

May 26, 1970

V. J. THOMSON

3,513,522

UNBALING MACHINE

Filed April 3, 1967

8 Sheets-Sheet 1

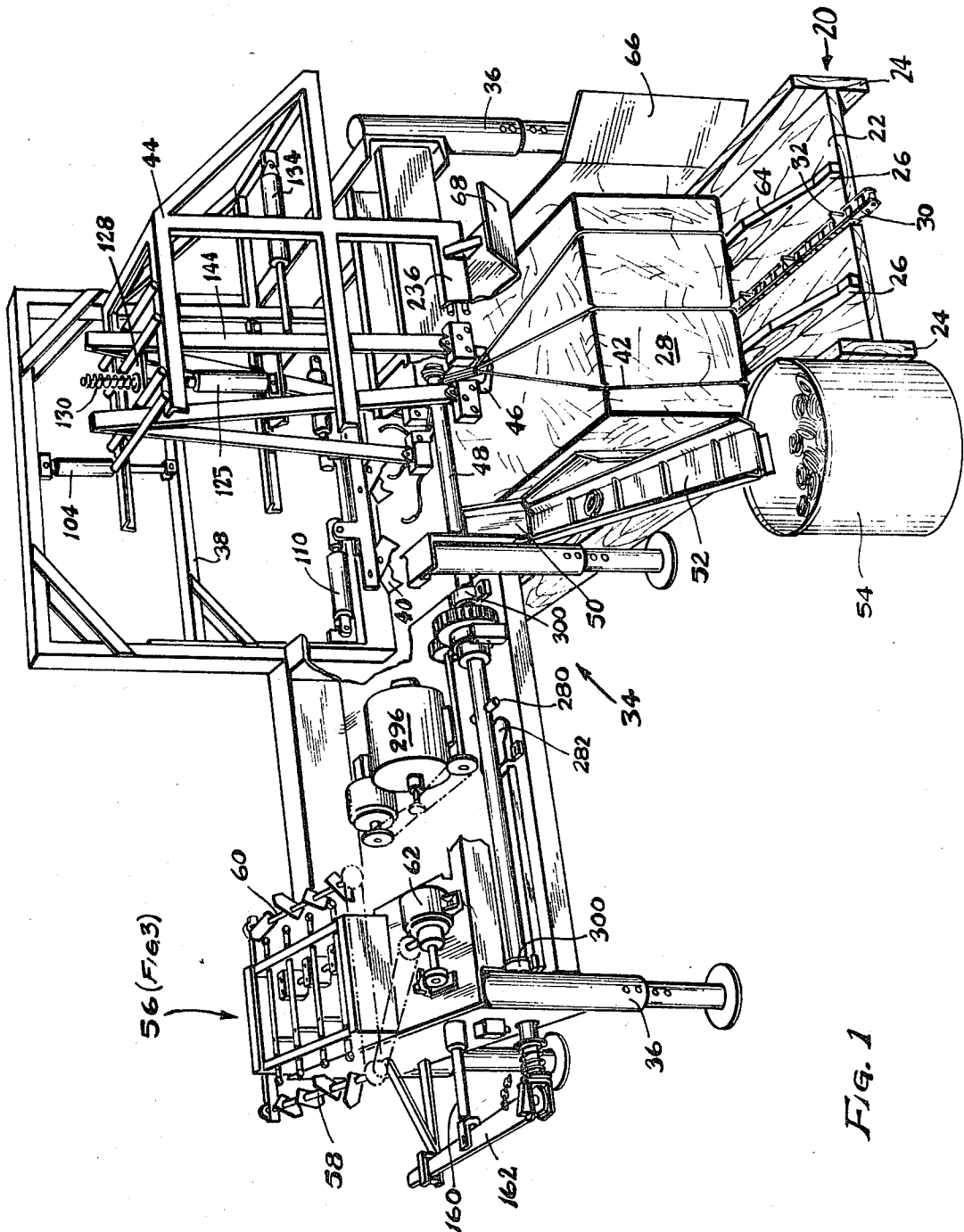


Fig. 1

INVENTOR.

