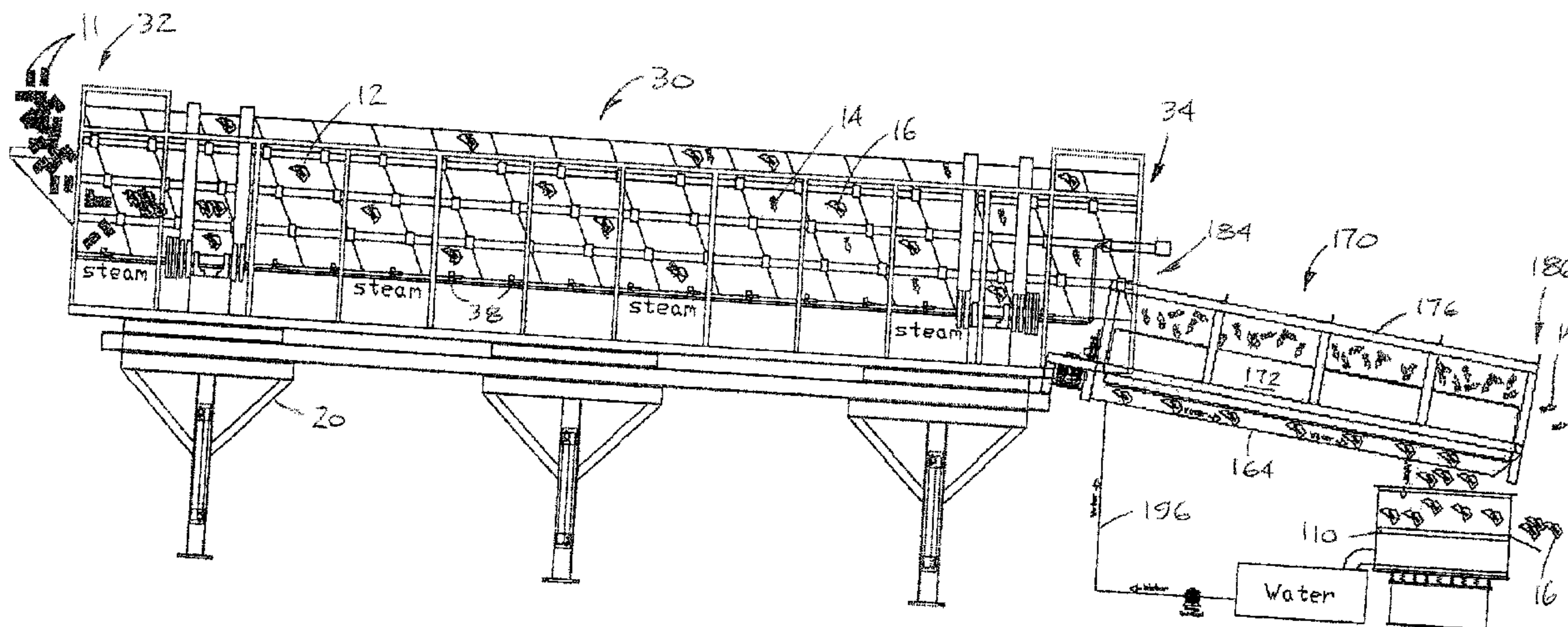




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(54) Titre : SYSTEME DE SEPARATION DE BRIQUETTES ET D'ETIQUETTES
(54) Title: BRIQUETTE AND LABEL SEPARATION SYSTEM



(57) Abrégé/Abstract:

A system for processing containers, such as post-consumer plastic bottles, has a releaser for breaking apart compacted bales of containers and mixing them with steam to aid with the de-clumping process and to promote label release from the containers. The system further includes a separator for receiving the containers from the releaser. The separator has two counter-rotating rollers inclined to the horizontal adapted to urge the labels away from the containers. Beater bars on the rollers assist in tearing away labels from the containers and urging the released labels through established gaps in the separator. Water is not needed to de-clump the bales and de-label the containers as the releaser functions with steam alone and gravity moves the containers along the separator. Water is optionally used to periodically flush the releaser and separator of any labels and contaminants. Two or more separators may be used in series.

