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(72) Inventor ROBERT GORDON YOUNG

(54) IMPROVEMENTS IN OR RELATING TO BALERS

(71) We, SPERRY RAND CORPORATION, a Corporation organised and existing under the laws of the State of Delaware, United States of America, of 1290 Avenue of the Americas, New York, New York 10019, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to balers and is concerned with improved means for controlling the shape of bales successively formed within and discharged from the bale chambers of the balers.

A conventional baler includes an elongated, longitudinally extending bale chamber within which bales are successively formed and moved towards a rear discharge end thereof. In order to form bales having a desired density, it is common practice to provide spaced top and bottom rails for the bale chamber, the rails being longitudinally orientated and pivotally mounted on the baler at their forward ends.

Under some baling conditions, such as in light crop materials, in order to be able to achieve the desired level of bale density, the rearward ends of the rails must be held closer to each other than the forward ends by an adjustable tension control device which is commonly provided on the bale chamber such that the rails converge towards one another at their rearward ends. Under such conditions, the bale chamber is provided with its shortest vertical dimension at the rear discharge end thereof which forms a restriction within the bale chamber to the passage of a bale and forces the rearward ends of the top and bottom rails into the top and bottom surfaces of the bale. Because of the added effect of gravity, the rearward end of the top rail is forced deeper into the top surface of a bale discharging from the bale chamber than is the rearward end of the bottom rail into the bottom surface of the bale. Bales formed under such conditions emerge from the bale chamber in a distorted form or shape which causes problems in subsequent handling and storage of the bales.

The present invention aims to provide improved control of bale shape and thereby obviate the aforementioned problems associated with distorted bale shape.

According to one aspect of the invention there is provided a baler having a bale chamber with the bale chamber including a rear discharge end towards which in use bales are successively moved as the bales are formed in the chamber, the bale chamber having bale shape control means comprising a top rail having front and rear portions, an elongated, generally straight bottom rail, and means allowing the rear portion of the top rail to occupy a position in which the rear portion is spaced above and substantially parallel to the bottom rail and the front portion of the top rail to occupy a position in which the front portion extends rearwardly and downwardly towards the bottom rail.

According to another aspect of the invention there is provided a baler including an elongated bale chamber having a bottom and within which bales are successively formed and moved toward a discharge end of the bale chamber, the chamber having a compound member forming a top of the bale chamber and including a front portion and a rear portion, the front portion having a forward end which is pivotally mounted on a frame of the baler and a rearward end which is pivotally connected to a forward end of the rear portion of the compound member, and means enabling the rear portion of the compound member to occupy a position in which the rear portion is spaced above and substantially parallel to the bottom and enabling the front portion of the compound member to occupy a position in which the front portion extends rearwardly and downwardly towards the bottom, whereby a forward section is defined in said

bale chamber remote from its discharge end and between the bottom thereof and the front portion of said compound member, in which forward section the bales are subjected to increasing compressive force as the bales are successively moved therethrough towards said discharge end, while a rear section is defined in the bale chamber extending from the rear of the forward section to the discharge end thereof and between the bottom thereof and the rear portion of said compound member, in which rear section the bales are subjected to substantially uniform compressive force as the bales are successively moved therethrough towards the discharge end.

By recourse to the invention, substantially uniform and equal force can be imposed on the bale along the length thereof after it has been banded and tied and as it emerges from the discharge end of the bale chamber, which reduces any tendency toward bale shape distortion. Also, initial rail penetration into the top surface of the bale may be provided forward of and remote from the discharge end of the bale chamber, which further reduces the tendency toward bale distortion. Furthermore, a greater proportion of rail surface contact may be maintained with the top surface of the bale, which allows the desired level of bale density to be reached through the application of a reduce force from the rail, whereby excessive forcing of the top rail into the top surface of the bale is avoided and better bale shape is attained. As a consequence, the need for auxiliary restricting devices, such as hay wedges, in the rear portion of bale chamber is reduced or eliminated.

