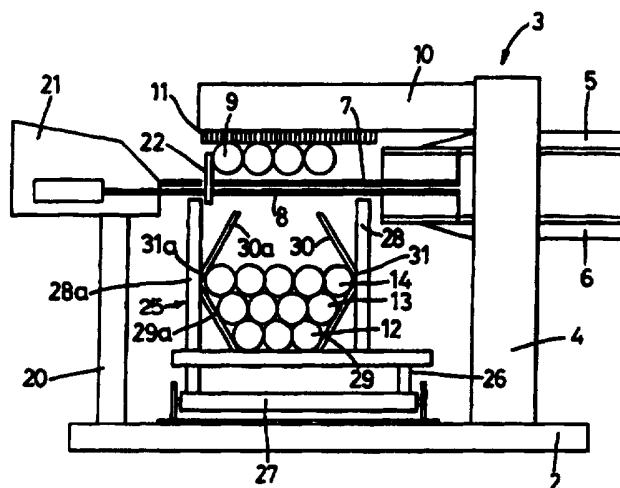




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : B65B 27/10	A2	(11) International Publication Number: WO 96/14247 (43) International Publication Date: 17 May 1996 (17.05.96)
(21) International Application Number: PCT/GB95/02589 (22) International Filing Date: 3 November 1995 (03.11.95) (30) Priority Data: 9422197.5 3 November 1994 (03.11.94) GB (71) Applicant (for all designated States except US): JOHN MARSHALL ENGINEERS LIMITED [GB/GB]; High Street, Henley-in-Arden, West Midlands B95 5AA (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): HAND, Brian, Lawrence [GB/GB]; 15 Fairwater Crescent, Alcester, Warwickshire B49 6QX (GB). (74) Agent: BARKER, BRETTELL & DUNCAN; 138 Hagley Road, Edgbaston, Birmingham B16 9PW (GB).		(81) Designated States: US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>Without international search report and to be republished upon receipt of that report.</i>

(54) Title: TUBE BUNDLING MACHINES



(57) Abstract

A machine (1) for bundling tubes (9) into packs of predetermined configuration comprises a loading station having upper and lower load receiving elements (5, 6) including retractable arms (7, 8) for supporting the tubes at each end thereof and a receiving station positioned below the loading station comprising a cradle (25). Predetermined numbers of tubes (9), which may be delivered from a lift conveyor (103), are counted onto the arms (7) of the upper element (5) in a side-by-side relationship and transferred to the arms (8) of the lower element (6) by retraction of arms (7). The layer of tubes is then lowered into the receiving cradle (25) between support arms (28, 29, 30) and released into the cradle by retraction of the supporting arms (8) which then return to the upper position to receive the next layer of tubes. The process is repeated until a predetermined number of layers of tubes is contained in the cradle (25) at which point the cradle is moved away and the tubes banded into a pack for removal. A microprocessor (21) is programmed to control the machine operation and to count the number of tubes (9) onto the load receiving elements (5) to provide layers of predetermined numbers of tubes whereby the layers are received in the cradle (25) in a predetermined configuration which may be rectangular or hexagonal shaped. For receiving tubes in a hexagonal configuration the arms (29, 30) of the cradle are moveably positioned to retain successive layers of tubes in that configuration.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

TUBE BUNDLING MACHINES

The present application relates to machines for bundling together predetermined numbers of tubes to enable them to be handled with the minimum risk of damage and transported more readily than when loose.

Traditionally tubes have been supplied from manufacturers and companies treating manufactured tubes to end users in quantities in metal containers, the tubes being loosely packed in the containers. The end users have now, however, introduced a requirement that tubes are supplied in an easily handled form and in relatively small quantities. To this end, therefore, machines have been developed that accept the manufactured tubes and bundle the tubes into packs of a predetermined number which may then be easily handled by fork-lift trucks or cranes, for example.

The cost of the machines is, however, high and in many cases the systems are incapable of accepting tubes direct from the mill at the high rates of production which necessitates an extra step of first collecting tubes and then providing them to the bundling machine.

We have now developed a machine that is relatively cheap to manufacture and is capable of producing round, square, oblong or hexagonal shaped bundles. The machine is also able to receive tubes at a high speed, either directly from a tube mill or from a tube treatment machine, such as a deburring machine. The machine operates at a reduced noise level compared with tube collection systems.

From one aspect, therefore, the present invention provides an apparatus for bundling tubes comprising:

a first station including means for repeatedly loading and counting predetermined numbers of tubes onto a preferably horizontal support member in a side-by-side arrangement to provide a single layer of tubes,

a second station including means for receiving the tubes in a predetermined pattern of horizontal layers, and

means for transferring and releasing said tubes from said support member into said receiving means, to provide a layer of tubes therein,

said loading and transferring being continued until a predetermined number of layers of tubes has been received in said receiving means in said predetermined pattern, and

means programmed to control the number of tubes loaded onto said support member for transfer as a layer to said receiving means and to control the number of layers of tubes transferred to said receiving means to provide a bundle of tubes in the required predetermined pattern.