BY **VICTOR J. THOMSON**
Warren T. Jessup
attorney

May 26, 1970

V. J. THOMSON
UNBALING MACHINE

3,513,522

Filed April 3, 1967

8 Sheets-Sheet 2

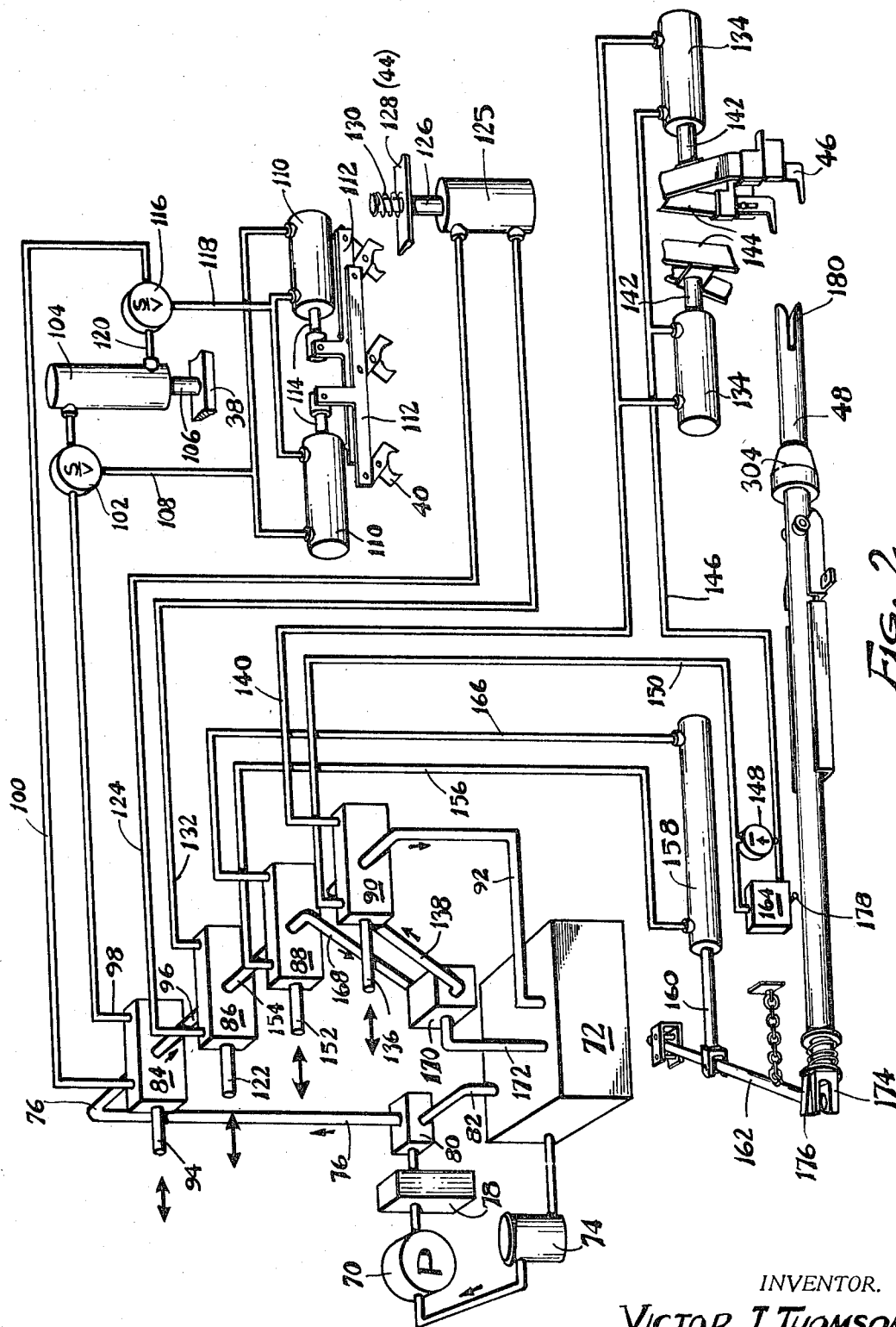


FIG. 2

