problems of tagging the baggage of departing passengers, collecting or accumulating the baggage from the various check-in counters, and then routing the baggage to stations from which it is finally placed aboard the proper planes to carry it to its destination are becoming more and more intense because of the increasing number of individual flights and the increasing number of passengers carried by each aircraft—several hundred passengers being anticipated for the newest jet planes. The same general problems pertain to distribution of the baggage of deplaning passengers, and the present complexities in this respect will be aggravated by the large masses of passengers deplaning from such newer planes.

The difficulties inherent in the processing of such baggage is more evident when it is appreciated that at present each piece of baggage is completely dormant or inactive, unable to cooperate in reaching its destination (as do airline passengers) except to carry a tag that must be manually inspected at each position along the baggage route at which a change in direction or other selection might be made in routing the baggage toward its destination. Any such change in direction also requires manual attention,

and not only does all this requirement for manual attention prove costly, but error in misdirection due to human omissions and vagaries occurs at an increasing rate.

In view of the foregoing, it is evident that it would be advantageous to have an improved system for handling baggage at airline terminals, and especially a system in which each individual piece of baggage could take an active part in determining the routing therefor necessary to reach its proper destination without the requirement for human intervention; and it is, accordingly, an object of the present invention to provide such an improved system. Another object of the present invention is in the provision of an improved article-handling system in which intermingled articles, respectively equipped with self-identifying responders providing control indicia corresponding to certain predetermined characteristics of the articles, are distributed in accordance with such characteristics in response to the control indicia provided by the responders in answer to interrogation signals directed thereto. Additional objects and advantages of the invention will become apparent hereinafter as the specification develops.

An article-handling system embodying the invention includes a conveyor having a collection section along which articles are accumulated in an intermingled manner unrelated to any group-determining characteristics thereof. The conveyor also has a distribution section providing a plurality of distribution branches or stations respectively corresponding to certain characteristics (flight destinations, for example) by which the articles are to be collected or grouped. A plurality of diverters disposed in respective association with the distribution branches are operative selectively to effect diversion into the branches of individual articles being advanced along the conveyor. Each such article is equipped with a self-identifying responder providing control indicia corresponding to a particular characteristic by which the article is to be grouped; and a plurality of interrogation units respectively associated with the diverters are operative to interrogate the articles as they are advanced by the conveyor. Whenever control indicia of a predetermined character answers an interrogation signal, the interrogation unit responsive thereto actuates the associated diverter causing it to segregate or divert the article equipped with the answering responder into the appropriate distribution branch of the conveyor.

An embodiment of the invention is illustrated in the accompanying drawing, in which:

FIG. 1 is a diagrammatic view of an article-handling system embodying the invention; and

FIG. 2 is a broken perspective view illustrating one of the diverters of the system in association with an interrogation unit.

The particular articles-handling system illustrated in FIG. 1 is intended for use at an airline terminal to process the baggage of departing passengers. The system includes a conveyor **10** comprising a collection section **11** and a distribution section **12**. The collection section **11** has a plurality of supply branches **13**, **14** and **15** feeding thereinto, and such branch conveyors may be located at quite divergent or separated positions throughout the terminal as, for example, the parking garage thereof, street entrance to the terminal, and each of the ticket counters therewithin. It will be appreciated that any convenient number of branch infeed or supply conveyors can be provided each leading either directly or indirectly to the main line of the collection section **11**. As will be brought out more clearly hereinafter, each piece of baggage is tagged before being delivered to the collection section **11** of the conveyor, and tagging stations **16**, **17**

and 18 are shown in respective association with the branch infeed conveyors.

The distribution section 12 of the conveyor 10 has a plurality of distribution branches or stations located therealong respectively representative of particular characteristics by means of which the articles are to be distributed or grouped. In the case of the baggage-handling system illustrated, the distribution branches represent different flights or trip destinations for the baggage, and from such branches the pieces of baggage grouped or collected therealong will be placed upon proper aircraft for transport thereby to the appropriate destination. In the particular system shown, there are ten such distribution branches respectively denoted with the numerals 19 through 28; and a further branch or collection station at the end of the distribution section 12 is also provided so as to collect as a group baggage which has not been diverted into one of the branches 19 through 28.