The first said station may be an upper station and the second station a lower station positioned below the first station.

The support member preferably comprises two elements supporting the tubes at each end. Two support members may be provided spaced vertically apart, the predetermined number of tubes counted onto the upper member being transferred to the lower member for transfer to the receiving means during which

operation a further predetermined number of tubes is counted onto the upper member, the lower member then returning to its initial position to receive the next layer of tubes. Means may be located above the support member to frictionally engage the surface of the tubes as they are loaded whereby the tubes are maintained in a close, preferably touching side-by-side relationship.

The support members are carried on spaced apart machine frame members positioned on a common base; preferably one of the frame members is adjustably carried on the base for movement towards or away from the other member to accommodate tubes of different lengths.

The receiving means may be carried on a support frame movable away from the loading station to a location for strapping the tubes for removal and storage. The support frame may be carried on a track, for example a roller conveyor for ease of movement. Two receiving means and support frames may be employed spaced apart on the track whereby one receiving means is loaded whilst the other is unloaded.

The receiving means may be arranged to receive the tubes to form a round, square, oblong or hexagonal pattern and preferably includes means to urge the transfer tubes into a side-by-side touching arrangement within the receiving means and to ensure that the layers of tubes take up the required configuration.

The receiving means will generally comprise at least two spaced apart formations located at points towards the ends of the layers of the tubes and carried on a common sub-frame, the formations including side

walls to retain the tubes in the required configuration. One of the said formations may be carried on the sub-frame for movement towards and away from the other formation to accommodate tubes of different lengths.

Where the tubes are to be bundled into a square or oblong pattern, the control is programmed to count equal numbers of tubes onto the loading means for each layer of tubes to be transferred to the receiving means and further to count the number of layers in order to form the square or oblong configuration.

For bundling tubes in a square or oblong pattern the receiving means formation has vertical side walls spaced apart to retain the tubes in a touching side-by-side relationship.

When the tubes are to be bundled into a hexagonal pattern the control is programmed to count an initial predetermined number of tubes for the first layer to be received by the receiving means and then one tube more in each additional layer for a predetermined number of layers followed by one tube less for a next equal number of layers plus one.

For bundling the tubes in a hexagonal pattern the receiving means formation has lower side walls sloped outwardly from the base to accommodate the tubes in the required pattern for the lower half of the bundle and upper side wall including pivoted elements for movement between a position in which they slope inwardly to accommodate the tubes in the required pattern for the upper half of the bundle and a substantially vertical position to receive a layer of tubes from the loading support member, the upper side walls being actuated in

response to signals from the control means. A cam operated mechanism ensures that each layer of tubes is correctly orientated in relation to the centre position.

From another aspect the invention provides a method of bundling tubes into a predetermined configuration comprising:

counting a predetermined number of tubes into a first loading means,

transferring the tubes into a second loading means,

moving the second loading means and supported tubes to a means for receiving the tubes in layers of a predetermined configuration,

releasing the tubes into said receiving means as a discrete layer,

repeating the loading, transferring, moving and releasing apparatus with subsequent predetermined numbers of tubes to form each discrete layer whereby the layers of tubes in the receiving means form the predetermined configuration,

banding the tubes together in the said configuration and removing the banded bundle of tubes from the receiving means.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:

Figure 1a-1e are diagrammatic illustrations of side elevations of one embodiment

of a machine of the invention in a sequence of loading tubes into a receiving means in a hexagonal configuration, and

Figure 2 is a side elevation of a second embodiment of a machine receiving tubes from a tube deburring machine forming into a hexagonal configuration.

Referring to Figures 1a-1e, a bundling machine comprises a fixed base member 2, a machine frame 3 having vertical support members 4 carrying fixed upper and movable lower loading means 5 and 6 respectively. The frame member 4 and associated loading means is positioned at one side of base 2 and a second identical frame member and associated parts is positioned at the opposite side of base 2, the frames being spaced apart to allow the loading means 8 to support the tubes 9 to be bundled at each end. The second frame is adjustably mounted on the base for movement towards and away from frame 4 to permit the machine to handle tubes of different fixed lengths one side only of the machine being described in respect of the operation thereof.

The upper and lower loading means 5 and 6 include arms 7 and 8 extending horizontally across the base member 2 to support respective ends of a row of tubes 9, arms 7 and 8 being spaced apart in the same vertical plane.

Upper loading arms 7 is movable normally to the axes of the row of tubes 9 to transfer the tubes onto the lower loading arm 8 of the lower support means 6. Lower support means 6 is movable vertically on frame 4

between an upper first position (Figure 1b) and a lower second position (Figure 1c) where arm 8 is movable normally of the tubes axes to release the tubes as a layer into a tube receiving cradle 25.

Arm 10 extends horizontally across base 2 and carries a brush element 11 positioned to make frictional contact with the surface of tubes 9 to maintain the tubes in the side-by-side relationship during loading onto the upper loading arm 7.