INVENTOR.
VICTOR J. THOMSON
BY
Warren T. Jessup
Attorney

May 26, 1970

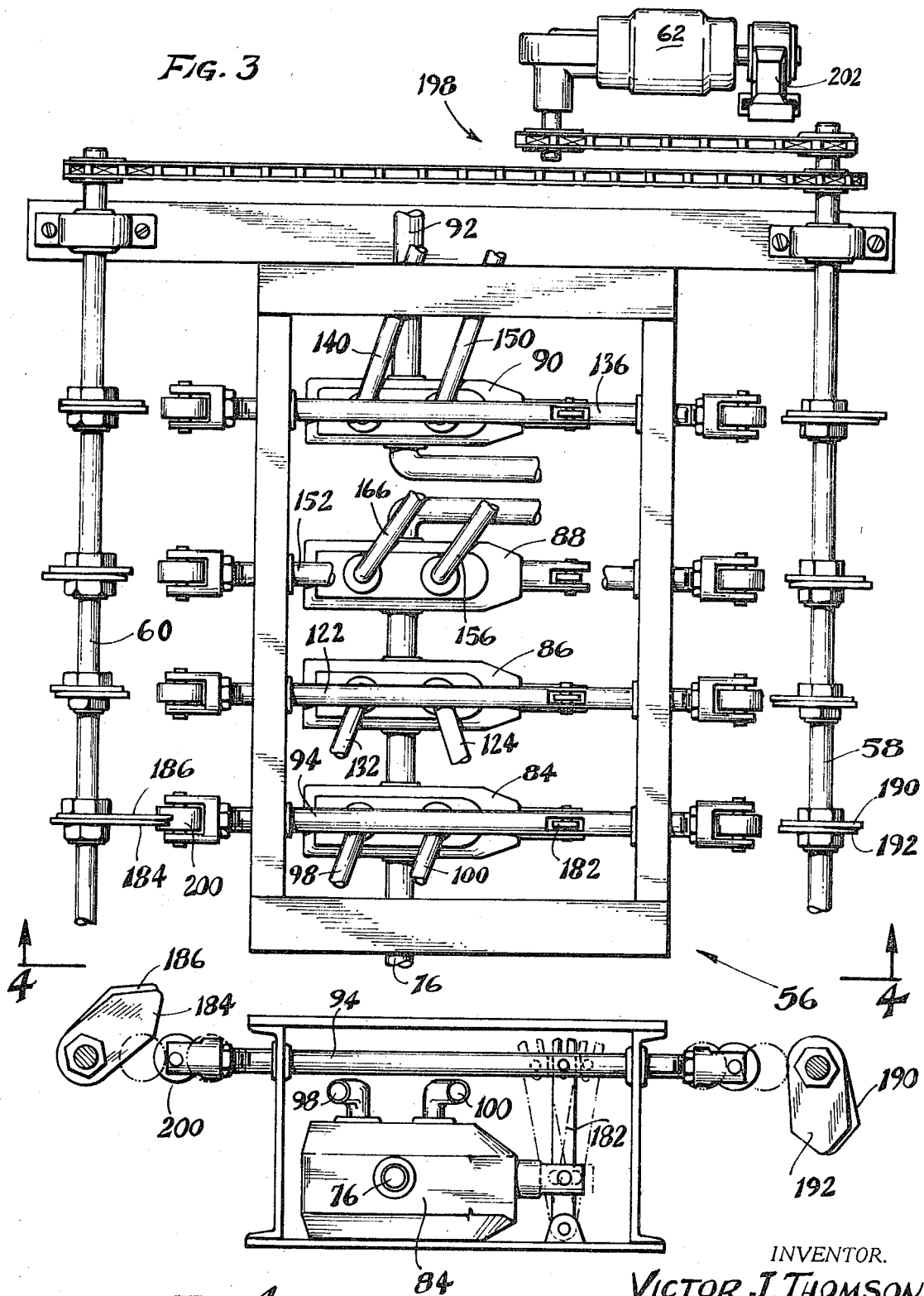
V. J. THOMSON

3,513,522

UNBALING MACHINE

Filed April 3, 1967

8 Sheets-Sheet 3



INVENTOR.

