(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 200035544 B2
(10) Patent No. 770962

(54) Title
Automatic tray-handling system for sorter

(51)6 International Patent Classification(s)
B07C 003/00

(21) Application No: 200035544

(22) Application Date: 2000.03.08

(87) WIPO No: WO00/53344

(30) Priority Data

(31) Number	(32) Date	(33) Country
60/123484	1999.03.09	US

(43) Publication Date : 2000.09.28
(43) Publication Journal Date : 2000.11.23
(44) Accepted Journal Date : 2004.03.11

(71) Applicant(s)
Siemens Aktiengesellschaft

(72) Inventor(s)
David Harley Cotter; Gerald A. Brouwer; Ricardo N Schiesser ; Douglas E. Olson; Scott W. Kalm

(74) Agent/Attorney
Griffith Hack,GPO Box 1285K,MELBOURNE VIC 3001

(56) Related Art
US 5959868

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B07C 3/00 — A1

(11) International Publication Number: **WO 00/53344**

(43) International Publication Date: 14 September 2000 (14.09.00)

(21) International Application Number: PCT/EP00/02002

(22) International Filing Date: 8 March 2000 (08.03.00)

(30) Priority Data:
60/123,484 9 March 1999 (09.03.99) US

(71) Applicant *(for all designated States except US)*: ~~MAN-NESMANN~~ AG [DE/DE]; ~~Mannesmannufer 2, D-40213 Düsseldorf (DE)~~. Siemens Aktiengesellschaft Wittelsbacherplatz, 80 333 München (DE)

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: COTTER, David, Harley [US/US]; 5071 Leonard Avenue, N.W. Coopersville, MI 49404 (US). BROUWER, Gerald, A. [US/US]; 3935 Aaron, S.W. Grandville, MI 49418 (US). SCHIESSER, Ricardo, N. [BR/US]; 4091 Omaha, S.W. Grandville, MI 49418 (US). OLSON, Douglas, E. [US/US]; 6171 Dunbarton, S.E. Grand Rapids, MI 49546 (US). KALM, Scott, W. [US/US]; 6328 Courtland Drive, Plano, TX 75093 (US).

(74) Agent: MEISSNER, Peter, E.; Patentanwaltsbüro Meissner & Meissner, Hohenzollerndamm 89, D-14199 Berlin (DE).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

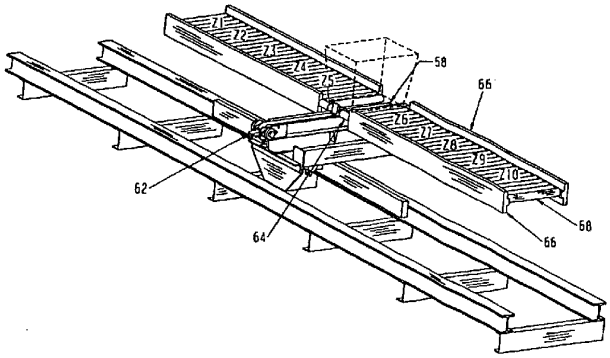
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

AUSTRALIAN PATENT OFFICE R.92 bis

AUSTRALIAN PATENT OFFICE SEC 113

(54) Title: AUTOMATIC TRAY-HANDLING SYSTEM FOR SORTER



(57) Abstract

An automatic tray-handling system for use with a mail sorter (26) having a plurality of tray supporters, comprises a transporter (50) having a conveying surface (56) and an insertion/extraction assembly (58); and respective feed (44a, 44b) and discharge conveyors (46a, 46b) adapted to feed empty trays (38) to the transporter conveying surface (56) and receiving at least partially full trays (38) from the transporter conveying surface. The insertion/extraction assembly (58) is adapted to insert empty trays (38) to tray support areas and remove at least partially full trays (38) from tray support areas. The conveying surface operational is adapted to receive empty trays (38) from the feed conveyor (44a, 44b) and at least partially full trays (38) from the insertion/extraction assembly (58). Moreover from the conveying surface empty trays are dischargeable to the insertion/extraction assembly (58) and to the discharge conveyor (46a, 46b).

AUTOMATIC TRAY-HANDLING SYSTEM FOR SORTER

The present invention relates to tray-handling equipment for removing full or partially full trays from a mail sorter and replenishing the mail sorter with empty trays. The present invention is particularly useful with flat mail sorters.

A flat mail sorter of the type marketed by Mannesmann Dematic Rapistan Corp. under Model No. FSM-100 is commercially available. Such flat sorter sorts flat mail, such as magazines, large envelopes, and the like to trays, typically plastic trays, each one devoted to a particular zip code. There is a requirement that full trays be removed from their respective support shelf and replaced with an empty tray. There is also a requirement that an occasional sweep operation be accommodated. A sweep operation is one in which all of the trays are removed from their respective shelves, even if only partially full. The empty shelves are then stocked with empty trays.

This tray-handling function is traditionally performed manually. It is desirable to automate this manual function. In addition to performing the functions carried out manually, it is desirable that an automatic tray-handling system allow manual tray replacement should the automatic tray-handling system be unusable for whatever reason.

An automatic tray-handling system is disclosed in US 5959868. The system comprises a transporter with a conveying surface and an insertion/extraction station for inserting and removing trays and a discharge conveyor. A transfer device moves the collecting containers horizontally and vertically between the delivery locations and the belt conveyor, which is positioned at a level below the delivery locations.

In a first aspect, the present invention provides an automatic tray-handling system for use with a mail

sorter having a plurality of tray support areas, comprising:

a transporter having a conveying surface and an insertion/extraction assembly; and

respective feed and discharge conveyors adapted to feed empty trays to the transporter conveying surface and receive at least partially full trays from the transporter conveying surface; the transporter conveying surface being configured to be generally horizontally aligned with the tray support areas; the insertion/extraction assembly adapted to insert empty trays to tray support areas and remove at least partially full trays from tray support areas; the conveying surface operational to receive empty trays from the feed conveyor and at least partially full trays from the insertion/extraction assembly, the conveying surface operational to discharge empty trays to the insertion/extraction assembly and to the discharge conveyor.

In a second aspect, the present invention provides a method of selectively and automatically replacing at least partially full trays on a mail sorter having a plurality of tray support areas, the method comprising:

providing a transporter having a conveying surface and an insertion/extraction assembly;

supplying a plurality of empty trays on the conveying surface;

moving the transporter to position the insertion/extraction assembly adjacent a tray that is at least partially full;

extracting the at least partially full tray with the insertion/extraction assembly;

positioning the at least partially full tray on the conveying surface; and

inserting an empty tray from the conveying surface to the tray support areas with the

insertion/extraction assembly.