Vertical frame member 20 extends from base 2 opposite to frame 5 and carries a programme control and counter 21, the counter registering each time a pneumatically operated pusher device 22 contacts a trigger as it urges a tube received by the machine onto the upper loading means 7.

Tube receiving cradle 25 is supported on a sub-frame member 26 carried on a roller track 27 for movement in a direction at right angles to the loader arms 7 and 8 away from the loading station to a banding and unloading station.

Cradle 25 as illustrated is designed to receive tubes for bundling in a hexagon configuration and includes vertical side supports 28, 28a which, with the cradle in the loading position are positioned between the two sets of arms 7 and 8 of upper and lower loaders 5 and 6. Lower fixed arms 29, 29a of cradle 25 extend outwardly from the base 26 of the cradle to supports 28, 28a to determine the configuration of the lower half of the bundle of tubes. Upper arms 30, 30a extend from support 28, 28a at the top of arms 29, 29a to define the configuration of the upper half of the hexagon. Upper arms 30, 30a are pivoted to support

members 28, 28c at 31, 31a and are pneumatically operated to move between a first closed position (figure 1a) to contain the upper layers of tubes in a hexagon configuration (figure 1d) and a retracted open position (figure 1c) parallel to side support 28, 28a to allow a load of tubes to be received in the cradle (figure 1c).

A mechanically operated pusher device (not shown) is positioned adjacent side walls 28, 28a and includes members which move inwardly from each side of the cradle to urge the tubes in each layer forming the lower half of a hexagon configuration into a side-by-side touching arrangement.

The pusher device does not operate when tubes are transferred to fill the upper half of a hexagon configuration or when the cradle is formed to accept tubes for a square or oblong configured bundle.

A sequence of operations for loading tubes into the cradle is illustrated in Figures 1a - 1e. All components of the machine described above are pneumatically operated and the sequence of steps illustrated in the drawings is controlled by a micro-processor contained in the programme control and counter 21 which micro-processor is programmed according to the configuration of tube bundle required.

Figure 1a shows cradle 25 holding three layers of tubes 12, 13 and 14 forming the lower half of a hexagon configuration. The next layer of tubes 9 (1 tube less than upper layer 14 in the cradle) is shown supported on arms 7 of upper loader 5 with push device 22 constraining movement toward the frame 20. Arms 30, 30a of cradle 25 are shown in the closed position.

When the appropriate number of tubes have been counted onto arm 7 the controller actuates a piston and cylinder arrangement in upper loader 5 to cause arm 7 to be retracted in the direction normal to the tube axes to allow the tubes 9 to fall onto the lower loader 6 support arms 8 as shown in Figure 1b. Arms 30, 30a of cradle 25 then take up the retract position and the lower loader and arm 8 supporting tubes 9 is caused to descend down frame 5 to lower the tubes into the cradle 25. Simultaneously, arm 9 returns to its start position and as the lower loader 6 descends the next layer of tubes 15 (two tubes less than layer 14) are counted onto the arms 7 of the upper loader 5 (figure 1c). When arms 8 of the lower loader reach the level of the surface of the tubes in layer 14 contained in the cradle, upper arms 30, 30a of the cradle are actuated to move into the closed position causing the tubes 9 to take the required configuration for the next layer in the cradle (figure 1d). Arms 8 of the lower loader 6 then retract in the direction normal to the axes of the tubes to allow the tubes to fall onto the upper layer 14 (figure 1e). Simultaneously further tubes 15 are counted onto the upper loader arms 7. Lower loader 4 then returns to the position shown in Figure 1a and the sequence is repeated until the desired number of tubes is contained within the cradle 25.

When the appropriate number of layers of tubes have been transferred to cradle 25, support means 26 is moved along roller 27 away from the loading station to a first unloading station where the tubes are banded and removed from the cradle. During this operation a second cradle is moved to the loading station along roller 27 and the sequence of counting tubes onto arm 7 and transferring to the cradle is repeated.

When the second cradle has been loaded it is moved along track 27 in the opposite direction to the first cradle to a second unloading station and the first cradle then takes up its position at the loading station.

It is, of course, not necessary that the cradle be contained on a track; provision can be made for the tubes to be banded at the loading station and removed from the cradle at that point. However, this results in an interruption in the loading procedure and therefore the use of two cradles is desirable.

Again it is not necessary that the track 27 be a roller track; any suitable form of track along which movement can be attained may be employed.

Whilst the operation of the bundling machine has been described with reference to just two loaders supporting the tubes at each end three or more such units may be required for tubes in excess of about 3 meters in length, in which case it may also be desirable to use two or more cradles to retain the tubes in the required configuration prior to banding.