VICTOR J. THOMSON
BY
Warren T. Jessup
attorney

May 26, 1970

V. J. THOMSON

3,513,522

UNBALING MACHINE

Filed April 3, 1967

8 Sheets-Sheet 4

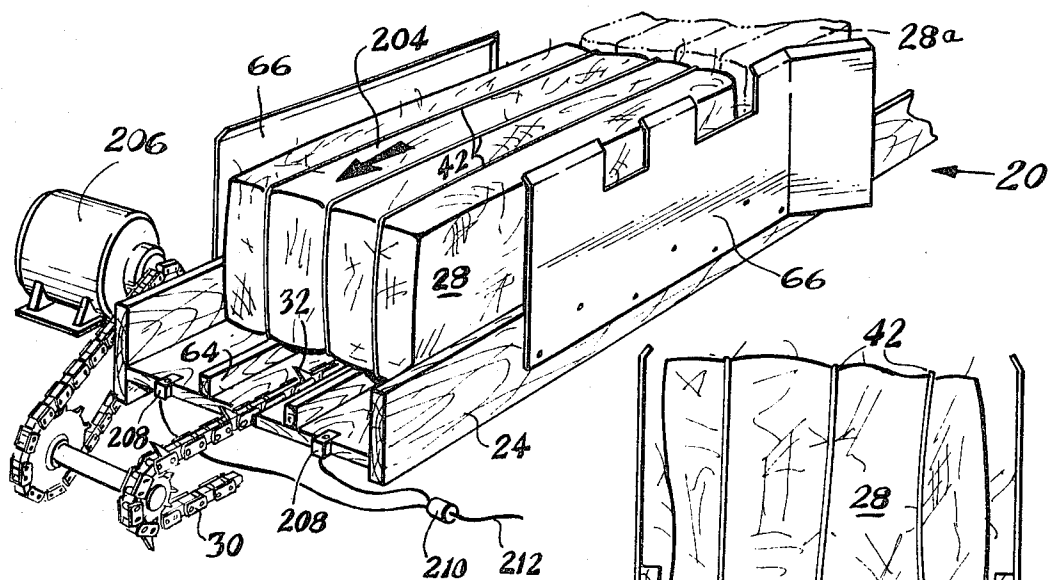


FIG. 5