In a third aspect, the present invention provides a method of automatically sweeping substantially all trays from mail sorter tray support areas and automatically substantially filling the tray support areas with empty trays on a mail sorter having a plurality of tray support areas, comprising:

providing a transporter having a conveying surface and an insertion/extraction assembly;

moving the transporter to sequentially position the insertion/extraction assembly adjacent tray support areas; and

removing trays from the tray support areas with the insertion/extraction assembly while positioning the removed trays on the conveying surface.

In a fourth aspect, the present invention provides an automatic tray-handling system for use with a mail sorter having a plurality of tray support areas, the system comprising:

a transporter;

an insertion and extraction assembly; and

respective feed and discharge conveyors adapted to feed empty trays to the transporter and receive at least partially full trays from the transporter, the transporter being configured to be generally horizontally aligned with the tray support areas, the insertion and extraction assembly being adapted to insert empty trays to tray support areas and remove at least partially full trays from tray support areas, the transporter being operable to receive empty trays from the feed conveyor and at least partially full trays from the insertion and extraction assembly, the transporter being operable to discharge empty trays to the insertion and extraction assembly and to the discharge conveyor, the transporter being generally horizontally aligned with the tray support areas.

In a fifth aspect, the present invention provides a method of selectively and automatically replacing at least partially full trays on a mail sorter having a plurality of tray support areas, the method comprising:

providing a transporter and an insertion and extraction assembly;

supplying a plurality of empty trays on the transporter;

moving the transporter to position the insertion and extraction assembly adjacent to a tray support area supporting a tray that is at least partially full; and

extracting the at least partially full tray with the insertion and extraction assembly, positioning the at least partially full tray on the transporter and inserting an empty tray from the transporter to the tray support area with the insertion and extraction assembly.

In a sixth aspect, the present invention provides an automatic tray-handling system for use with a mail sorter having a plurality of tray support areas, the system comprising:

a transporter;

an insertion and extraction assembly; and

respective feed and discharge conveyors adapted to feed empty trays to the transporter and receive at least partially full trays from the transporter, the insertion and extraction assembly being adapted to insert empty trays to tray support areas and remove at least partially full trays from tray support areas, the transporter being operable to receive empty trays from the feed conveyor and at least partially full trays from the insertion and extraction assembly, the transporter being operable to discharge empty trays to the insertion and extraction assembly and to the discharge conveyor, the transporter being movable to position the insertion and extraction assembly at the tray support areas.

Preferred embodiments of the present invention will now be described, by way of example only, with

reference to the accompanying drawings, in which:

Fig. 1 is a plan view of a flat mail sorter including an automatic tray-handling system, according to the invention;

Fig. 2 is a side elevation taken along the lines II-II in Fig. 1;

Fig. 3 is a sectional view taken along the lines III-III in Fig. 1;





Fig. 4 is a plan view of the apparatus shown in Fig. 2;
Fig. 5 is an enlarged view similar to Fig. 3 showing a manual operator utilizing the flat sorter when the automatic tray-handling system is not in operation;
Fig. 6 is a perspective view taken generally from the sorter location looking outwardly of an automatic tray-handling system, according to the invention;
Fig. 7 is the same view as Fig. 5 with the automatic tray-handling system operational;
Fig. 8 is an enlargement of the area shown at VIII in Fig. 7;
Fig. 9 is the same view as Fig. 2 showing the automatic tray-handling system;
Fig. 10 is the same view as Fig. 9, but enlarged;
Fig. 11 is a view taken along the lines XI-XI in Fig. 9;
Fig. 12 is a sectional view taken along the lines XII-XII in Fig. 11;
Fig. 13 is a sectional view taken along the lines XIII-XIII in Fig. 11;
Fig. 14 is a view taken along the lines XIV-XIV in Fig. 13;
Fig. 15 is a view taken along the lines XV-XV in Fig. 14;
Fig. 16 is a perspective view of a movable stop useful with the invention;
Fig. 17 is an end elevation of the stop in Fig. 16;
Fig. 18 is a view taken along the lines XVIII-XVIII in Fig. 17;
Fig. 19 is a view taken along the lines XIX-XIX in Fig. 18;
Fig. 20 is an enlarged side elevation of an automatic tray-handling system, according to the invention; and
Fig. 21 is an extension of Fig. 20 as viewed to the right in Fig. 20.

Referring now specifically to the drawings, and the illustrative embodiments depicted therein, a flat mail sorter system 25 includes a flat mail sorter generally illustrated at 26 and an automatic tray-handling system generally illustrated at 28. The automatic tray-handling system includes two substantially identical portions including automatic tray-handling subsystem 30a and automatic tray-handling subsystem 30b, each to service identical portions of the sorter system. For ease of description, only one automatic tray-handling subsystem will generally be described.

Flat mail sorter 26 is a Model FSM-100 flat sorter which is commercially available for Mannesmann Dematic Rapistan Corp. in Grand Rapids, Michigan. It includes one or more injectors 32 which inject mail into buckets 34 arranged in a carousel, each of

which carries one piece of mail. A computer (not shown) causes the bucket 34 to open above a chute 36 causing the mail to be deposited in a tray 38. Tray 38 is positioned on a shelf 40 which has a slot or channel in its bottom support surface (not shown).

Automatic tray-handling subsystem 28 may include a stacker area 42 which feeds empty trays onto a feed conveyor 44a associated with tray-handling subsystems 30a and 44b associated with tray-handling subsystem 30b. Automatic tray-handling system 28 additionally includes a discharge conveyor 46a associated with tray-handling subsystems 30a and discharge conveyor 46b associated with tray-handling subsystem 30b. A label printer and application 48a is positioned adjacent discharge conveyor 46a and a label printer and application 48b is located adjacent discharge conveyor 46b. Such printer and applicators are commercially available from numerous sources. A reject conveyor 50a extends from discharge conveyor 46a opposite label printer and applicator 48a in order to receive trays whose labels cannot be read by a scanner positioned adjacent the label printer and application. A reject conveyor 50b extends from discharge conveyor 46b adjacent label printer and applicator 48b for the same purpose. Trays which make it past reject conveyors 50a, 50b are discharged to the right as illustrated in Fig. 1.

Automatic tray-handling system 30a includes a transporter 50 having a carriage 52 which travels laterally on a set of rails 54, a conveyor assembly 56 supported on carriage 52, and an insertion/extraction assembly 58 operatively associated with conveyor 56. Preferably, insertion/extraction assembly 58 is positioned in the general center of conveyor 56.

Insertion/extraction assembly 58 includes a belt 60, which is preferably a cog belt, which is precisely controlled by a servo motor (not shown). Up to four attachments 62 are substantially equally spaced along belt 60 and perform the function of inserting trays from conveyor 56 to a shelf 40 and extracting a tray from a shelf 40 to conveyor 56. In particular, as viewed in Fig. 7, a tray is inserted to shelf 40 by rotating belt 60 in a counterclockwise fashion causing attachment 62 to engage the tray and slide the tray to the left as viewed in Fig. 7. In order to extract a tray from shelf 40 and move the tray onto conveyor 56, belt 60 is rotated clockwise, as viewed in Fig. 7, causing the tray to move from shelf 40 to the right to conveyor 56. A pair of passive rollers 64 assist in the transfer motion between conveyor 56 and shelf 40.