ABSTRACT OF THE DISCLOSURE

A system for processing containers, such as post-consumer plastic bottles, has a releaser for breaking apart compacted bales of containers and mixing them with steam to aid with the de-clumping process and to promote label release from the containers. The system further includes a separator for receiving the containers from the releaser. The separator has two counter-rotating rollers inclined to the horizontal adapted to urge the labels away from the containers. Beater bars on the rollers assist in tearing away labels from the containers and urging the released labels through established gaps in the separator. Water is not needed to de-clump the bales and de-label the containers as the releaser functions with steam alone and gravity moves the containers along the separator. Water is optionally used to periodically flush the releaser and separator of any labels and contaminants. Two or more separators may be used in series.

TITLE: BRIQUETTE AND LABEL SEPARATION SYSTEM5 **FIELD OF THE INVENTION**

The present invention relates to a system for de-clumping briquettes of containers, such as plastic bottles, and separating labels from the containers for further use and recycling.

10 **BACKGROUND OF THE INVENTION**

Commercial recycling of post consumer plastic bottles and like containers involves the release and separation of labels from the containers, removal of non-recyclable materials, washing, and eventually grinding of the containers into a form for further use in the manufacture of new containers or other plastic goods. A typical
15 recycling operation also requires the segregation of the various types of plastics of which these containers are made according to type (e.g. PET, PVC, PP, and HDPE) and colour.

In North America, the bottles usually arrive at a processing facility in the form of compacted bales of different types and colours of containers that typically contain many contaminants, such as caps, cap rings, foil and dirt. These bales are fairly large,
20 measuring about 1.5m x 1.5m x 0.75m., with a density of about 300 kg/m³, and are held

by together by wires or strapping. A disadvantage of such bales is that they are bulky and require wires or strapping to hold them together. Another disadvantage is that the baling machines for forming such bales are too large and expensive for most bottle-recycling depots to do their own baling on site. Therefore, the containers have to be shipped in
5 loose form from the recycling depots to baling plants, and then from there to the plastic processing facility (i.e. recycling plant), thus adding expense to the recycling process.

To overcome some of these drawbacks, a new packaging process using high pressure compacting machines has been developed and is being used in Germany. These machines compact the containers into a log (or "briquette") about 80cm by 80cm in
10 profile with a density of about 730 kg/m³. The bottles are severely deformed and wrapped around each other. The compacting machines have an indentation in their briquette-forming chute which folds the edge of each bottle over a subsequent bottle, thus interlocking the whole briquette. The containers in a briquette appear to have lost their structural memory, and so the briquette remains intact without the use of baling wires or
15 strapping. Another advantage of this briquette packaging process is that the compacting machines are smaller and less expensive than the baling machines, making it possible for bottle-recycling depots to do their own compacting, thus saving on handling, storage and shipping.

However, the above briquette process suffers from an important disadvantage,
20 namely that a briquette is extremely difficult to de-clump or break apart (i.e. to separate

individual bottles from each other) by mechanical means. The processes currently in use in the plastic recycling industry appear unable to de-clump the briquettes efficiently, making it difficult for these recycling processes to use briquettes as the raw material.

What is therefore desired is a novel recycling process and apparatus for effectively
5 and efficiently processing plastic containers compacted in the form of a bale or briquette. Preferably the recycling process should also provide the steps required to produce a final homogeneous product in a form readily usable for manufacture of other plastic products.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

10 Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a transparent elevational view of a system according to the present invention showing a first embodiment of a label separating apparatus downstream of a briquette de-clumping and label release apparatus;

15 Figure 2 is an end view from the right side of fig.1 showing the label separating apparatus in front of the briquette de-clumping and label release apparatus;

Figure 3 is a view similar to fig.1 but showing a second embodiment of a label separating apparatus downstream of a briquette de-clumping and label release apparatus;

Figure 4 is a plan view of the second embodiment of the label separating apparatus with guide plates shown partially broken away for a better view of the cylinders below;

Figure 5 is a side elevational view of the label separating apparatus of fig.4;

5 Figure 6 is an end view from the right side of fig.5 of the label separating apparatus; and,

Figure 6a is a close-up view of fig.6.