A plurality of diverters are disposed along the distribution section 12 in respective association with the branches 19 through 28 so as to selectively divert articles of baggage thereinto. Accordingly, there are ten such diverters in the particular baggage-handling system illustrated, and they are respectively denoted with the numerals 30 through 39 and are associated with the branches 19 through 28, respectively. A continuously operative diverter or turn section 40 is provided in association with the branch 29 so as to divert thereinto all articles of baggage not diverted into one of the branches 19 through 28. A plurality of interrogation units are respectively associated with the diverters 30 through 39, and such interrogation units are respectively denoted with the numerals 41 through 50.

The interrogation units are each operative to transmit an interrogation signal across the distribution section 12 of the conveyor so as to be intercepted by the articles of baggage being advanced therealong. As will be explained hereinafter, the interrogation units control operation of the respectively associated diverters and, in this respect, each unit actuates its diverter to cause the same to divert into the associated branch conduit each article of baggage that responds in a predetermined manner to the interrogation signals transmitted by the associated unit. It may be observed that the interrogation signals directed across the distribution section 12 of the conveyor are oriented so as to be intercepted by each piece of baggage just prior to its reaching the diverter associated with the particular interrogation unit so that adequate time is afforded for the interrogation unit to actuate the diverter and thereby cause it to segregate into the associated distribution branch each piece of baggage responding in a predetermined manner to the interrogation signal intercepted thereby.

Evidently, since there is no particular order to the manner in which baggage is fed to the collection section 11 and, therefore, no assurance of spacing between successive articles being advanced therealong, it is advantageous to provide some minimum spacing between successive articles along the distribution section 12 so as to afford sufficient time for each interrogation unit and diverter associated therewith to either divert or pass one article and be reconditioned for interception of the next successive article advanced thereto. Such separation between successive articles may be provided by having the distribution section 12 function at a higher linear velocity than that of the collection section 11; and by way of example, the collection section might have a linear velocity of the order of 100 feet per minute and the distribution section 12 a linear velocity of the order of 200 feet per minute. It will be apparent that the diverters are necessarily operative to accommodate articles at the rate or velocity at which they are advanced by the distribution sceion 12, and the interrogation units may be located with respect to the diverters so as to afford any lead time that may be required for their actuation.

A typical diverter is illustrated in FIG. 2, and for purposes a specific identification may be taken to be the aforementioned diverter 30. It should be noted, however, that each of the diverters 30 through 39 may be identical and, correspondingly, the interrogation units 41 through 50 may all be identical except for the particular interrogation signals respectively transmitted thereby.

The diverter 30 may be completely conventional and can be any one of a number of selective transfers such as the Automatic Diverter Transfer sold by the Stewart-Galpat Corporation of Zanesville, Ohio. Accordingly, and as shown in FIG. 2, the diverter 30 has a somewhat T-shape with the stem 51 thereof communicating with the distribution branch 19 so as to deliver articles thereto and the crossbar 52 communicating at each end thereof with the main line of the distribution section 12. The crossbar 52 comprises a plurality of spaced apart conveyor belts 53 continuously driven by a motor and drive train 54 so that the belts 53 travel from left to right along the upper stretches thereof, as viewed in FIG. 2.

Aligned with the stem 51 and defining the junction thereof with the crossbar 52 are a plurality of rollers 55 that are adapted to be positively driven and are alternately disposed between the spaced apart belts 53 and are selectively movable between a lower position in which they are positioned below the belts so as not to interfere with articles of baggage being advanced thereby, and the elevated position illustrated in FIG. 2 in which they project above the belts 53 and are therefore operative to engage such article of baggage and divert the same from movement along the bar 52 and main line of the conveyor section 12 into the stem 51 of the diverter and onto the associated distribution branch 19. The diverter rollers 55 are selectively movable between the lower, retracted and upper, operative positions thereof by mechanism provided for this purpose which is responsive to external command such as provided by a control switch. Since the diverter 30 is conventional, no further details concerning its construction and operation appear necessary.

Associated with the diverter 30 is the aforementioned interrogation unit 41 which is contained within a casing supported above the diverter 30 adjacent the entrance thereto by a support structure in the form of an L-shaped bracket 56 bolted or otherwise secured to the casing of the unit 41 and fixedly secured to the side wall structure 57 of the diverter. As indicated hereinbefore, all of the interrogation units 41 through 50 may be identical except for the particular interrogation signals respectively provided thereby and, for example, such unit might be a Sensormatic Detector commercially available from The JKR Corporation of Akron, Ohio. The details of such unit are set forth in U.S. Pat. No. 2,774,060, to which reference may be made for such details.