Conveyor 56 includes a frame 66 and a plurality of motorized rollers 68 positioned between the frame members. Preferably, a certain number of rollers 68 are motorized rollers of the type which are commercially available from Interroll and other manufacturers with the remaining rollers being passive rollers coupled to the motorized rollers in a conventional manner. Rollers 68 are arranged in five zones on each side of insertion/extraction assembly 58. The rollers in each zone are operated in unison and are capable of movement in both lateral directions. In particular, rollers 68 are arranged in the illustrated embodiment in 10 zones (Fig. 6). Zones Z1-Z5 are arranged to the right of insertion/extraction assembly 58 as viewed in the direction looking at flat mail sorter 26. Zones Z6-Z10 are located to the left of insertion/extraction assembly 58 as viewed looking toward flat mail sorter 26.

Carriage 52 receives electrical power from a commercially available power takeoff 70 and receives data signals from an infrared communication link (not shown). A pair of wheels 72 provide primary support for carriage 52 as it rides along one rail 54. Balancing rollers 74 engage the other rail 54 in order to prevent tipping of carriage 52. Carriage 52 is transported along rails 54 by a cog belt 56 whose ends are attached to carriage 52. A stationary servo motor 78 drives cog belt 76 in a manner which precisely positions carriage 52 at a location under the control of a computer-based control (not shown). A pair of bumpers or buffers 80 prevent carriage 52 from traveling off rails 54 in the event of a breakdown of the control system.

The automatic tray-handling system operates as follows. During a non-sweep operation of system 25; i.e., when full trays are being removed and replaced with empty trays, empty trays will be initially positioned in zones Z6-Z10 of transporter 50. When mail sorter 26 indicates that a particular tray on a shelf 40 is full, carriage 52 is moved in order to position insertion/extraction assembly 58 juxtaposed with the full tray. Belt 60 is actuated in order to extract the tray which is then transported by conveyor 56 to zone Z1. An empty tray is moved from zone Z6 into juxtaposition with insertion/extraction assembly 58 which then inserts the empty tray onto the shelf from which the full tray was removed. When the next full tray is handled, the full tray is removed by insertion/extraction assembly 58 and transported by conveyor 52 to zone Z2. The empty tray that was in zone Z7 is inserted by insertion/extraction assembly 58 onto the empty shelf. This process is repeated until full trays are present on zones Z1-Z5 and

zones Z6-Z10 are empty. Carriage 52 is then transported to a position juxtaposed with discharge conveyor 46b. Zones Z1-Z5 are actuated to transport the full trays from conveyor 56 to discharge conveyor 46b. Carriage 52 is then transported into a position juxtaposed with feed conveyor 44b. Conveyor 56 is then actuated in order to transport five empty trays onto zones Z6-Z10. Transporter 50 is now ready for replacing more full trays with empty trays and transporting the full trays to discharge conveyor 46b.

The second mode of operation occurs when it is desired to sweep flat mail sorter 26 of all trays whether full or partially full. During the sweep mode, transporter 50 starts out with no trays on conveyor 56. Carriage 52 is sequentially moved along the first 10 shelves and trays, whether full or partially full, are sequentially loaded onto conveyor 56 until all zones Z1-Z10 are full. Carriage 52 is then transported into a position juxtaposed with discharge conveyor 46b and all 10 trays are discharged. This process is carried out until all full and partially full trays are removed from flat mail sorter 26. Carriage 52 is then juxtaposed with feed conveyor 44a and 10 empty trays are positioned on conveyor 56. Carriage 52 then moves along the first 10 shelves and insertion/extraction assembly 58 positions empty trays on the 10 shelves. Carriage 52 then returns to feed conveyor 44a in order to receive 10 additional empty trays which are then placed on the next 10 shelves. This process is carried out until all shelves are filled with empty trays. Alternatively, the steps of removing 10 partially full trays could be immediately followed by replacing those shelves with empty trays.

Carriage 52 may also include one or more movable gates 82 on one or both sides of insertion/extraction assembly 58. Gate 82 is vertically actuated by an actuator 84. The purpose of gate 82 is in order to square up a tray 38 prior to insertion of that tray onto a shelf 40. Thus, gate or gates 82 are raised by actuator 84 after a tray has been moved by conveyor 56 into position on insertion/extraction 58 but prior to insertion of the tray on the juxtaposed shelf 40. After the tray is inserted, actuator 84 retracts the gate 82.

As can be seen in Fig. 5, an operator M can easily access trays 38 on shelves 40 when automatic tray-handling system 28 is not operational. In such mode, transporter 50 would be moved to a position away from the sorter. The only portion of the tray-handling system which operator M would need to work around are rails 54, which pose only a minor obstacle to the operator. Therefore, automatic tray-handling system 28 conveniently accommodates manual tray-handling, when necessary.

It should be understood that although the invention is illustrated for use with 10 trays positioned on conveyor 56, the system could be designed to handle fewer than 10 or more than 10 trays. Furthermore, depending upon the configuration of the flat mail sorter, it could be desirable to stack multiple conveyors 56 and insertion/extraction assemblies 58 on top of each other in order to service trays which are stacked on multiple vertically arranged shelves.

Throughout this specification and the claims, the words "comprise", "comprises" and "comprising" are used in a non-exclusive sense, except where the context requires otherwise.

It is to be clearly understood that any reference herein to a prior art publication does not constitute an admission that the document forms part of the common general knowledge in the art in Australia or in any other country.

List of reference-numbers

25 flat mail sorter system
26 flat mail sorter
28 automatic tray-handling subsystem
30a tray-handling subsystem
30b tray-handling subsystem
32 injector
34 buckets
36 chute
38 tray
40 shelf
42 stacker area
44a feed conveyor
44b feed conveyor
46a discharge conveyor
46b discharge conveyor
48a lable printer and application
48b lable printer and application
50 transporter
50a reject conveyor
50b reject conveyor
52 carriage
54 set of rails
56 conveyor assembly
58 insertion/extraction assembly
60 belt
62 attachments
64 passive rollers
66 frame
68 rollers
70 takeoff
72 pair of wheels
74 balancing rollers
76 cog belt

78 servo motor
80 buffers
82 gate
84 actuator

M operator
Z1-Z10 zone

Claims:

1. An automatic tray-handling system for use with a mail sorter having a plurality of tray support areas, comprising:

a transporter having a conveying surface and an insertion/extraction assembly; and

respective feed and discharge conveyors adapted to feed empty trays to the transporter conveying surface and receive at least partially full trays from the transporter conveying surface; the transporter conveying surface being configured to be generally horizontally aligned with the tray support areas; the insertion/extraction assembly adapted to insert empty trays to tray support areas and remove at least partially full trays from tray support areas; the conveying surface operational to receive empty trays from the feed conveyor and at least partially full trays from the insertion/extraction assembly, the conveying surface operational to discharge empty trays to the insertion/extraction assembly and to the discharge conveyor.