A hay baler according to the invention will now be described, by way of example, with reference to the accompanying drawings, in which: —

Figure 1 is a perspective view of the baler,

Figure 2 is an enlarged, fragmentary elevation of the rear portion of the left-hand side of a bale chamber of the baler,

Figure 3 is a top plan view of the portion of the bale chamber shown in Figure 2,

Figure 4 is a fragmentary view taken on the line 4–4 of Figure 2,

Figure 5 is a fragmentary view taken on the line 5–5 of Figure 2,

Figure 6 is an enlarged, fragmentary plan view of an articulated top rail of the bale chamber of Figure 3, showing the pivotal connection between front and rear members of the top rail,

Figure 7 is an enlarged, fragmentary elevation of the top rail shown in Figure 6,

Figure 8 is a front elevation of the rear member of the top rail, and

Figure 9 is a rear elevation of the front member of the top rail.

In the following description, reference to "right-hand" and "left-hand" relate to an observer standing at the rear of the baler and facing in the direction of forward travel, which is towards the left in Figure 1.

Referring now to Figure 1, the hay baler 10 includes a frame 12 supported and made mobile by right-hand and left-hand rotatably mounted ground-engaging wheels 14, 16. The baler has a tongue 18, pivotally connected to the frame 12 and extending forwardly from the latter. The tongue 18 has a hitch end 20 intended to be pivotally connected to the drawbar of a tractor (not shown) by which the baler 10 may be towed across a field.

The baler 10 further includes a longitudinally extending bale chamber 22 extending along the left-hand side of the frame 12 and having a forward end on which a flywheel 24 is rotatably mounted. Also, included on the baler 10 is a feeder housing 26 mounted transversely on the frame 12 adjacent the right-hand side of the bale chamber 22. Within the housing 26 is mounted a conventional feeding mechanism (not shown) adapted to convey crop material into the bale chamber 22 through an inlet opening (not shown) formed in the right-hand side of the chamber 22. A pick-up assembly (not shown), mounted on the frame 12 and positioned forwardly of and below the feeder housing 26, is adapted to lift crop material from the field and deliver it to the feeding mechanism.

A plunger (not shown) is mounted for reciprocating movement in the forward portion of the bale chamber 22 for forming the crop material into rectangular bales. As the bales are successively formed within the bale chamber 22, they are moved progressively towards the rear end of the bale chamber 22. As each bale is completed, it is banded with a suitable tie by a tying mechanism 28 mounted on the bale chamber 22. Once completed, each bale emerges from the rear or discharge end 30 of the bale chamber 22.

An input driveline 32, connected at its rear end to the baler flywheel 24, is adapted to be connected at its forward end to the power take-off (pto) shaft of the tractor to supply rotary driving power to the operating components of the baler 10 through additional power transmitting components (not shown).

Referring more particularly to Figures 2 and 3, there is illustrated in detail the rear portion of the bale chamber 22 through which the completed bales successively move toward the discharge end 30. The rear portion of the bale chamber 22 is generally rectangular in cross-section and defined in

part by laterally spaced, generally parallel side members 34, 36. As illustrated, the side members 34, 36 respectively define vertically disposed sidewalls 38, 40 and are channel shaped, having inturned horizontal flanges 42, 44 along their upper edges and similar inturned horizontal flanges 46, 48 along their lower edges. These flanges define portions of the top and bottom walls of the rear portion of the bale chamber 22. The side members 34, 36 are maintained in substantially parallel relationship by upper and lower pairs of spaced, rigid, arched braces 50, 52 which extend transversely between the upper and lower flanges 42, 44 and 46, 48.