A second embodiment of a tube bundling machine generally indicated at 110 according to the present invention is shown in diagrammatic form in Figure 2. Tubes to be bundled are received from a tube deburring machine 101 and loaded at 102 onto a lift conveyor 103 and carried to bundling machine 110. In this machine like parts have the same reference numerals as in the previous embodiment. The counter and controller for machine 110 are contained in a separate unit 101, upper and lower loaders 5 and 6 have tube supporting arms 111

and 112 respectively. Frame members supporting the loaders are spaced apart such that the tubes are supported initially on arm 111 at their extreme ends only. The loading and subsequent sequence of movements of the operating parts is identical with that described above except that when a layer of tubes 113 has been counted onto arm 111 the arm is moved in a direction axially of the tubes to release the tubes onto the arm 112 of lower loader 6 which also supports the tubes at their extreme end portions. Similarly, when lower loader 6 releases the layer of tubes into the cradle 25, arm 112 also moves in a direction axially of the tubes.

This mode of release of the tubes from the loader arms permits an increase in bundling speed compared with arm movements normal to the tube axes because of the relatively short movement required. However, since the tubes can be supported at their extreme ends only, this machine is generally only suitable for use with tube lengths in the range of about 1-3 meters.

CLAIMS:

1. An apparatus for bundling tubes comprising:
 - a first station including means for repeatedly loading and counting predetermined numbers of tubes onto a support member in a side-by-side arrangement to provide a plurality of single layers of tubes,
 - a second station including means for receiving the tubes in a predetermined pattern of layers, and
 - means for transferring and releasing said tubes from said support member into said receiving means, to provide layers of tubes therein,
 - said loading and transferring being continued until a predetermined number of layers of tubes has been received in said receiving means in said predetermined pattern, and
 - means programmed to control the number of tubes loaded onto said support member for transfer as a layer to said receiving means and to control the number of layers of tubes transferred to said receiving means to provide a bundle of tubes in the required predetermined pattern.
2. An apparatus according to claim 1 wherein the first said station may be an upper station and the second station a lower station positioned below the first station.
3. An apparatus according to claim 1 or claim 2 wherein the support member is horizontal and comprises elements supporting the tubes at each end.
4. An apparatus according to claim 3 wherein two support members are provided spaced vertically apart, a predetermined number of tubes are counted onto the

upper member and transferred to the lower member for transfer to the receiving means during which operation a further predetermined number of tubes is counted onto the upper member, the lower member then returning to its initial position to receiving the next layer of tubes.

5. An apparatus according to any one of the preceding claims wherein means is located above the support member to frictionally engage the surface of the tubes as they are loaded onto the support member whereby the tubes are maintained in a close side-by-side relationship.

6. Apparatus according to claim 5 wherein the said means comprises a brush element extending longitudinally of the tubes.

7. Apparatus according to any one of the claims 3-6 wherein the support members are carried on spaced apart machine frame members positioned on a common base, one of said frame members being adjustably carried on the base for movement towards or away from the other member whereby tubes of different lengths can be accommodated.

8. Apparatus according to any one of the preceding claims wherein the receiving means is carried on a support frame movable away from the loading station to a location for strapping the tubes for removal and storage.

9. Apparatus according to claim 8 wherein the support frame is carried on a track.

10. Apparatus according to claim 9 wherein the track is a roller conveyor.

11. Apparatus according to any one of claims 8-10 wherein two receiving means and support frames are spaced apart on the track whereby one receiving means is loaded whilst the other is unloaded.

12. Apparatus according to any one of the preceding claims wherein the receiving means is arranged to receive the tubes to form a round, square, oblong or hexagonal pattern.

13. Apparatus according to claim 12 including means to urge the transferred tubes into a side-by-side touching arrangement within the receiving means and to ensure that the layers of tubes take up the required configuration.

14. Apparatus according to claim 12 wherein the receiving means comprises at least two spaced apart formations located at points towards the ends of the layers of the tubes and carried on a common sub-frame, the formations including side walls to retain the tubes in the required configuration.

15. Apparatus according to claim 14 wherein one of the said formations is carried on a sub-frame for movement towards and away from the other formation whereby tubes of different lengths can be accommodated.

16. Apparatus according to claim 14 or 15 wherein the receiving means formation includes spaced apart vertical side walls to retain the tubes in a touching side-by-side relationship when used for bundling tubes in a square or oblong formation.

17. Apparatus according to any one of claims 12-15 wherein, when used for bundling the tubes in a

hexagonal pattern, the receiving means formation includes lower side walls sloped outwardly from the base to accommodate tubes in the required pattern for the lower half of the bundle and upper side walls including pivoted elements for movement between a first position in which they slope inwardly to accommodate the tubes in the required pattern for the upper half of the bundle and a second substantially vertical position, to receive a layer of tubes from the loading support member, the upper side walls being actuated in response to signals from the control means.

18. Apparatus according to claim 17 including a cam operated mechanism operable to ensure that each layer of tubes is correctly orientated in relation to the centre position of the receiving means.

19. A method of bundling tubes into a predetermined configuration comprising:

counting a predetermined number of tubes into a first loading means,

transferring the tubes into a second loading means,

moving the second loading means and supported tubes to a means for receiving the tubes in layers of a predetermined configuration,

releasing the tubes into said receiving means as a discrete layer,

repeating the loading, transferring, moving and releasing apparatus with subsequent predetermined numbers of tubes to form each discrete layer whereby the layers of tubes in the receiving means form the predetermined configuration,

banding the tubes together in the said configuration and removing the banded bundle of tubes from the receiving means.