2. A system as claimed in claim 1 wherein the transporter includes a carriage which supports the conveying surface and the insertion/extraction assembly and which is moveable between the feed and discharge conveyors and the tray support areas of the mail sorter.

3. A system as claimed in claim 1 or claim 2 wherein the insertion/extraction assembly comprises an endless member which is moveable in one direction to insert trays on the tray support areas and in an opposite direction to remove trays from the tray support areas.

4. A system as claimed in claim 3 further comprising a plurality of attachments on the endless

member to apply a force to a tray on the endless member.

5. A system as claimed in any one of the preceding claims further comprising at least one gate adjacent the insertion/extraction assembly adapted to align a tray prior to insertion on a tray support area.

6. A system as claimed in any one of the preceding claims wherein the conveying surface comprises a plurality of rollers which are arranged in zones and which are selectively driven in opposite directions.

7. A system as claimed in claim 6 wherein at least some of the rollers are motorised rollers.

8. A system as claimed in any one of the preceding claims wherein the transporter is movable to position the insertion/extraction assembly at the tray support areas.

9. A method of selectively and automatically replacing at least partially full trays on a mail sorter having a plurality of tray support areas, the method comprising:

providing a transporter having a conveying surface and an insertion/extraction assembly;

supplying a plurality of empty trays on the conveying surface;

moving the transporter to position the insertion/extraction assembly adjacent a tray that is at least partially full;

extracting the at least partially full tray with the insertion/extraction assembly;

positioning the at least partially full tray on the conveying surface; and

inserting an empty tray from the conveying surface to the tray support areas with the

insertion/extraction assembly.

10. A method as claimed in claim 9 further comprising juxtaposing the transporter conveying surface with a discharge conveyor to discharge at least partially full trays from the conveying surface.

11. A method as claimed in claim 10 further comprising juxtaposing the transporter conveying surface with a feed conveyor to receive empty trays on the conveying surface.

12. A method as claimed in any one of claims 9 - 11 further comprising:

sweeping substantially all trays from the mail sorter tray support areas; and

substantially filling the tray support areas with empty trays, including moving the transporter to sequentially position the insertion/extraction assembly adjacent tray support areas and removing trays from the tray support areas with the insertion/extraction assembly while positioning the removed trays on the conveying surface.

13. A method as claimed in claim 12 further comprising juxtaposing the transporter conveying surface with a discharge conveyor to discharge the removed trays from the conveying surface.

14. A method as claimed in claim 13 further comprising juxtaposing the transporter conveying surface with a feed conveyor to substantially fill the transporter conveying surface with empty trays.

15. A method as claimed in claim 14 further comprising moving the transporter to sequentially position the insertion and extraction assembly adjacent empty tray

support areas and inserting trays from the conveying surface with the insertion and extraction assembly to the empty tray support areas.

16. A method of automatically sweeping substantially all trays from mail sorter tray support areas and automatically substantially filling the tray support areas with empty trays on a mail sorter having a plurality of tray support areas, comprising:

providing a transporter having a conveying surface and an insertion/extraction assembly;

moving the transporter to sequentially position the insertion/extraction assembly adjacent tray support areas; and

removing trays from the tray support areas with the insertion/extraction assembly while positioning the removed trays on the conveying surface.

17. A method as claimed in claim 16 further comprising juxtaposing the transporter conveying surface with a discharge conveyor to discharge the removed trays from the conveying surface.

18. A method as claimed in claim 16 further comprising juxtaposing the transporter conveying surface with a feed conveyor to substantially fill the transporter conveying surface with empty trays.

19. A method as claimed in claim 18 further comprising moving the transporter to sequentially position the insertion/extraction assembly adjacent empty tray support areas and inserting trays from the conveying surface with the insertion/extraction assembly to the empty tray support areas.

20. An automatic tray-handling system for use with a mail sorter having a plurality of tray support

areas, the system comprising:

a transporter;

an insertion and extraction assembly; and

respective feed and discharge conveyors adapted to feed empty trays to the transporter and receive at least partially full trays from the transporter, the transporter being configured to be generally horizontally aligned with the tray support areas, the insertion and extraction assembly being adapted to insert empty trays to tray support areas and remove at least partially full trays from tray support areas, the transporter being operable to receive empty trays from the feed conveyor and at least partially full trays from the insertion and extraction assembly, the transporter being operable to discharge empty trays to the insertion and extraction assembly and to the discharge conveyor, the transporter being generally horizontally aligned with the tray support areas.

21. A system as claimed in claim 20 wherein the transporter is movable to position the insertion and extraction assembly adjacent to the tray support areas of the mail sorter.

22. A system as claimed in claim 20 or claim 21 wherein the transporter includes a carriage which supports a conveying surface and the insertion and extraction assembly and which is movable between the feed and discharge conveyors and the tray support areas of the mail sorter.

23. A system as claimed in claim 22 wherein the conveying surface comprises a plurality of rollers which are arranged in zones and which are selectively driven in opposite directions.

24. A system as claimed in claim 23 wherein at least some of the rollers are motorised rollers.

25. A system as claimed in any one of claims 20 - 24 wherein the insertion and extraction assembly comprises an endless member which is movable in one direction to insert trays on the tray support areas and in an opposite direction to remove trays from the tray support areas.

26. A system as claimed in claim 25 further comprising a plurality of attachments on the endless member to apply a force to a tray on the endless member.

27. A system as claimed in any one of claims 20 - 26 wherein the transporter is movable to position the insertion and extraction assembly at the tray support areas.

28. A method of selectively and automatically replacing at least partially full trays on a mail sorter having a plurality of tray support areas, the method comprising:

providing a transporter and an insertion and extraction assembly;

supplying a plurality of empty trays on the transporter;

moving the transporter to position the insertion and extraction assembly adjacent to a tray support area supporting a tray that is at least partially full; and

extracting the at least partially full tray with the insertion and extraction assembly, positioning the at least partially full tray on the transporter and inserting an empty tray from the transporter to the tray support area with the insertion and extraction assembly.

29. A method as claimed in claim 28 further comprising juxtaposing the transporter with a discharge conveyor to discharge at least partially full trays from the transporter.

30. A method as claimed in claim 29 further comprising juxtaposing the transporter with a feed conveyor to receive empty trays on the transporter.

31. A method as claimed in claim 30 further comprising sweeping substantially all trays from the mail sorter tray support areas and substantially filling the tray support areas with empty trays.