In the forward portion of the bale chamber 22 in which charges of crop material are formed into bales, the bottom of the bale chamber 22 is closed by a sheet metal structure 54 except for longitudinally extending slots (not shown) which allow entry into the bottom of the bale chamber 22 of needles 56 of the bale tying mechanism 28. The top of the bale chamber 22, forwardly of a collar- or box-like mounting frame 58 attached to the members 34, 36, is similarly closed by a sheet metal structure 60 except for longitudinally extending slots (not shown) which allow the top portions of the respective needles 56 to emerge from the top of the bale chamber 22 and deliver portions of the tying medium to other components of the tying mechanism 28 supported above this portion of the bale chamber 22.

As mentioned previously, crop material to be baled is fed into the forward portion of the bale chamber 22 through an inlet opening (not shown). Successive charges of material so fed into the bale chamber 22 are compacted into a bale by the plunger (not shown) which reciprocates longitudinally within the forward portion of the bale chamber 22 and past the inlet opening therein. As seen in Figures 2 and 3, the rear portion of the bale chamber 22 is sufficient in length to accommodate two previously formed and tied bales B_1, B_2 while another bale is being formed in the forward portion of the bale chamber 22. The forward end of the bale B_2 thus, in effect, serves as the end abutment against which the crop material being formed into the new bale (not shown) is compressed. As the new bale is formed, both completed bales B_1, B_2 are gradually pushed rearwardly in increments upon each working stroke of the plunger toward the discharge end 30 of the bale chamber and eventually emerge therefrom.

Movement of the bales B_1, B_2 through the bale chamber 22 towards the discharge end 30 is resisted by bale shape control means generally designated by numeral 62 in Figures 1 to 3. The means 62 allow the achievement of a desired level of density of crop material in the bale being formed in the forward portion of the bale chamber 22 while, at the same time, providing improved control over the shape of the completed bales B_1, B_2 as they successively move through the rear portion of the bale member 22.

The bale shape control means 62 includes an improved top rail 64 having front and rear portion 66, 68 respectively, a conventional elongated bottom rail 70 and conventional force control means 72 on the bale chamber 22 for adjusting the position of the top rail 64 relative to the bottom rail 70.

Hitherto, the bale chamber of a baler has been provided with a generally straight bottom rail which forms the central portion of the bottom wall of the bale chamber. Similarly, the bottom tension rail 70 of the present embodiment extends centrally between the lower inturned horizontal flanges 46, 48 to form a central portion of the bottom of the bale chamber 22. The bottom rail 70 is pivotally connected for vertical movements about a horizontal axis at its forward end by pins 74 (only the left-hand pin being seen in Figure 2). The rail 70 is pivoted to a pair of spaced brackets 76 (only the left-hand bracket being shown in Figure 2) attached on and projecting rearwardly from a lower transverse portion 78 of the collar-like mounting frame 58.

The control means 72 includes upper and lower channel members 80, 82 respectively disposed above and below, and extending transversely across, the bale chamber 22. The corresponding opposite end portions of the upper and lower transverse channel members 80, 82 are respectively interconnected by identical adjustment devices 84 of the means 72.

Each of the devices 84 includes a vertically extending rod 86 received through an opening formed in the respective end portion of the upper transverse channel member 80 and having an integral crank 88 at an upper end by which the rod may be rotated manually. The lower end portion of the rod 86 remote from its crank end is threaded and screwed through a nut element 90 fixed on the upper end of a vertically-disposed sleeve 92 which is received through an opening formed in the respective end portion of the lower transverse channel member 82. The lower end of the sleeve 92 below the lower channel member 82 has a head 94 which retains the sleeve 92 in the opening in the respective lower channel member. A bolt 96 fastened through the lower channel member 82 below the sleeve head 94 limits downward

movement of the sleeve 92 relative to the lower channel member 82.