DESCRIPTION OF PREFERRED EMBODIMENTS

10 The figures show a system according to the present invention (generally designated by reference numeral 10) for de-clumping or breaking apart blocks, more commonly referred to as "briquettes" 11, of post-consumer plastic bottles 12, namely "raw" or labeled bottles, and releasing and separating labels 16 from these bottles. The system works equally well with the earlier noted compacted bales of containers. The
15 system 10 has two primary components, namely a release apparatus 30 (also referred to as a "washer" or "label releaser") followed at its downstream end 34, or outlet, by a label separating and removing apparatus 70 (also referred to herein as a "label separator" or "separator"). In general, the system functions by introducing one or more briquettes 11 of raw labeled bottles and other contaminants to an upstream end 32, or inlet, of the
20 releaser 30. The drum 36 of the releaser is rotated in a pre-set manner to agitate the

briquettes to begin mechanically de-clumping (i.e. breaking or unraveling) them apart into their constituent elements, namely individual plastic bottles, and to mix the briquettes with steam that is injected at selected supply points 38 along the drum to aid in the de-clumping process. An archimedian-type screw fixed within the drum urges the
5 briquettes and labeled bottles 12 (which have separated from the briquettes) through the drum. Most of the bottles will have had their labels released by the time the mixture of liquid (i.e. condensed steam), labels 16, delabeled bottles 14 and other contaminants is expelled from the outlet 34 and conveyed onto the inclined label separator 70. Any liquid from the mixture is channeled by gravity to a hot water holding tank 100 for re-
10 circulation and re-use in the system if so required. As shown in fig.1, the mixture is directed over a series of counter-rotating cylinders 72 having certain features and orientation discussed in applicant's earlier co-pending patent applications in Canada and the US titled "Label Release and Separation System". Hence, this first embodiment of the label separator 70 will not be described in any great detail herein. However, an
15 improved second embodiment of the label separator 170 will be described in more detail below for urging the labels 16 away from the bottles 14 to fall below the separator into a vibrating filter 110, and for urging the delabeled bottles to be substantially de-watered and to travel down the separator 170 where they are transported for further processing.

Referring now to the invention in more detail, the releaser 30 has a generally
20 elongate, cylindrical shell or drum 36 defining a hollow interior space for co-axially

housing a helical screw 40 fixed therewithin. A superstructure 20 supports the drum 36 above a floor 22, and carries a drive mechanism 44 for rotating the drum about a longitudinal axis 42 in a pre-set manner to advance the drum's contents from the open inlet 32 to the open outlet 34 in the direction indicated (i.e. to the right in fig.1). The
5 mechanism 44 drives a family of wheels 46 that travel along circumferential tracks 48 to spin the drum. A stationary hopper 50 is supported by the frame 20 at the drum's inlet 32 to introduce the briquettes 11 of labeled bottles 12, including contaminants such as bottle caps, cap rings, loose labels and dirt, into the drum to begin the de-clumping, cleaning and label release stage of the process. Steam is introduced into the drum at
10 selected spaced locations along the length of the drum through peripherally located steam injector nozzles 38. The steam is delivered to the nozzles at low pressure through a supply pipe 39 which communicates with a steam header 23 and steam boilers 24. In this embodiment the nozzles 38 are spaced about the same distance as the longitudinal gap between vanes of the helical screw 40, although such spacing may be varied depending on
15 specific requirements. The steam is injected at low pressure (i.e. below 15 psi) into each "chamber" 41 of the screw to maintain a temperature that is high enough for de-clumping the briquettes, for cleaning the de-clumped bottles and for effectively releasing labels from the bottles. The amount of steam injected into each chamber 41 of the drum can be independently regulated at each respective nozzle 38 so as to maintain a desired internal
20 temperature gradient along the length of the drum to optimize cleaning and label release

conditions. Further, the inside surface of the drum has corrugations 37 for enhancing agitation of the briquettes and separated bottles within. It is noted that although hot water may optionally be added to the releaser 30 to facilitate movement of materials along the drum toward the outlet 34, it is not required nor preferred in the current embodiment.

5 The use of steam alone has been found to provide sufficient de-clumping of the briquettes and loosening of labels from the bottles for efficient and effective processing.

The movement of the drum is designed to increase the retention, or residence time for the briquettes and bottles within the drum, and to further increase agitation of these items, while maintaining a fairly low rpm, namely under 3 rpm in the preferred

10 embodiment, which may be adjusted as needed. The aim is to provide enough time and agitation to properly de-clump individual bottles from the briquettes and to release labels and other contaminants from the bottles, yet not too much time to unduly reduce productivity. The drum movement is a combination of roll, or spin, and oscillation. A favourable sequence has been found to be one 180 degree oscillation for every full (i.e.