32. A method as claimed in claim 31 further comprising:

moving the transporter to sequentially position the insertion and extraction assembly adjacent tray support areas; and

removing trays from the tray support areas with the insertion and extraction assembly while positioning the removed trays on the transporter.

33. A method as claimed in claim 32 further comprising:

moving the transporter to sequentially position the insertion and extraction assembly adjacent empty tray support areas; and

inserting trays from the transporter with the insertion and extraction assembly to the empty tray support areas.

34. An automatic tray-handling system for use with a mail sorter having a plurality of tray support areas, the system comprising:

a transporter;

an insertion and extraction assembly; and

respective feed and discharge conveyors adapted to feed empty trays to the transporter and receive at least partially full trays from the transporter, the insertion and extraction assembly being adapted to insert empty trays to tray support areas and remove at least partially full trays from tray support areas, the transporter being operable to receive empty trays from the feed conveyor and at least partially full trays from the insertion and extraction assembly, the transporter being operable to discharge empty trays to the insertion and extraction assembly and to the discharge conveyor, the transporter being movable to position the insertion and extraction assembly at the tray support areas.

35. A system as claimed in claim 34 wherein the transporter includes a carriage which supports a conveying surface and the insertion and extraction assembly and which is movable between the feed and discharge conveyors and the tray support areas of the mail sorter.

36. A system as claimed in claim 35 wherein the conveying surface comprises a plurality of rollers which are arranged in zones and which are selectively driven in opposite directions.

37. A system as claimed in claim 36 wherein at least some of the rollers are motorised rollers.

38. A system as claimed in any one of claims 34 - 37 wherein the insertion and extraction assembly comprises an endless member which is movable in one direction to insert trays on the tray support areas and in an opposite direction to remove trays from the tray support areas.

39. A system as claimed in claim 38 further comprising a plurality of attachments on the endless

member to apply a force to a tray on the endless member.

40. A system as claimed in claim 38 wherein the transporter generally is horizontally alignable with the tray support areas.

41. An automatic tray-handling system substantially as herein described with reference to the accompanying drawings.

Dated this 9th day of January 2004
ATECS MANNESMANN AG
By its Patent Attorneys
GRIFFITH HACK