Each of the devices 84 further includes a coil spring 98 surrounding the rod 86 and confined between the top surface of the respective end of the upper channel member 80 and a collar 100 fixed on the rod 86 adjacent to and below the crank 88, whereby clockwise rotation of the crank 88, as viewed in Figure 3, screws the rod 86 into the nut element 90 and increasingly compresses the spring 98 which thereby forces the upper and lower channel members 80, 82 towards each other. Counterclockwise rotation of the crank 88 screws the rod 86 out of the nut element 90 and increasingly relaxes the spring 98 with accompanying separation of the members 80, 82.

Hitherto, it has been common practice to provide a generally straight elongated top rail on the bale chamber of a baler, the top rail being pivotally mounted at its forward end about a horizontal axis for vertical movement. The force control mechanism has been commonly provided on the bale chamber adjacent the rear discharge end thereof so as to resist the movement of completed bales therethrough by holding the rear ends of the straight top and bottom rails closer together than the forward ends thereof. In so doing, the control mechanism causes the rails to converge toward one another at the rearward end of the bale chamber. As mentioned earlier, bales formed under such conditions emerge from the bale chamber in a distorted shape which causes problems in subsequent handling and storage of the bales.

The improved top rail 64 of the present embodiment replaces the above-mentioned conventional straight top rail, and in the present embodiment the force control means 72 is relocated forwardly of the discharge end 30 of the bale chamber 22. The upper transverse channel member 80 is located at an intermediate position between the opposite ends of the rear portion 68 of the top rail 64. The rear portion 68 has a bale-engaging base 102 (Figures 5 to 8) which merges at its opposed longitudinal edges into respective upstanding sides 104, 106 having upper inturned horizontal flanges 108, 110. The upper channel member 80 is U-shaped, having a base 112 with upstanding spaced sides 114, 116. As seen in Figures 3 and 5, the rear portion 68 is attached to a mid-section of the upper channel member 80 by a pair of bolts 118 which clamp the inturned flanges 108, 110 to the base 112.

The bottom rail 70 is formed by a bale-engaging base 120 which merges at its opposed longitudinal edges into respective spaced sides 122, 124 (Figure 4) which have lower inturned horizontal flanges 126, 128. The lower transverse channel member 82 is located directly below the upper channel member 80 and below the bottom rail 70. The lower channel member 82 is U-shaped having a base 130 with depending spaced sides 132, 134. As seen in Figure 4, the bottom rail 70 is attached to a mid-section of the lower channel member 82 by a pair of bolts 136 which clamp the inturned flanges 126, 128 to the base 130.

Normally, the devices 84 of the control means 72 are similarly adjusted so as to dispose the rear portion 68 of the top rail 64 in a position in which it is substantially parallel to the bottom rail 70, the front portion 66 of the top rail 64 being inclined downwardly and rearwardly towards the bottom rail 70, as shown in Figure 2.

A forward section of the chamber 22 is defined below the inclined front portion 66 of the top rail 64, and in this forward section the bales are subjected to increasing compressive force as they move towards the end 30. A rear section of the chamber 22 is defined below the horizontal rear portion 68 of the top rail 64, and in this forward section the bales are subjected to a substantially uniform compressive forces by the rails.

It will be appreciated that initial rail penetration into the top surface of each of the successive bales occurs near the rear end of the forward portion 66 of the top rail 64 and thus forward of and remote from the discharge end 30 of the bale chamber 22. This reduces the tendency to bale distortion which occurred hitherto due to rail penetration at the discharge end of the bale chamber. Furthermore, due to the above-described positional relationship of the rails 64, 70, a greater proportion of rail surface contact is maintained with the top surface of each of the bales by the bale-engaging base 102 of the rear portion 68 of the top rail 64. This allows the desired level of bale density to be reached in the bale being formed in the forward portion of the bale chamber 22 through the application of a level of force which is less than that necessary hitherto, so that forcing of the top rail into the top surface of the bale is avoided and better bale shape is attained.

The front and rear portions 66, 68 of the top rail 64 are pivotally connected together. The forward end of the front portion 66 of the top rail 64 is pivotally mounted about a horizontal axis and by pins 135, on a pair of spaced brackets 137 attached to and projecting rearwardly from an upper transverse portion 139 of the collar-like mounting frame 58.