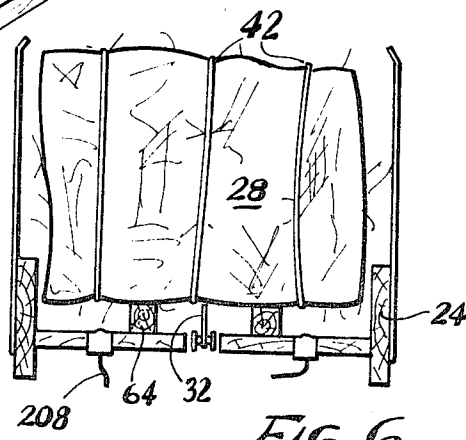


FIG. 6

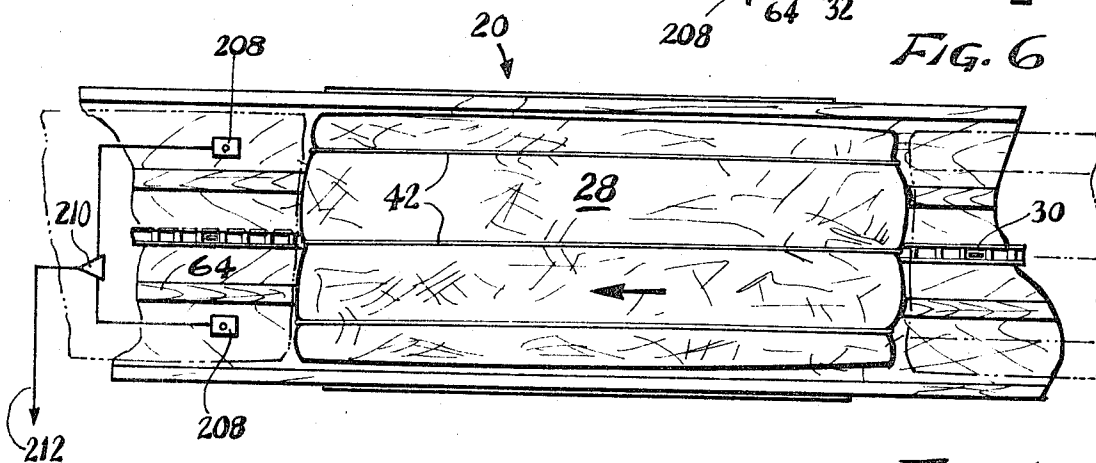


FIG. 7

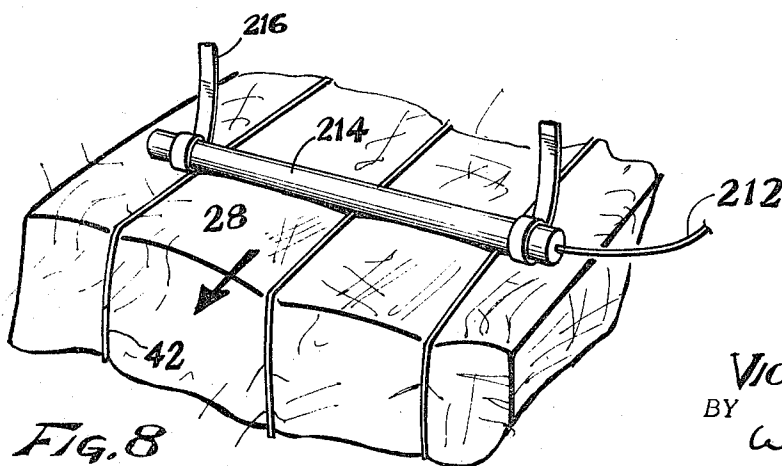


FIG. 8

INVENTOR.
VICTOR J. THOMSON
BY Warren T. Jessup
attorney

May 26, 1970