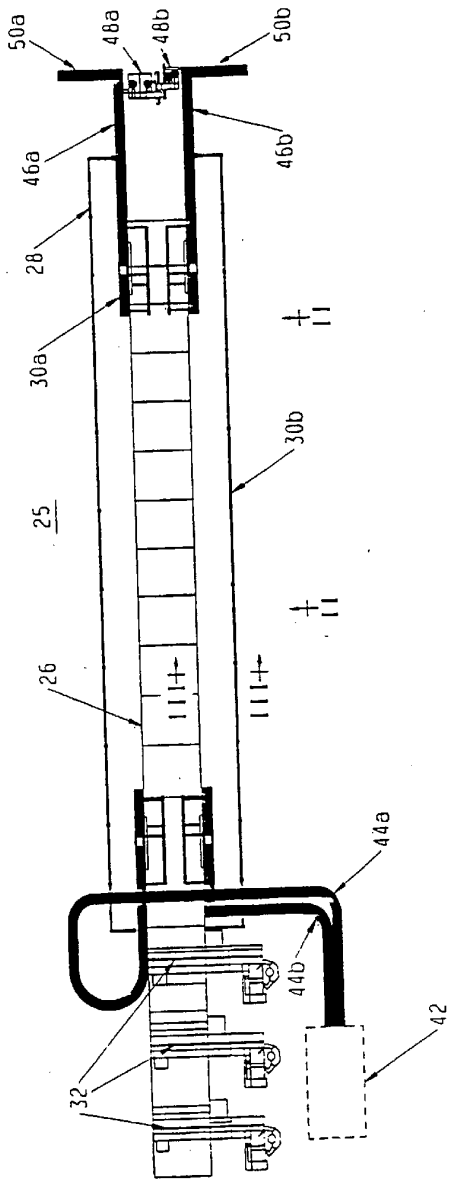


Fig. 1

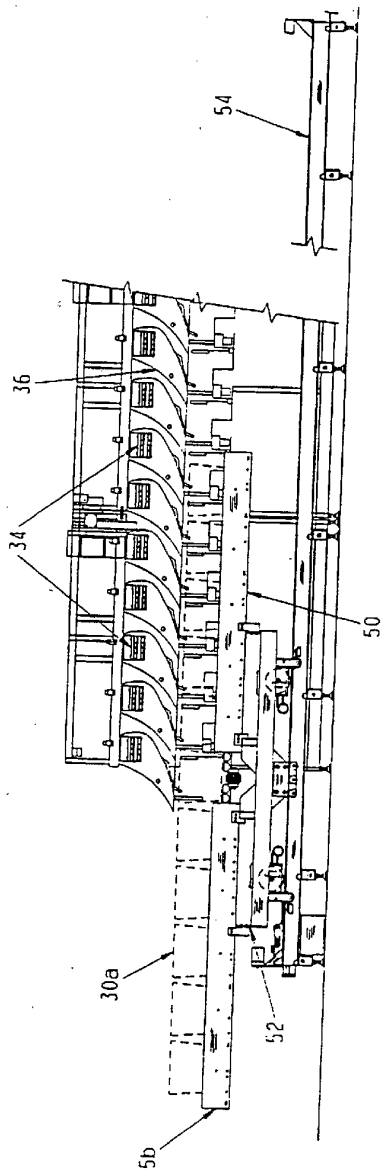


Fig. 2

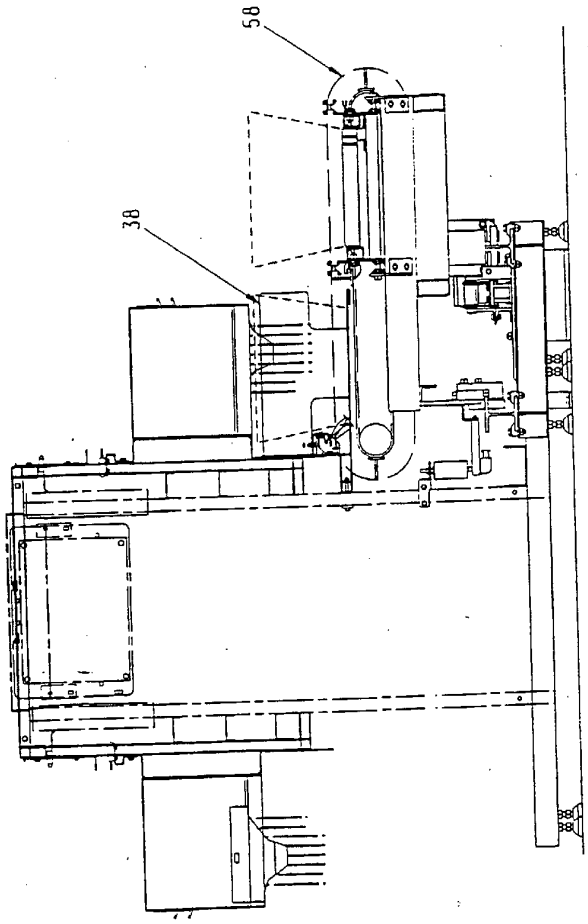


Fig. 3

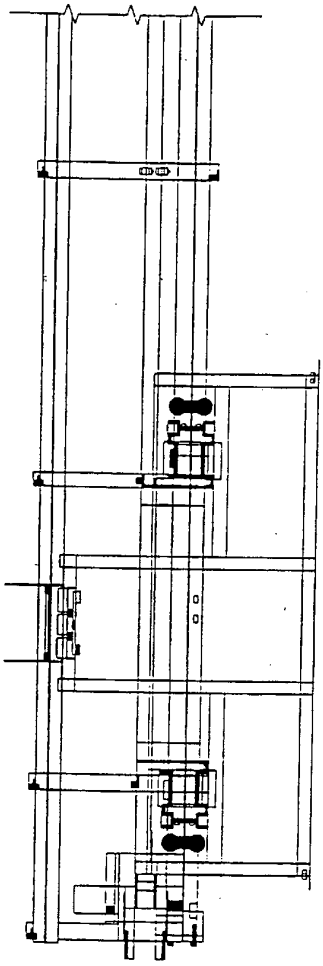


Fig. 4

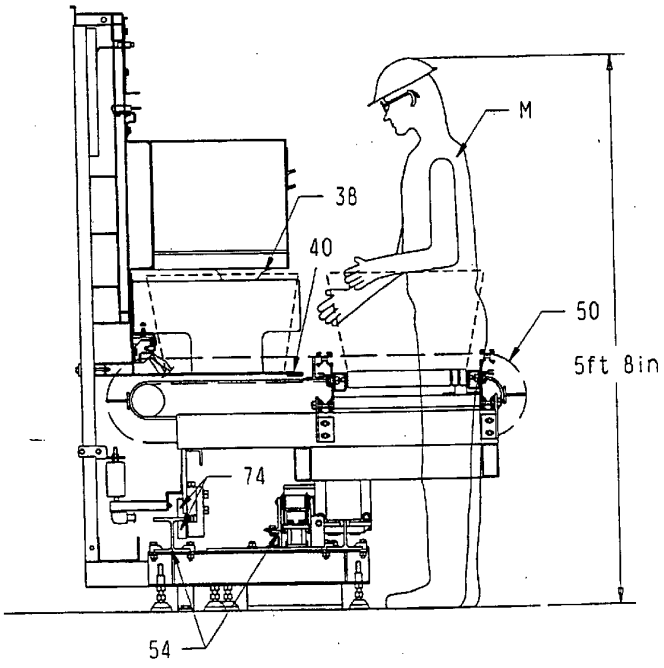


Fig. 5

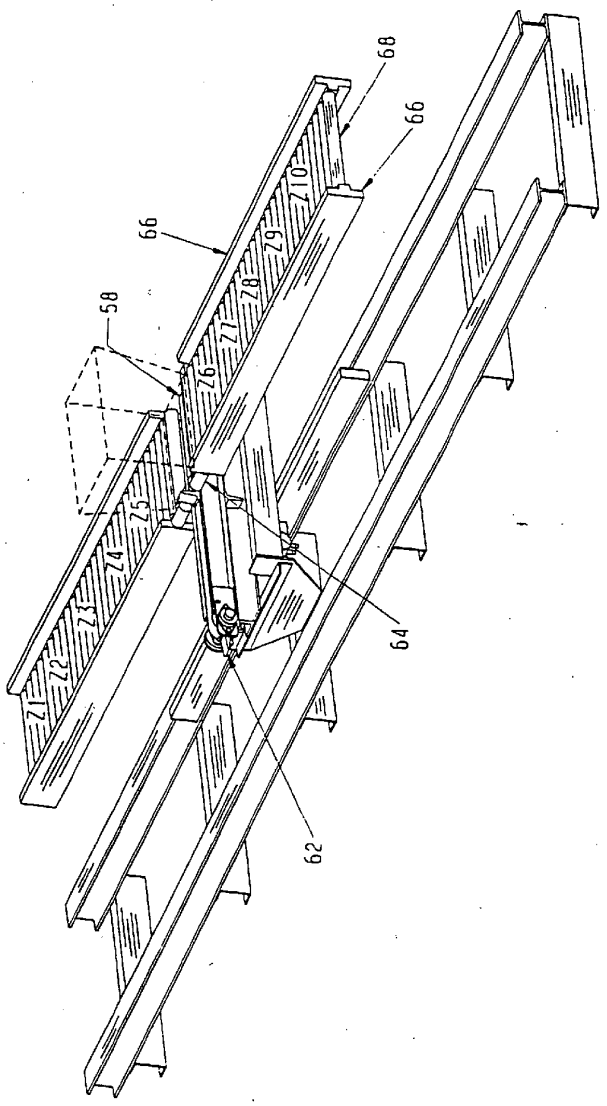


Fig. 6

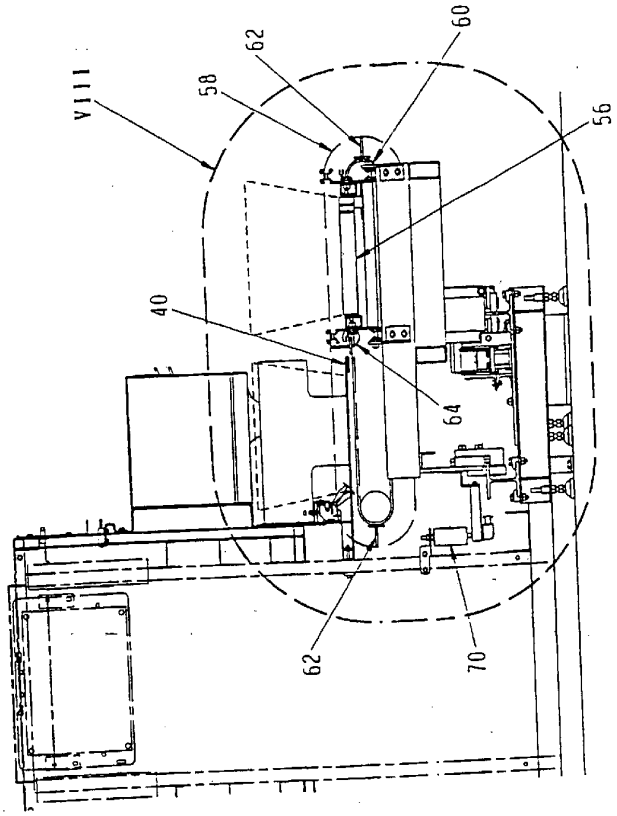


Fig. 7