Referring to Figures 6, 7 and 9, it will be seen that the front top rail portion 66 is formed by a bale-engaging base 138 which merges at its opposed longitudinal edges

into respective upstanding sides 140, 142 having upper inturned horizontal flanges 144, 146. The base 138 has an elongated slot 148 through which extends a metering wheel 150 of the tying mechanism 28.

The rear end portions of the sides 140, 142 each have a square opening 152 receiving a carriage bolt 154. Plates 156, 158 are respectively welded to the inner surfaces of the rear end portions of the sides 140, 142 and each has a circular opening 160 centred on the corresponding square opening 152 and receiving a threaded stem 162 of the bolt 154. Stop member 164, 166, each in the form of a flat plate, are vertically disposed between, and welded to, the upper surface of the base 138 and respective lower surfaces of the inturned flanges 144, 146 at locations similarly spaced inwardly from the respective plates 156, 158. Each of the stop members 164, 166 has a circular opening 167 aligned with the openings 152, 160.

Referring to Figures 6, 7 and 8, rear ends 172, 174 of tabs 168, 170 are welded to the inner surfaces of the front end portions of the sides 104, 106 respectively. Forwardly of the top rail rear portion 68, the tabs 168, 170 converge forwardly to respective forward ends 176, 178 which are thereby inwardly offset with respect to the ends 172, 174. The ends 176, 178 are disposed between the respective stop members 164, 166 and plates 156, 158 and in close side-by-sile relationship with the plates 156, 158, as shown in Figure 6. Each of the ends 176, 178 has a circular opening 180 formed therein which may be aligned with the openings 152, 160 and 167.

When the carriage bolts 154 are inserted through the aligned openings, 152, 160 and 167 as shown in Figures 6 and 7, and respective nuts 182 are threaded thereon, the front and rear portions 66, 68 of the top rail 64 are pivotally coupled together.

The stop members 164, 166 project rearwardly frim the top rail front portion 66 and are disposed between the upper inturned flanges 108, 110 and the base 102 of the top rail rear portion 68. A flat plate 184 bridges the flanges 108, 110 and is welded thereto to strengthen the rear portion 68. The rearwardly projecting portions of the stop members 164, 166 have upper edges 186, 188 and lower tapered edges 190, 192. The portions 66, 68 may pivot in a direction which raises the pivot axis until the edges 186, 188 of the stop members 164, 166 abut the inturned flanges 108, 110 and may pivot in a direction which lowers the pivot axis until the lower tapered edges 190, 192 of the stop members 164, 166 abut the base 102. When the upper edges 186, 188 of the stop members 164, 166 engage inturned flanges 108, 110, the edges 186 and 188 are horizontal and the portions 66, 68 extend generally horizontally along the top of the side members 38, 40 of the base chamber 22. Thus, the top rail is prevented from rising out of the bale chamber 22. The portions 66, 68 of the top rail may only pivot on the lower side of a horizontal plane occupied by the portions 66, 68 when they extend substantially hirizontally. The only significance attached to the lower limit defined by the tapered edges on the stop members 164, 166 is that the taper be sufficient to accommodate a desired amount of downward articulation of the portions 66, 68 relative to each other.

WHAT WE CLAIM IS:—

1. A baler having a bale chamber with the bale chamber including a rear discharge end towards which in use bales are successively moved as the bales are formed in the chamber, the bale chamber having bale shape control means comprising a top rail having front and rear portions, an elongated, generally straight bottom rail, and means allowing the rear portion of the top rail, and means allowing the rear portion of the top rail to occupy a position in which the rear portion is spaced above and substantially parallel to the bottom rail and the front portion of the top rail to occupy a position in which the front portion extends rearwardly and downwardly towards the bottom rail.