Interrogation units of this type in effect transmit or supply interrogation signals having a predetermined frequency usually in the megacycle range and often in the range of from 300 to 5,000 megacycles. In the particular system shown in FIG. 1, the interrogation units 41 through 50 will transmit interrogation signals having different frequencies as, for example, frequencies differing from each other in steps of 100 megacycles although the particular frequencies employed are not critical. It may be observed that in a baggage-handling system for airline terminals, it may be convenient or desirable to change from time to time the flight destinations represented by one or more of the distribution branches 19 through 28; and such change is most expeditiously accomplished by changing the frequency of the interrogation signal transmitted by the associated interrogation unit. This could be done either by interchanging interrogation units in those cases in which the units are non-adjustable or by selectively varying the frequency when multiple-frequency units are provided. In any event, the interrogation units are constructed and arranged so that when a response of a predetermined character is sensed in answer to the

interrogation signals transmitted thereby, the unit actuates the control switch for the associated diverter to elevate the rollers **55** thereof and thereby divert the responding article to the distribution branch connected with such diverter. Each interrogation unit includes a relay or solenoid that is energized in response to the sensing of an answering signal of predetermined character; and accordingly, to interconnect the unit **41** with the diverter **30**, it is only necessary to provide a conventional interconnection between such relay or solenoid and the control switch of the diverter.

Each article of baggage being advanced by the distribution conveyor **12** is equipped with a responder adapted to provide control indicia corresponding to the destination of the article, and this is most conveniently provided by incorporating such responder in the tags customarily attached to each article of baggage and which also designate by visual identification the destination intended for the article. Thus in FIG. 2, a typical article of baggage **58** is shown advancing along the conveyor section **12** toward the diverter **30**, and it carries a tag **59** having incorporated therein a responder providing a control indicia which may be sensed by one of the interrogation units **41** through **50**. The particular form of responder will depend upon the character of the interrogation unit employed; and in the event of the interrogation units being of the type disclosed in the aforementioned U.S. Pat. No. 2,774,060, the responder may be a tuned or resonant circuit and can take the form of an electric conductor of predetermined length printed onto the tag **59**. Again, for details concerning such responder, reference may be made to the disclosure comprised by the issued patent.

By way of example, if the distribution branch **19** is intended to collect articles of baggage thereon having say Chicago for a destination, all of the articles of baggage intended for Chicago will carry a tag **59** corresponding to such destination and such tags will have been placed upon the article at one of the stations **16** through **18** in the usual manner. The tag **59** will, therefore, contain a responder providing control indicia of predetermined character which, for example, might be a resonant circuit tuned to a frequency of 300 megacycles. Correspondingly, the interrogation unit **41** would continuously transmit signals at such frequency of 300 megacycles. When each Chicago-bound article **58** is advanced by the distribution section **12** into the range of the signals transmitted by the unit **41** so as to intercept such signals, the consequent change in load on the circuitry within the unit **41** is sensed thereby so as to energize the associated relay or solenoid and thereby elevate the rollers **55** to divert such responding article of baggage onto the distribution branch **19**.

Each of the interrogation units and diverter associated therewith will function in exactly the same manner to divert each article of baggage carrying a responder-equipped tag providing control indicia corresponding to the flight destination represented by the interrogation unit, diverter and distribution branch associated therewith. As stated hereinbefore, the flight destinations represented by any distribution branch can be changed by shifting the frequency of the interrogation signals provided by the associated interrogation unit to a frequency descriptive of a different flight destination or by interchanging diverters, as the case may be. The distribution branch **29** and continuously operative diverter or turn unit **40** associated therewith are provided to collect any articles of baggage that may fail to carry a suitable baggage tag, that for some reason might fail to be sensed by the appropriate interrogation unit therefor, which might be intended for flights leaving at some future date, etc., and must be manually inspected and directed to the appropriate locations therefor.