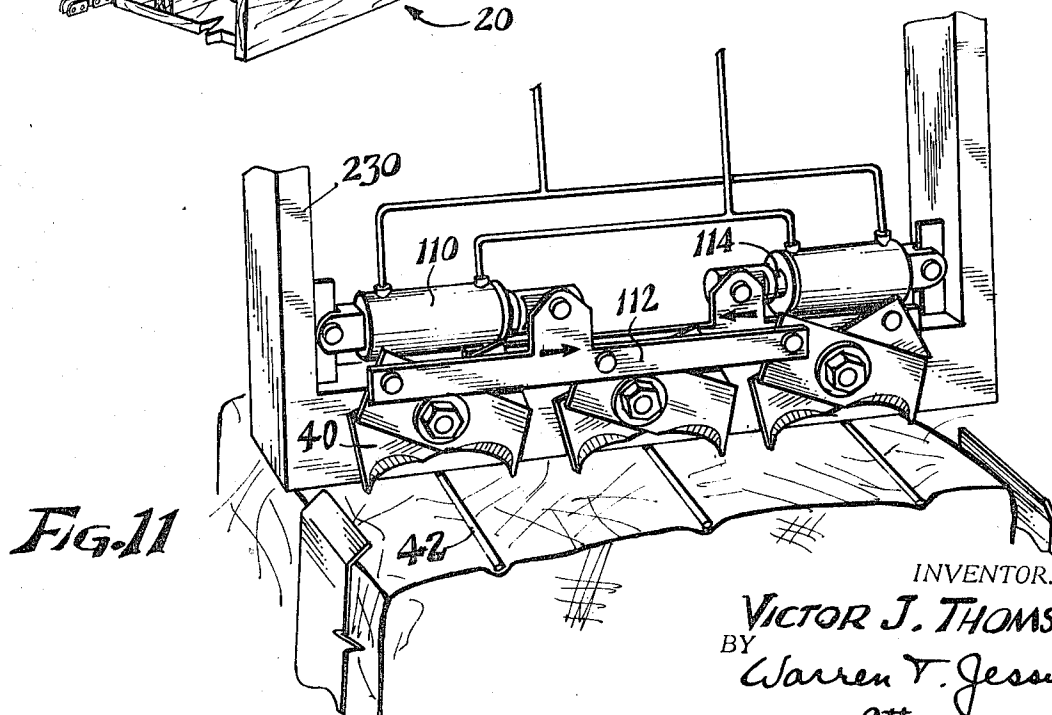
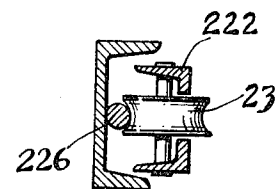
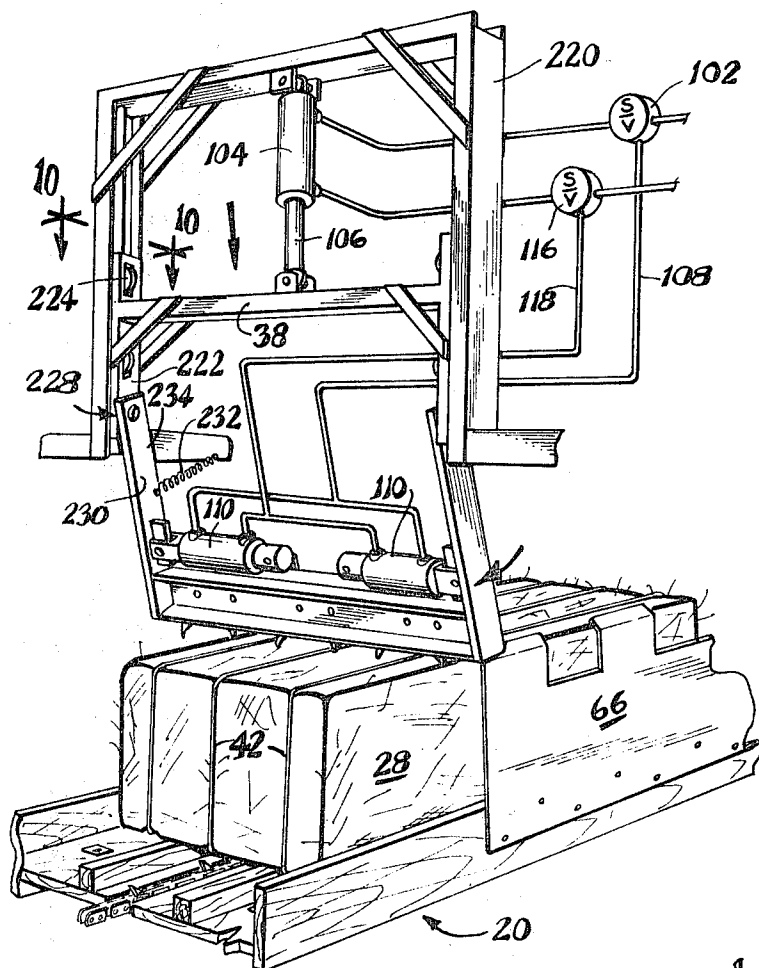
V. J. THOMSON

3,513,522

UNBALING MACHINE

Filed April 3, 1967

8 Sheets-Sheet 5



INVENTOR.