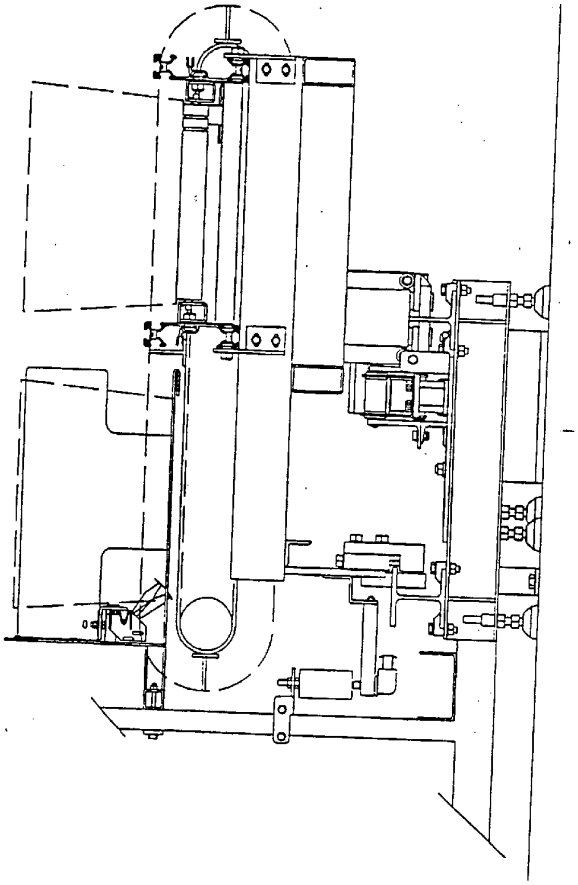


Fig. 8

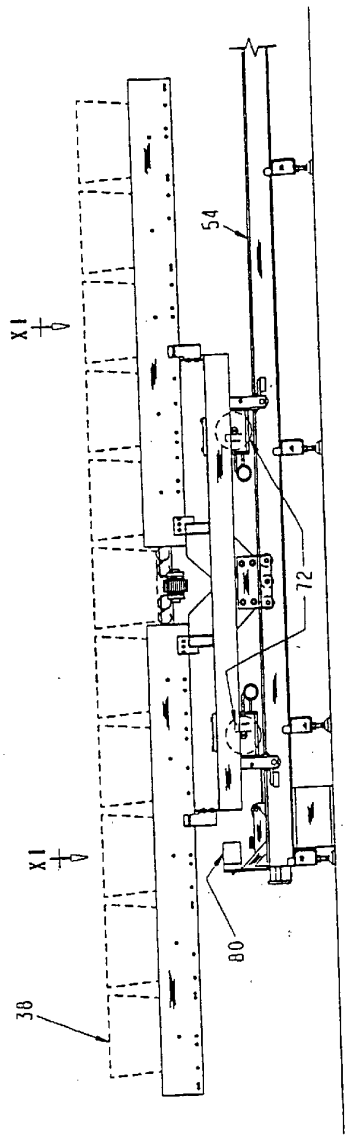


Fig. 9

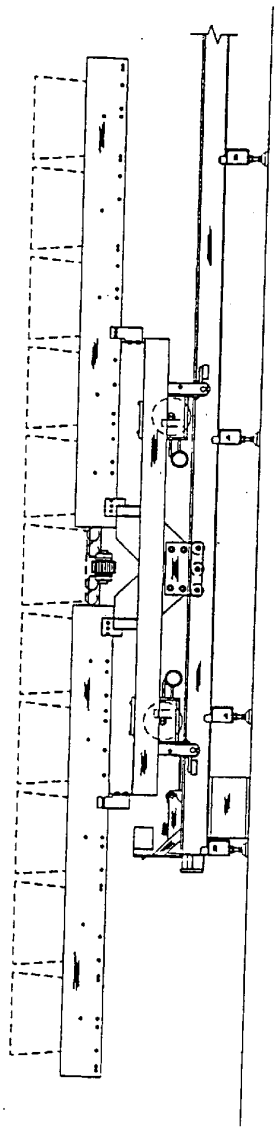


Fig. 10

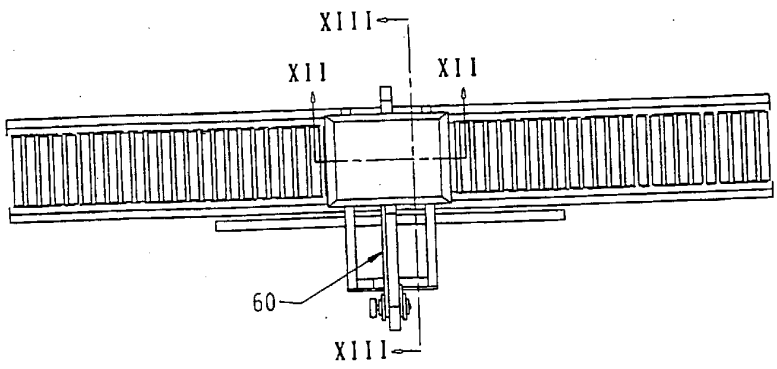


Fig. 11

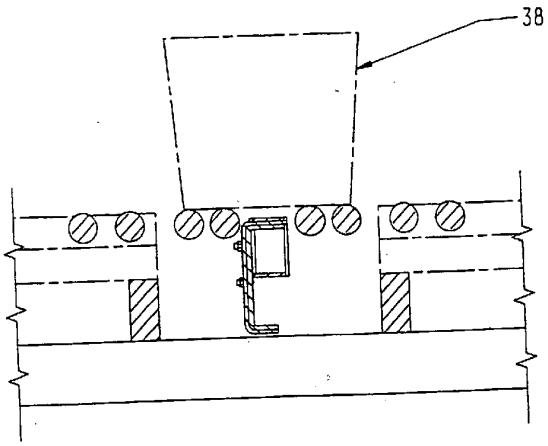


Fig. 12

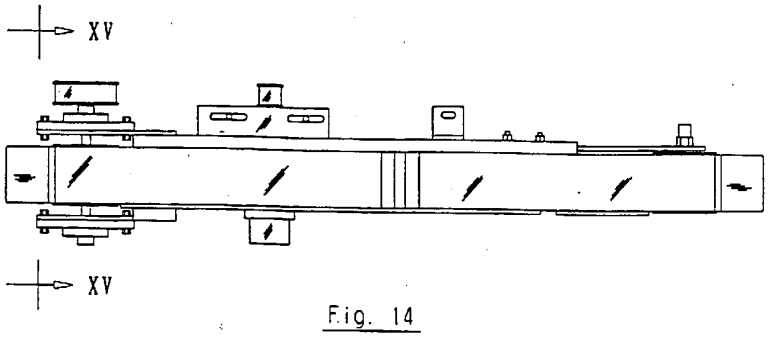


Fig. 14

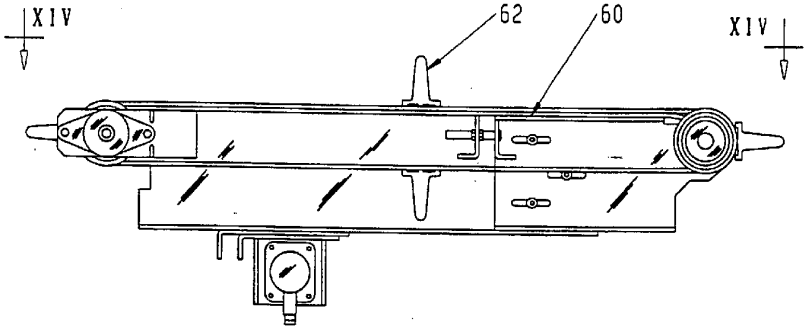