2. A baler according to Claim 1, wherein the front and rear portions of the top rail are pivotally interconnected.

3. A baler according to Claim 2, wherein the front and rear portions of the top rail are pivotally connected together at respective adjacent ends about a substantially horizontal axis, and stop means are provided to limit relative pivotal movement of the front and rear portions to movement on the lower side only of the generally horizontal plane which passes through the pivotally connected ends of the front and rear portions when the latter extend substantially horizontally.

4. A baler according to Claim 3, wherein the stop means comprise a stop member fixed on one of the front and rear portions of the top rail and projecting therefrom into the other of said portions, and a part of the other one of said portions which overlies the stop member and abuts the latter when the portions extend in said generally horizontal plane.

5. A baler including an elongated bale chamber having a bottom and within which bales are successively formed and moved toward a discharge end of the bale chamber, the chamber having a compound member forming a top of the bale chamber and

including a front portion and a rear portion, the front portion having a forward end which is pivotally mounted on a frame of the baler and a rearward end which is pivotally connected to a forward end of the rear portion of the compound member, and means enabling the rear portion of the compound member to occupy a position in which the rear portion is spaced above and substantially parallel to the bottom and enabling the front portion of the compound member to occupy a position in which the front portion extends rearwardly and downwardly towards the bottom whereby a forward section is defined in said bale chamber remote from its discharge end and between the bottom thereof and the front portion of said compound member, in which forward section the bales are subjected to increasing compressive force as the bales are successively moved therethrough towards said discharge end, while a rear section is defined in the bale chamber extending from the rear of the forward section to the discharge end thereof and between the bottom thereof and the rear portion of said compound member, in which rear section the bales are subjected to substantially uniform compressive force as the bales are successively moved therethrough towards the discharge end.

6. A baler according to Claim 5, wherein the bale chamber has a pair of laterally spaced, substantially parallel side members, upper and lower cross members located remote from said discharge end and respectively extending between and secured to the upper and lower edges of said side wall members, said bottom being an elongated bottom wall member disposed generally between the lower edges of the side wall members and connected to the lower cross member, and the front portion being pivotally connected at its forward end to the upper cross member.

7. A baler constructed and arranged substantially as herein particularly described with reference to the accompanying drawings.

Agent for the Applicants:
J. SINGLETON,
Chartered Patent Agent.

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1574097 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

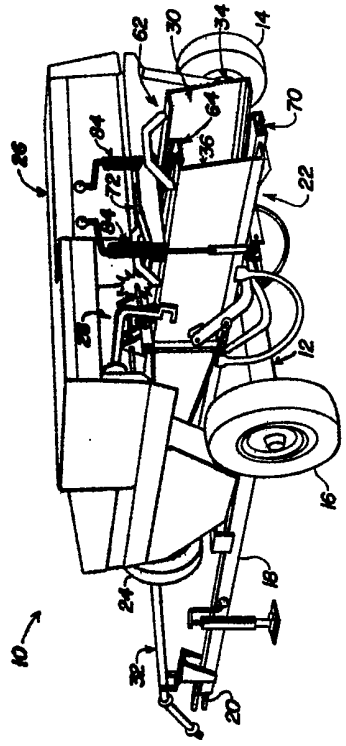
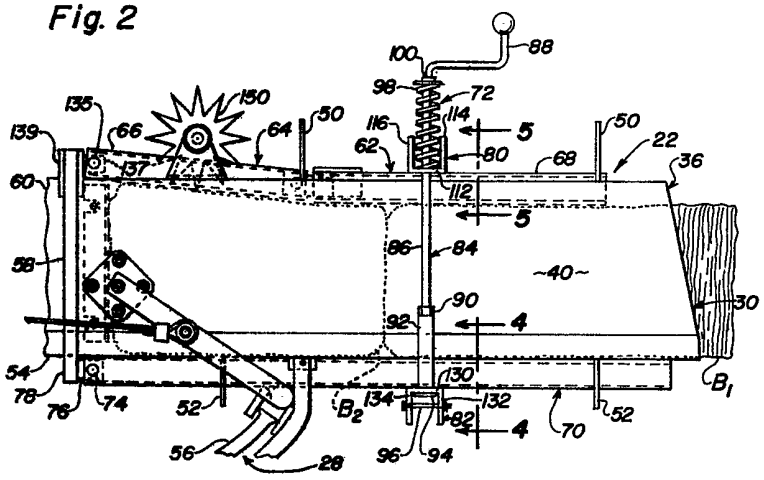