VICTOR J. THOMSON
BY Warren T. Jessup
attorney

May 26, 1970

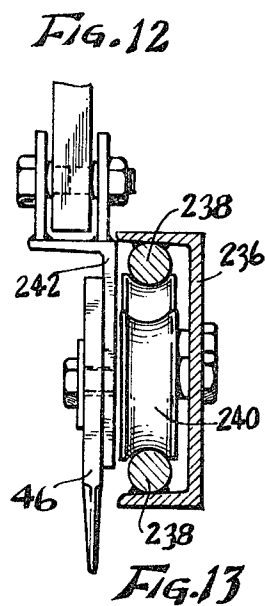
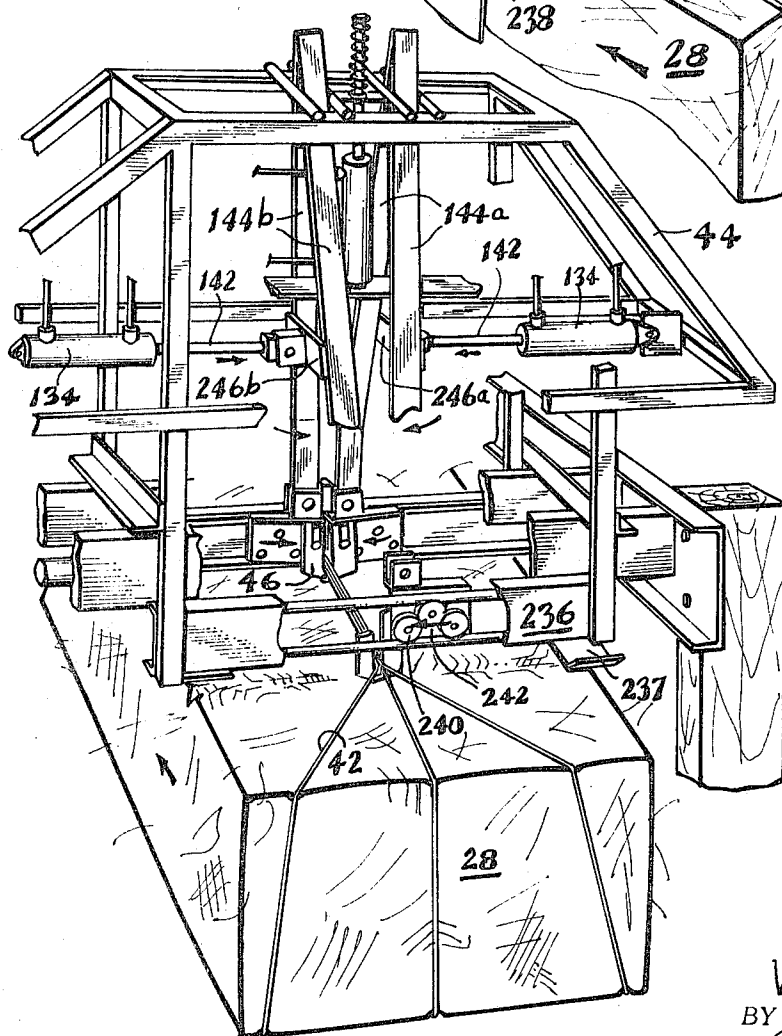
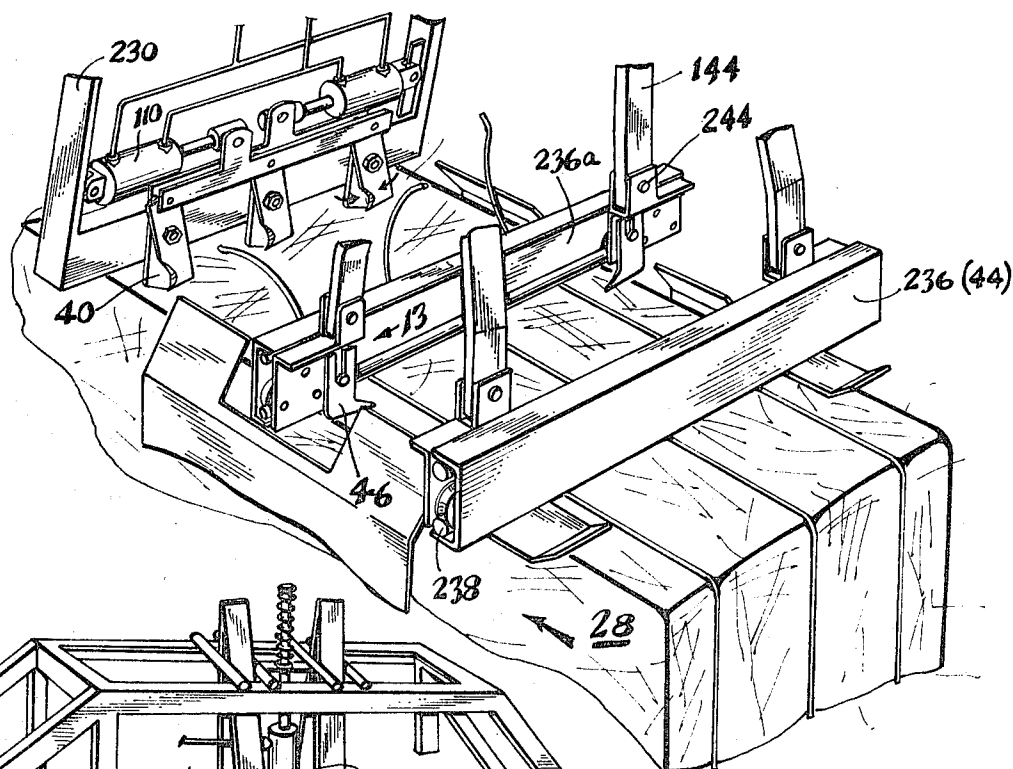
V. J. THOMSON