20. A method according to claim 19 wherein the number of tubes loaded on to the support means and the number of layers of tubes received by the receiving means is controlled by programmable control means.

21. A method according to claim 19 or 20 wherein the tubes are received into the receiving means in a square or oblong configuration.

22. A method according to claim 21 wherein the control means is programmed to count equal numbers of tubes onto the first loading means for each layer to be transferred to the receiving means and to count the number of layers in order to form the required configuration.

23. A method according to claim 20 wherein the tubes are received into the receiving means in an hexagonal configuration.

24. A method according to claim 23 wherein the control means is programmed to count an initial predetermined number of tubes for the first layer to be received by the receiving means and then one tube more in each additional layer for a predetermined number of layers followed by one tube less for a next equal number of layers plus one.

1/3

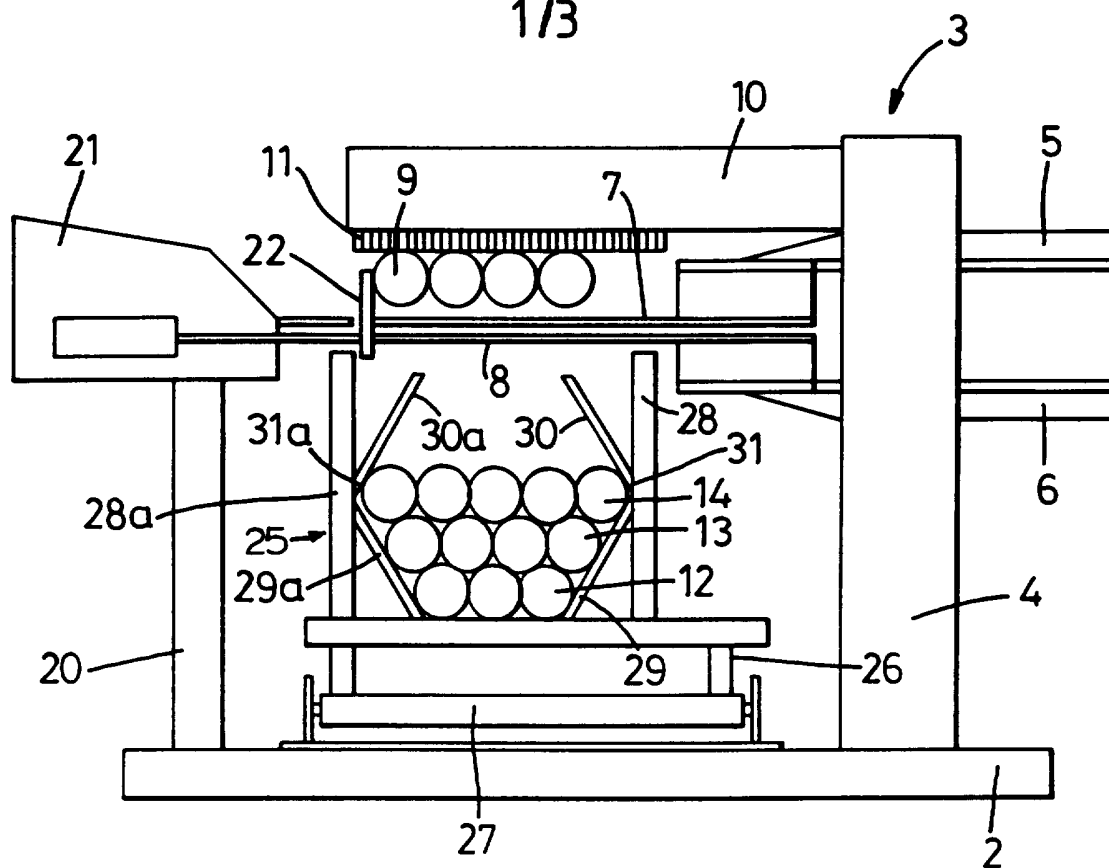


Fig. 1a

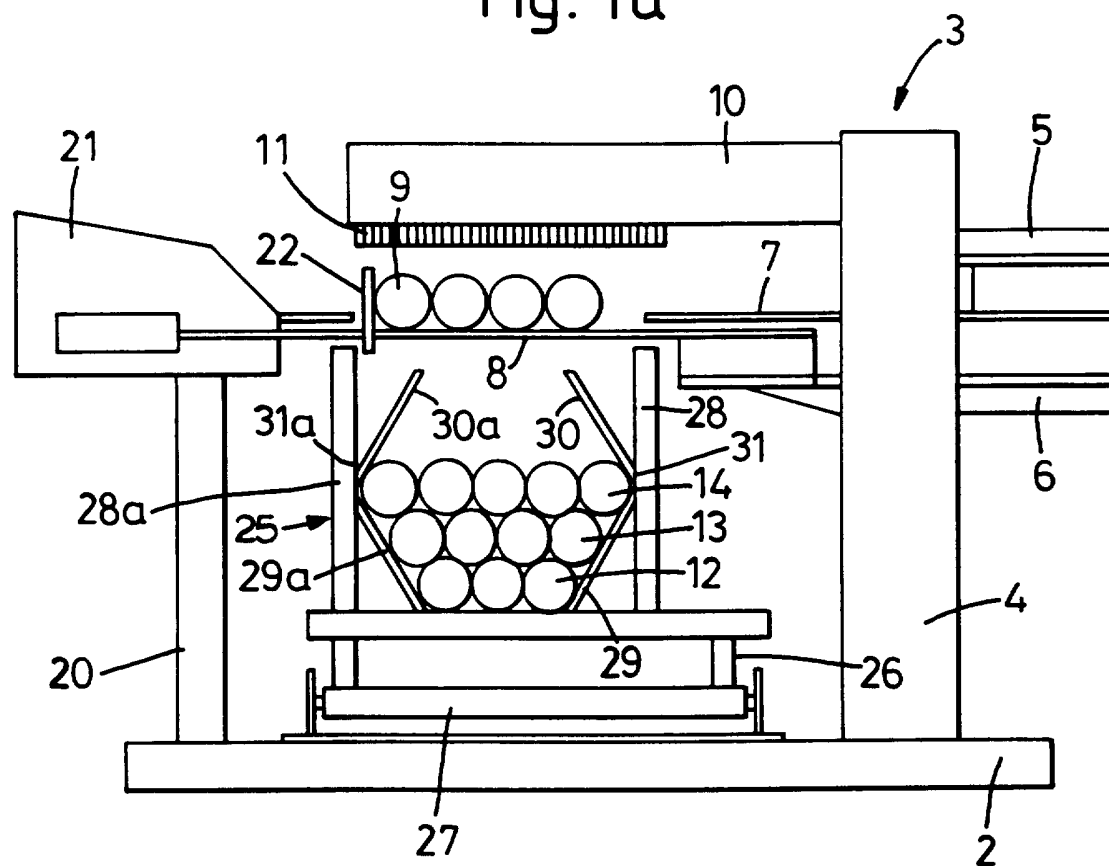


Fig. 1b

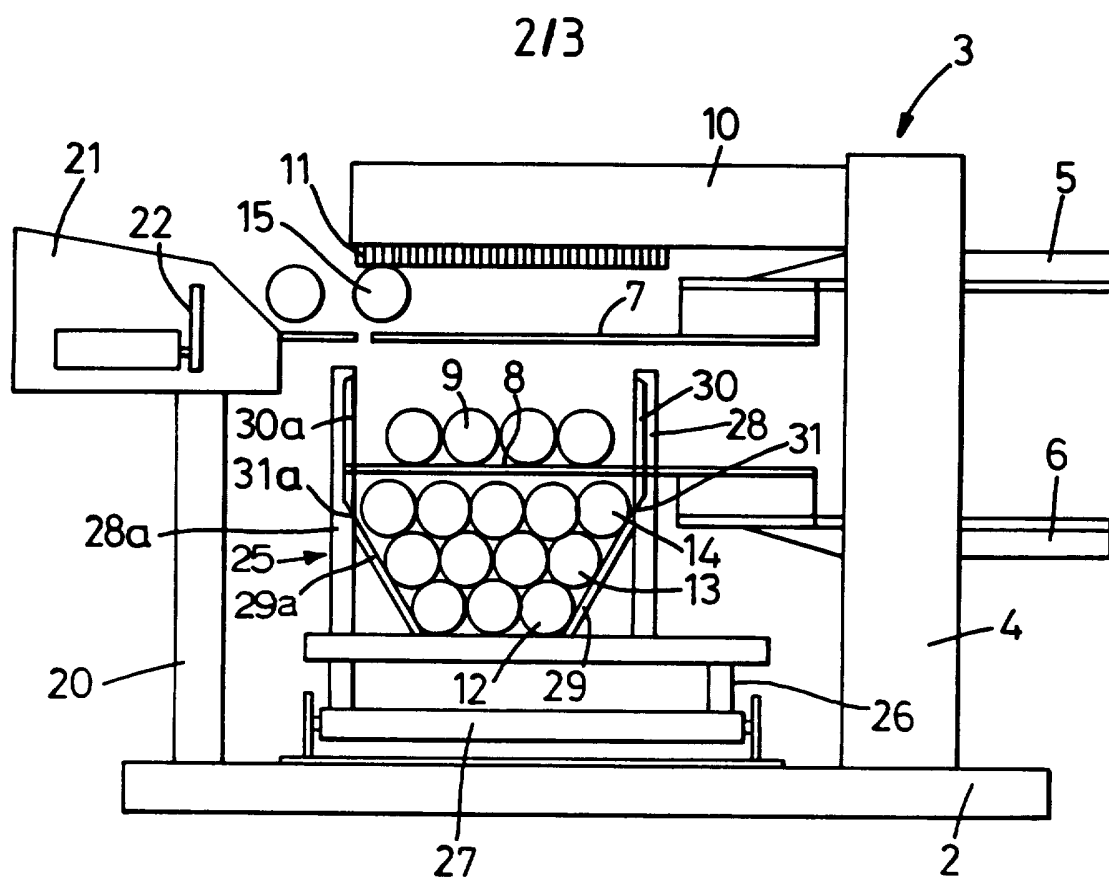


Fig. 1c

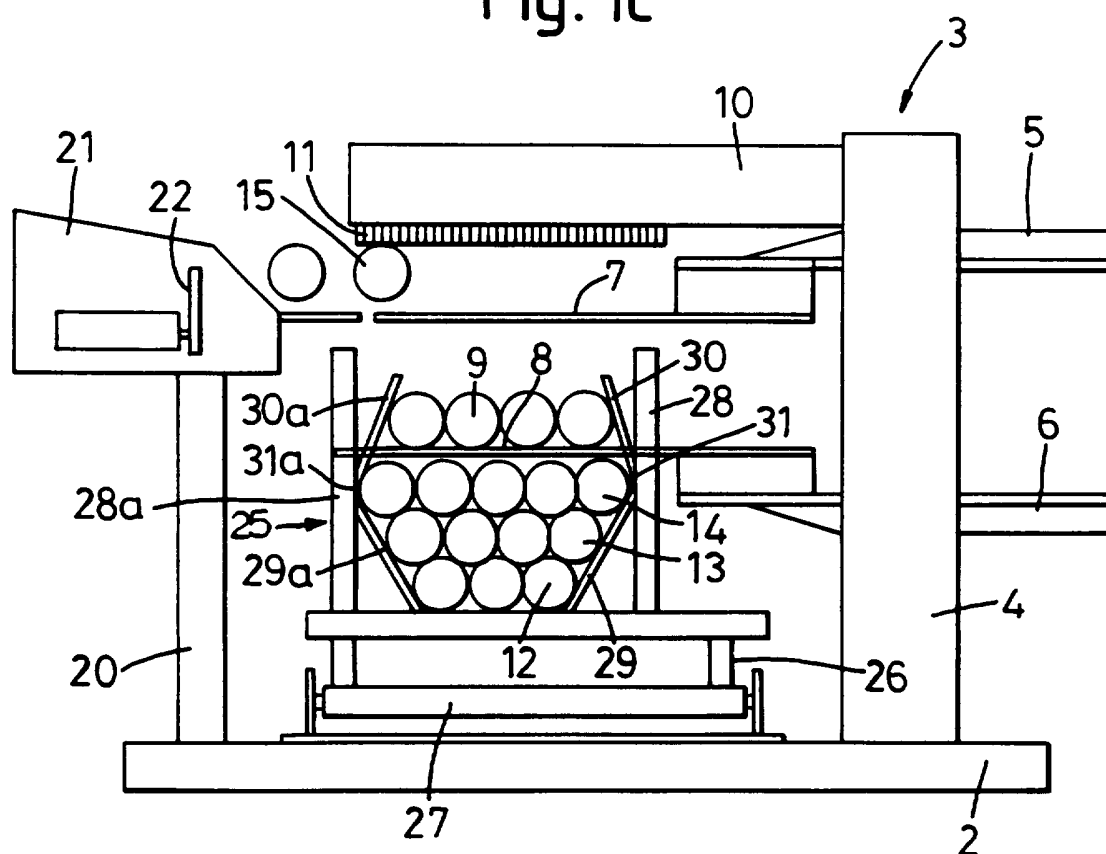


Fig. 1d

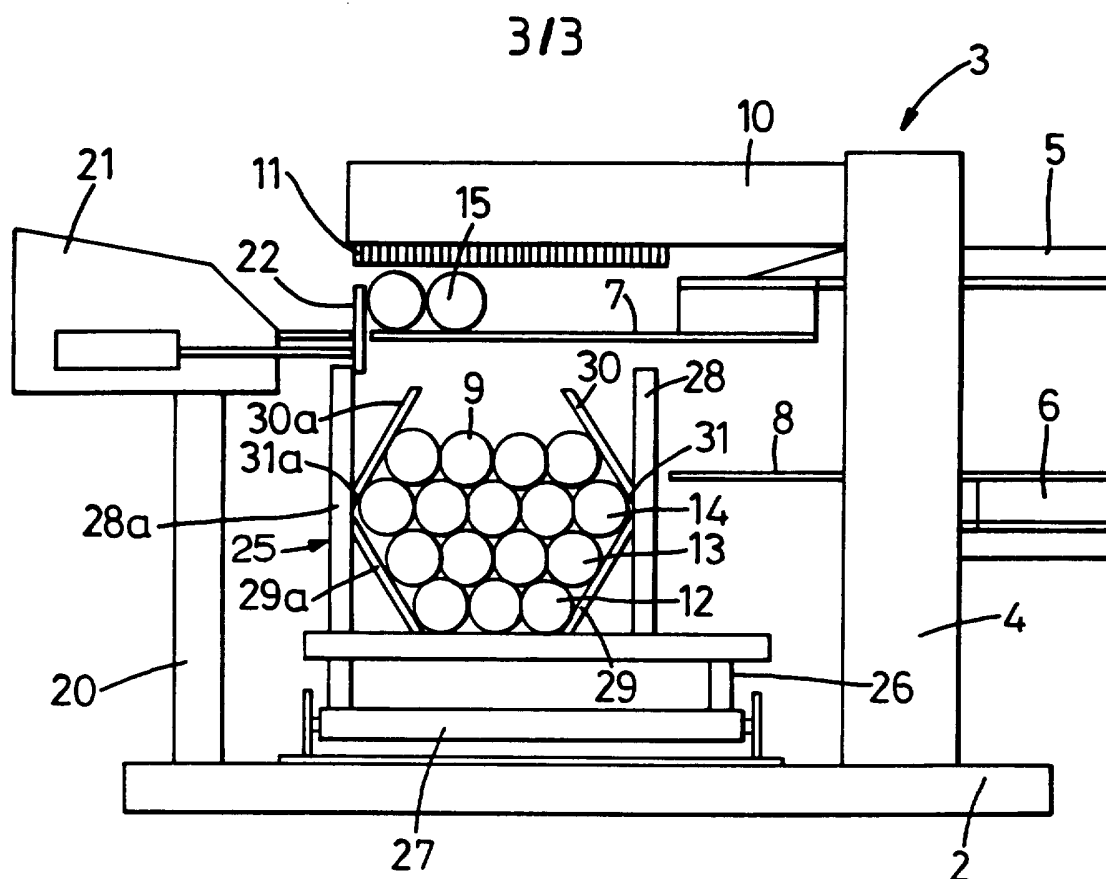


Fig. 1e

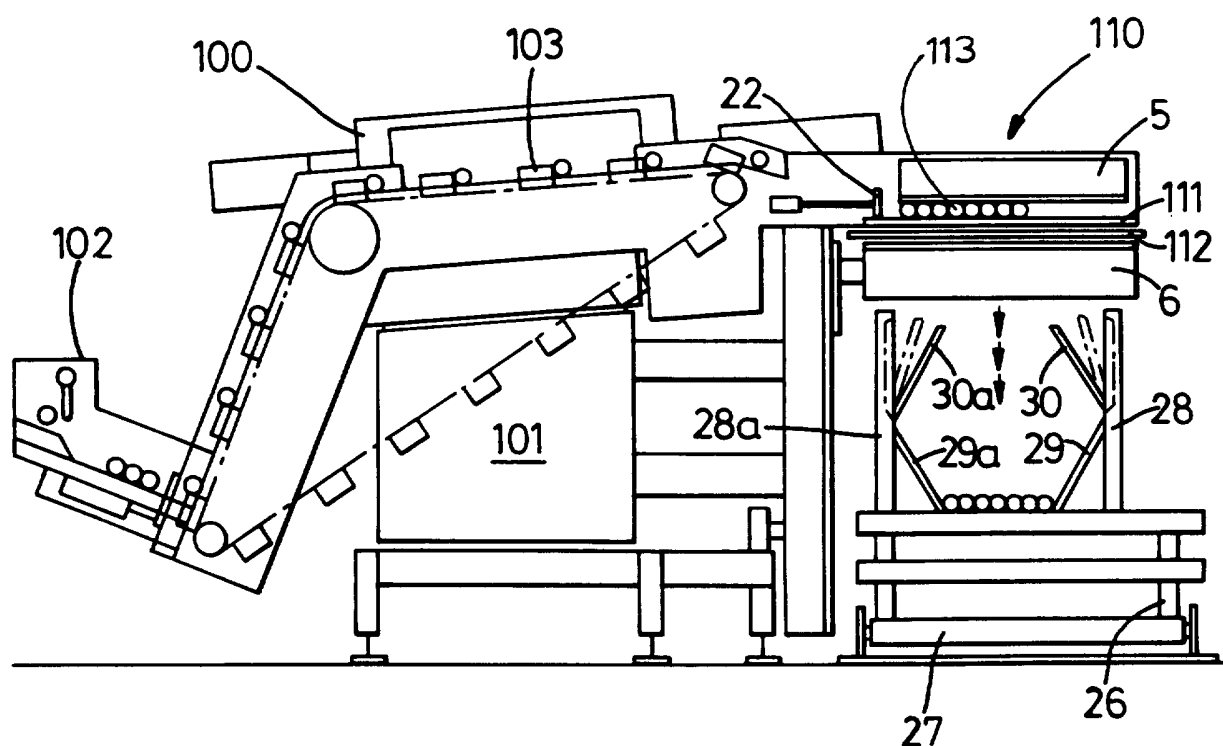


Fig. 2