Fig. 1

Fig. 2



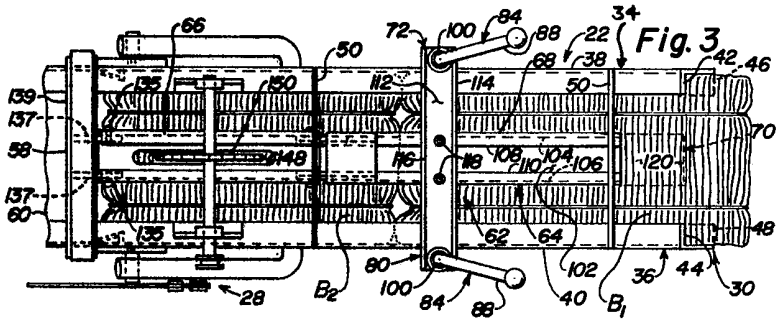


Fig. 3

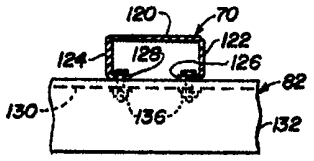


Fig. 4

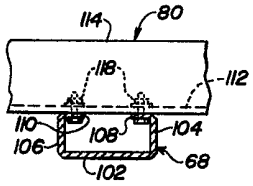


Fig. 5

Fig. 6

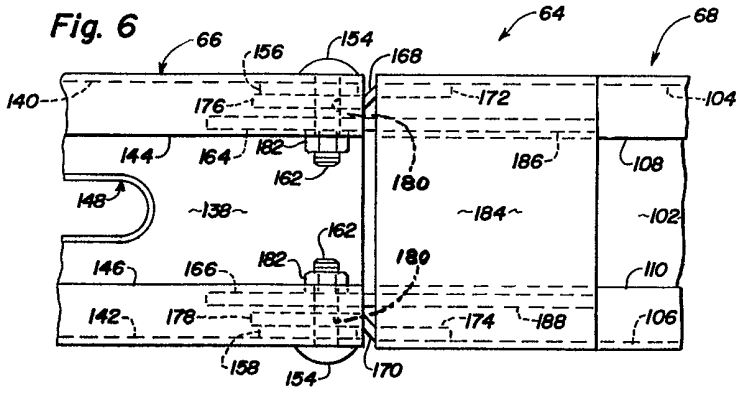


Fig. 7

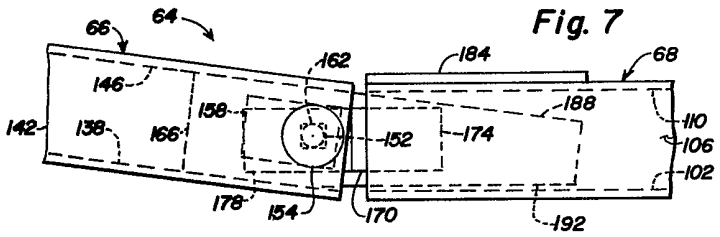


Fig.8

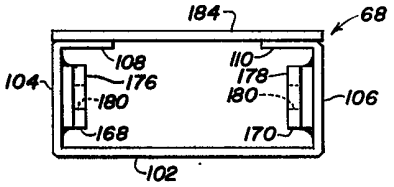


Fig. 9