15 360 degree) revolution of the drum. Hence, referring to the end view of the drum in fig.2, for every 360 degree roll in a first direction indicated by 43a, the drum is then turned (i.e. "oscillated") 180 degrees in the opposite (second) direction and brought back 180 degrees in the first direction, as indicated by 43b and 43c, respectively. The cycle is then repeated. Each roll propels the load forwardly toward the outlet 34, and each oscillation

promotes de-clumping, washing and label release. In the preferred embodiment the drum's movement provides a residence time of between 6 to 8 minutes on average.

Upon each revolution of the drum, a mixed load of labels 16, delabeled bottles 14, bottles with labels still clinging, liquid (i.e. condensed steam) and other contaminants is expelled from the outlet 34 onto a first conveyor 60 for moving the load forward (in the direction of arrow 42) toward the separator 70 . Optionally, a conveyor 60 may be provided which serves to spread out the load into a more uniform stream before it reaches the separator 70. In particular, numerous chains (not shown) are suspended immediately above the conveyor belt across its width to contact and even out any mounds of bottles that are deposited from the washer. The conveyor 60 is also inclined to the rear (i.e. down to the left toward the outlet 34 in fig.1, where the incline is exaggerated) to drain the expelled liquid onto a forwardly inclined (i.e. downwardly to the right in fig.1) plate member 64. The plate member 64 channels the water, and any labels which might be caught up in the water, into a vibrating filter 110, whose function is described later. It is noted that in the drum of the present embodiment any condensed liquid resulting from the steam introduced into the drum is expelled from the outlet 34, and not at any intermediate point along the drum, to help with washing of labels down the plate 64 into the vibrating filter 110. If the conveyor 60 is omitted, however, then the load from the releaser's outlet 34 is deposited directly onto the separator 70.

The wet bottle mixture is discharged (either from the conveyor 60 or directly from the releaser 30) onto the label separator 70 having a series of elongate steel cylinders, or rollers 72, oriented in parallel relationship, all of which are rotatably driven in the same direction. Each roller's longitudinal axis is preferably set horizontally and perpendicular
5 to the line of travel of the bottles 14, and is therefore sometimes referred to a "tangential flow label separator". Each roller 72 is driven counter to the prevailing movement of the bottles 14 along the separator, namely counterclockwise when viewed in fig.1. Further details of this embodiment are discussed in applicant's earlier co-pending patent applications in Canada and the US titled "Label Release and Separation System".

10 An improved second embodiment of the label separator is shown in figs. 3-6 and indicated by reference numeral 170. The separator 170 is preferably placed at the releaser's outlet end 34 as shown in fig.3. In alternate embodiments, two or more separators 170 may be used in series, or one or more separators 170 may be used in series with one or more separators 70, namely a separator 170 may be located upstream and/or
15 downstream of a separator 70.

The separator 170, sometimes referred to as an "axial or linear flow label separator", has a frame 176 with bearing assemblies 174 which carry two closely spaced elongate steel cylinders, or rollers 172, oriented in parallel relationship. The rollers 172 are driven in opposite directions (indicated by arrows 172a and 172b in fig.6) by a
20 continuous chain drive mechanism 178 driven by a drive motor 180. The separator 170 is

the opposite of the separator 70 in that the longitudinal axes 182 of the rollers 172 are oriented parallel to the line of travel of the washed bottles 14. The separator 170 and its rollers 172 are inclined downwardly from a first input end 184 to a second output end 186 to allow gravity to urge the bottles along the separator toward the output end. The separator's incline should be great enough to allow gravity to advance the bottles, but shallow enough to allow the bottles sufficient retention time on the rollers for adequate label separation. It has been found that an angle of about 7 degrees from the horizontal provides very good results.