The described baggage-handling system requires the use of no carts or other carriers for the individual pieces of baggage because no special orientation of the articles is required in order to be sensed by the appropriate interrogation units. The system lends itself to passenger tagging of the baggage since it is only necessary to select a tag for the proper destination and attach it to the article of baggage in any manner since, as stated, precise positioning of the article of baggage or the tag thereon is not essential. In a physical sense, the distribution section **12** could extend along a tunnel or passageway underlying the walkways from the main terminal building to the various loading stations, and the distribution branches could extend directly to the service area associated with the loading stations. All of the conveyor mechanisms may be completely conventional and can be of the type now in use to transport baggage from one location to another at an airline terminal. In such event, the conveyor mechanisms ordinarily will comprise endless belts which are more suitable to handling odd-shaped pieces of baggage than are roller-type conveyors.

The system is applicable to the handling and distribution of articles and materials generally as well as for processing baggage at airline terminals and, for example, the distribution of parts and components in various manufacturing plants (an automobile assembly line, for example) is another typical use. Also, various signal sensing or interrogation arrangements might be used in place of the signal transmitter and tuned-circuit responder described, as for example magnetic, light, and sound systems. In any event, the particular articles being processed are self-identifying, and therefore take an active part in selecting the routes leading to their approximate destinations, and accomplish such selection wholly without human intervention.

While in the foregoing specification an embodiment of the invention has been set forth in considerable detail for purposes of making a complete disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in such details without departing from the spirit and principles of the invention.

What is claimed is:

1. In an article-handling system in which intermingled articles are separated by self-identification into a plurality of groups in accordance with certain group-determining characteristics, a conveyor having a collection section adapted to receive articles and advance the same in an intermingled succession thereof having no specific relation to their group-determining characteristics, a plurality of infeed branches respectively connected with said collection section so as to deliver articles thereto, said conveyor having also a distribution section for receiving such succession of intermingled articles from said collection section and being equipped with a plurality of distribution branches defining a plurality of assembly stations respectively corresponding to such groups and being adapted to have articles diverted thereto, mechanism providing a velocity differential between said conveyor sections with said distribution section having the greater velocity so as to enforce a minimum spacing between substantially all successive articles advanced along said distribution section, a plurality of diverters disposed along said distribution section in respective association with said distribution branches and each being selectively operative to divert articles into the associated distribution branches, each of said diverters having transversely oriented conveyor segments the first of which includes a plurality of spaced apart endless belts disposed in substantial alignment with said distribution section and effectively comprising a portion thereof and the second of which includes a plurality of power driven rollers interposed between said belts in substantial alignment with the associated distribution branch and selectively displaceable between an inoperative retracted position in which articles can be transported thereover by said first conveyor segment and an extended position for intercepting an article advanced thereto to divert the same into the associated distribution branch, means associated with each diverter for raising and lowering said second conveyor segment thereof be-

tween its extended and retracted positions, guide structure disposed along said distribution section adjacent each of said distribution branches for guiding the movement of any article diverted thereinto, a plurality of interrogation units for interrogating such articles and being respectively associated with said diverters for controlling operation of the movable components thereof in response to control indicia supplied by such articles, a plurality of inverted generally L-shaped support structures secured to said conveyor at spaced apart locations along said distribution section respectively adjacent said diverters and having substantailly horizontal legs extending over said distribution section and respectively supporting said interrogation unit in spaced relation with the path of movement of articles along said distribution section, a plurality of responders respectively carried by tags to be attached to articles and respectively providing control indicia specifically descriptive of the ground-determining characteristics of the particular article to which it is attached so as to acknowledge the interrogation of one particular interrogation unit and thereby cause it to actuate the diverter associated therewith to divert the responding articles into the associated distribution branch and its assembly station, and an accumulator station connected with said distribution section adjacent the terminus thereof for receiving articles not diverted into one of said distribution branches,

each of said interrogation units being operative to transmit radio frequency signal information in the megacycle range for interception by the successive articles along said distribution section, each of said responders comprising a circuit responsive to the frequency of a particular interrogation unit so as to respond only to the signal information thereof, and the signal information transmitted by said interrogation units being separated one from another by steps of the order of 100 megacycles.

2. The article-handling system of claim **1** characterized by being adapted to handle baggage at an airline terminal, and in which the aforesaid group-determining characteristics are flight destinations for the baggage articles.

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U.S. Cl. X.R.

214—11