Fig. 13

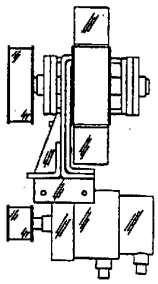


Fig. 15

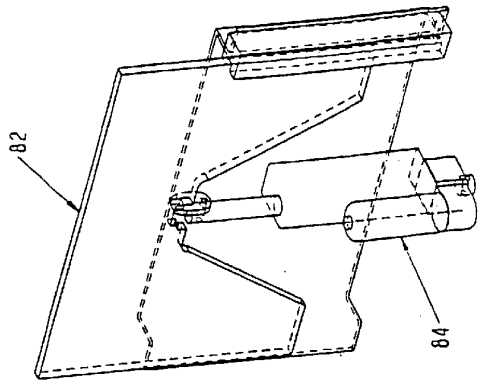


Fig. 16

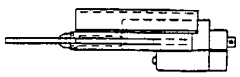


Fig. 19

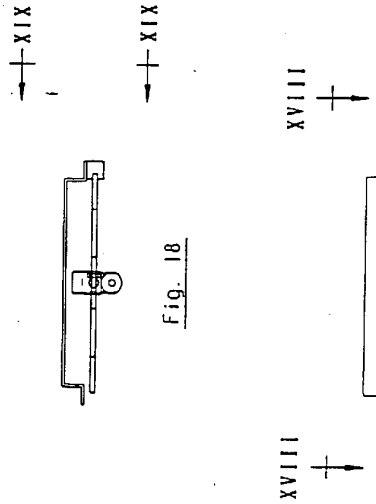


Fig. 18

Fig. 17

SUBSTITUTE SHEET (RULE 26)

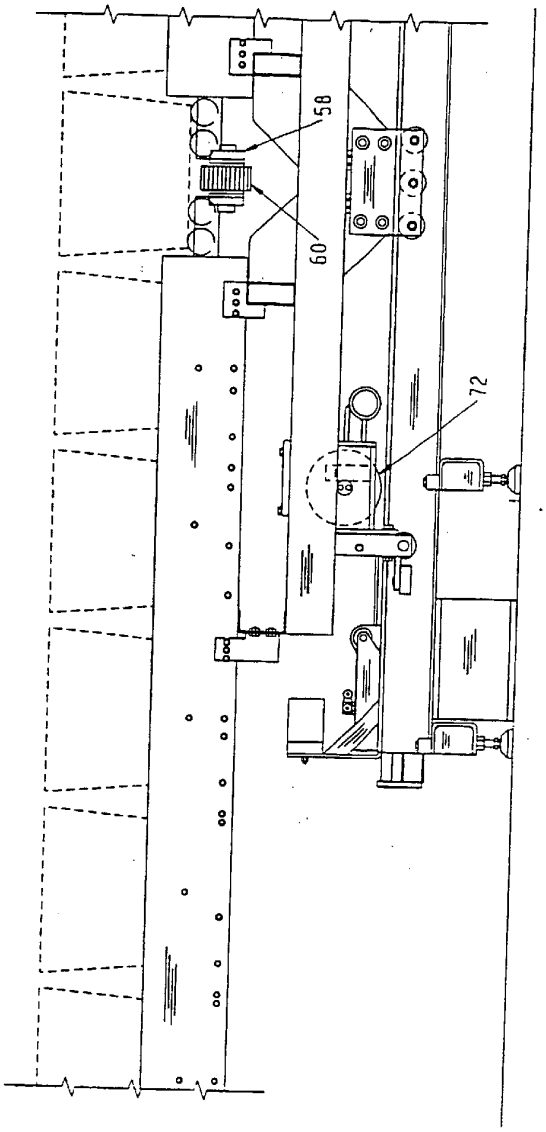


Fig. 20

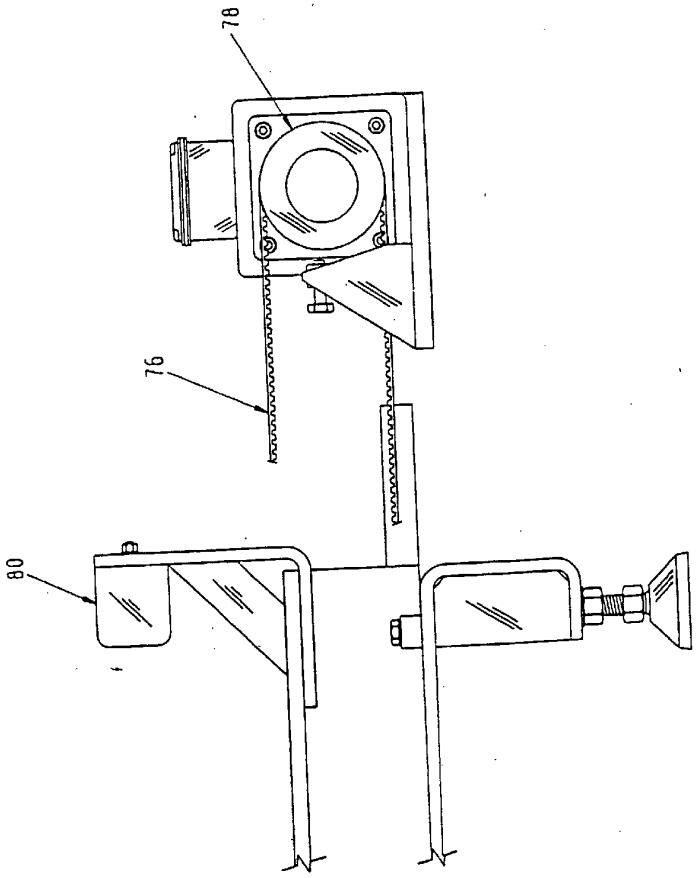


Fig. 21