The rollers 172 are spaced (indicated at 188) a sufficient distance apart to prevent contact and collision therebetween, but close enough to prevent bottles from falling therethrough. As noted earlier, the chain drive 178 rotates the two rollers in opposite directions 172a, 172b "outwardly" or "upwardly" (as viewed in fig.6a) so as to urge or drive bottles and other objects away from the space 188, and thus avoid items from jamming between the cylinders or falling therebetween, although some individual labels can and do fall by gravity through the space 188. At least one "beater" bar 190 is connected or fixed longitudinally to the outside surface of each roller 172 along most or all of the length of the roller. The bar 190 may be one continuous piece or may be divided into separate sections so that one section may be replaced as it wears out or is damaged without the need of replacing the remainder of the bar. As the rollers rotate, the bars 190 thereon move through respective gaps 192 formed between the rollers and respective

stationary guide plates 194. Each guide plate 194 has a continuous inwardly inclined surface 195 extending the length of the rollers to corral and guide bouncing bottles back onto the rollers rather than having them falling off the sides of the separator. The bars 190 urge released labels that have adhered to the rollers 172 through the gaps 192. The
5 bars 190 also assist in tearing away any labels that have not fully released from the bottles. Labels that travel through the gaps 192 rotate with the respective roller until they are at approximately at the lowest rotational position where they release from the roller due to combined centripetal and gravitational forces.. These released labels, and the few that fall between the space 188, land onto a forwardly inclined plate member 164 below
10 the rollers and are transported to the vibrating filter 110 below via the flushing action of water 196 introduced at the top end of the plate member 164.

An advantage of the separator 170 over the separator 70 is that the former employs far fewer rollers and driving mechanisms, and so the separator 170 performs the same function as the separator 70 but at a lower operating cost, and with less down-time
15 for maintenance and repair.

The operation and many advantages of the present invention may now be better understood. To summarize the process, a briquette of raw bottles (i.e. with labels attached), including bottle caps, cap rings, loose labels and dirt, indicated by 11, is fed into the releaser drum 36 at its feed end 32. As the releaser is rotated and the fixed
20 helical screw 40 within moves the briquette forward, steam is injected into the drum to

maintain a temperature sufficiently high to urge de-clumping of individual bottles from the briquette, cleaning of the bottles and the release of labels from the bottles. The drum is also oscillated between each full rotation to agitate the mixture and promote washing and label liberation. Unlike prior art systems, the introduced steam travels the length of the drum to its outlet 34. The steam and movement of the drum result in the complete de-clumping of the briquettes and release of labels 16 from the now substantially "delabeled" bottles 14. Although many of the labels fall from the bottles, some remain on the bottles, albeit in a loosened state. Not all labels need to be released from the bottles upon exiting the outlet end 34 since the next stage, namely the label separator 70/170, should complete the task of removing the labels and other contaminants from the bottles. Optionally, water may be introduced at preset intervals through piping 18 at the releaser's inlet 32 to help flush the releaser's contents toward the outlet 34.

The mixture of bottles, labels and contaminants exiting the drum next encounters the first end 184 of the separator 170. The separator essentially separates the labels 16 and other contaminants (i.e. caps, cap rings and dirt) from the mixture to provide a supply of cleaned and delabeled plastic bottles 14. The separation is accomplished by passing the mixture over the two counter-rotating rollers 172 inclined to the horizontal. The rollers, including the bars 190 fixed thereto, cause the bottles to bounce and flip, urging any still-attached labels to peel off and encouraging liquid removal from inside the bottles. The loose labels and other contaminants either fall by gravity through space 188

between the rollers, or are urged by the bars through the gaps 192, rotating along with the rollers until they are at approximately the lowest position where they release from the rollers (due to combined centripetal and gravitational forces) and fall onto the plate member 164 below. The plate member 164 channels the water (i.e. the water exiting the drum outlet 34 and the water introduced at the separator's input end by piping 196), and any labels or contaminants which are caught up in the water, into the vibrating filter 110. The delabeled bottles 14 that proceed by gravity to the separator's output end 186 are carried away, as by a conveyor belt, for further processing, namely sorting according to colour, type of plastic, shredding and pelletization. The labels and contaminants that fall from the separator into the vibrating filter 110 are then collected for further use or disposal.

In addition to the advantages already mentioned, the present invention requires little supervision, maintenance and shut-down time for cleaning and removal of paper/plastic jams.

Another advantage is that the present system does not require any water (hot or cold) to process the bottles (i.e. de-clump the briquettes and de-label the bottles) and to pass them through from the releaser's inlet 32 to the separator's output end 186. The screw mechanism 40 is adapted to push the bottles through the releaser 30 with steam alone, and gravity (not water) moves the bottles along the label separator 170. Water is only optionally introduced into the releaser as noted earlier to help flush the releaser of

labels and contaminants, and water is used at the separator 170 for the limited purpose of flushing the plate member 164 of labels and contaminants.

Yet another advantage of the present system is that the processing of the bottles is achieved with low pressure steam, thus avoiding the higher labour and other costs
5 associated with operation under high pressure steam.

The above description is intended in an illustrative rather than a restrictive sense, and variations to the specific configurations described may be apparent to skilled persons in adapting the present invention to other specific applications. Such variations are intended to form part of the present invention insofar as they are within the spirit and
10 scope of the claims below.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A system for processing bales of containers with labels thereon comprising:
5 a releaser with steam introduced thereinto for breaking apart said bales to provide individual containers and for promoting label release from said containers; and,
a separator for receiving said containers and labels from said releaser, said separator comprising at least two counter-rotating rollers inclined to the horizontal adapted to urge said labels away from said containers.

10

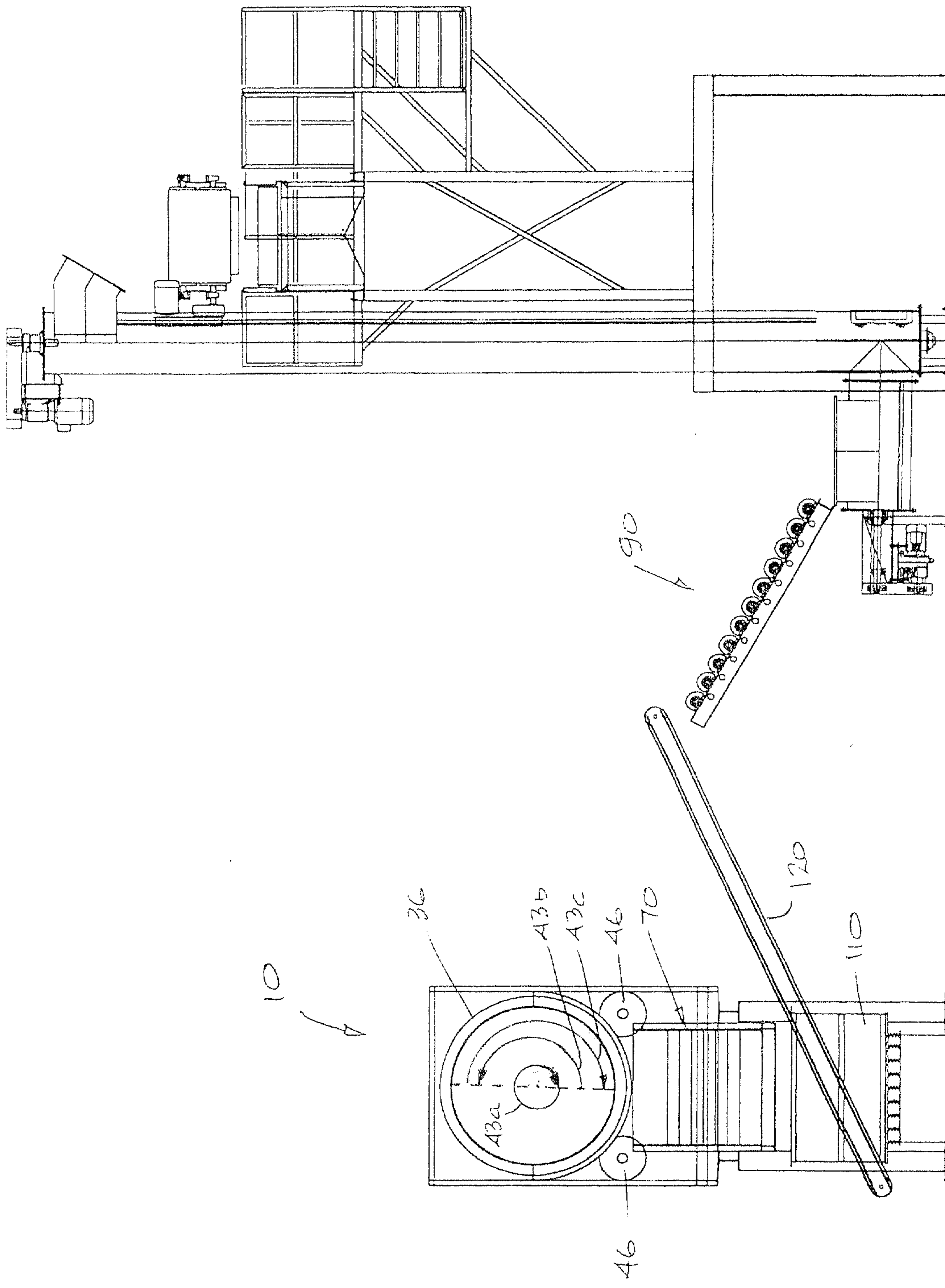


FIG. 2

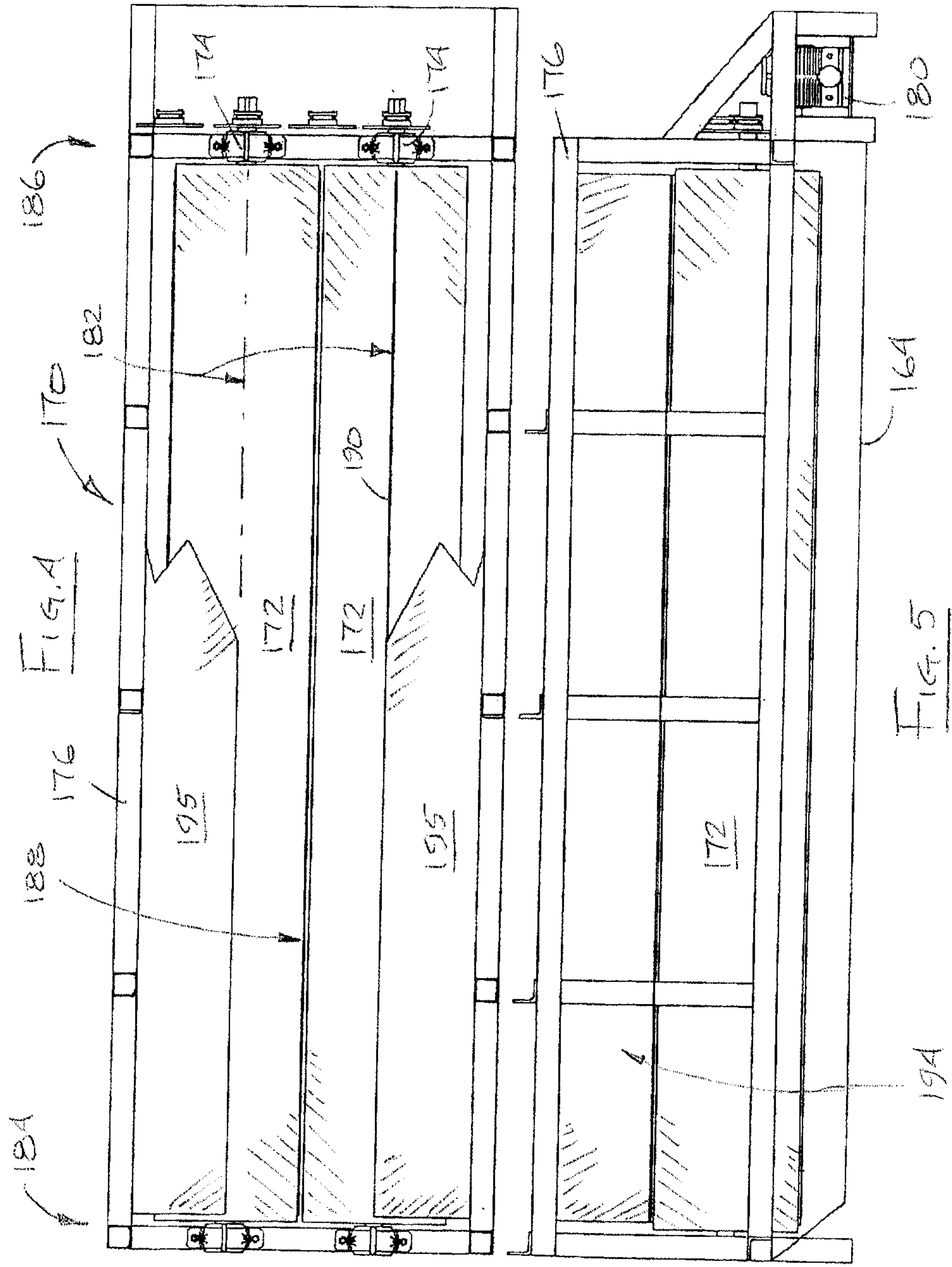


FIG. 5

FIG. 6

Fig. 6a