3,513,522

UNBALING MACHINE

Filed April 3, 1967

8 Sheets-Sheet 6



INVENTOR.
VICTOR J. THOMSON
BY Warren T. Jessup
attorney

May 26, 1970

V. J. THOMSON
UNBALING MACHINE

3,513,522

Filed April 3, 1967

8 Sheets-Sheet 7

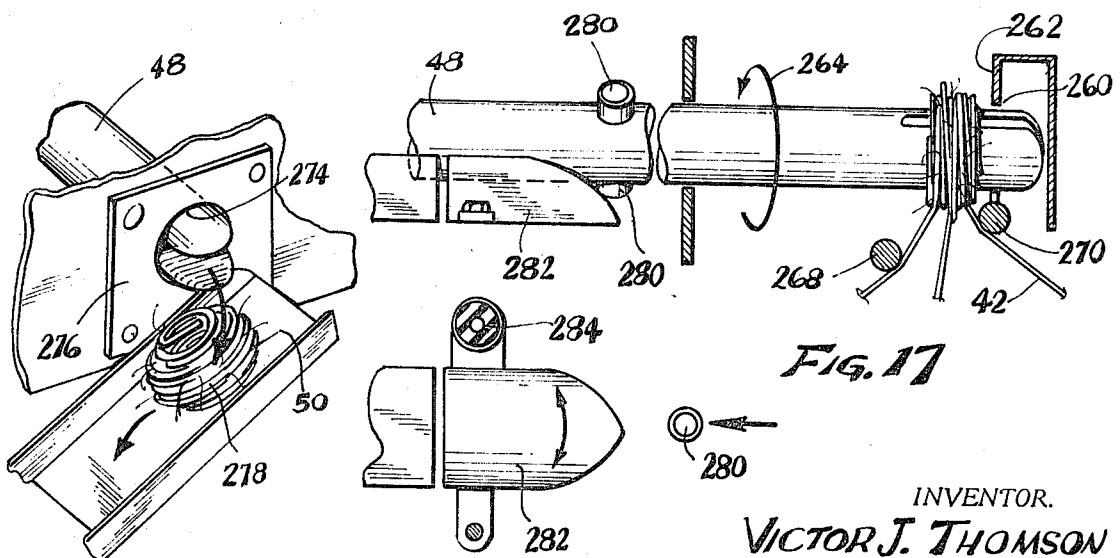
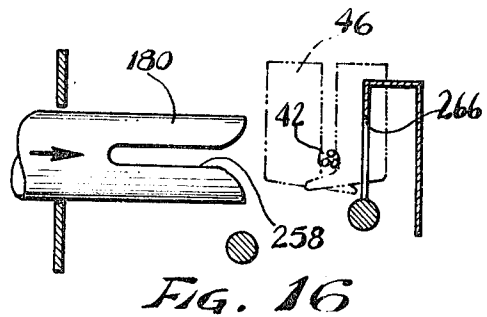
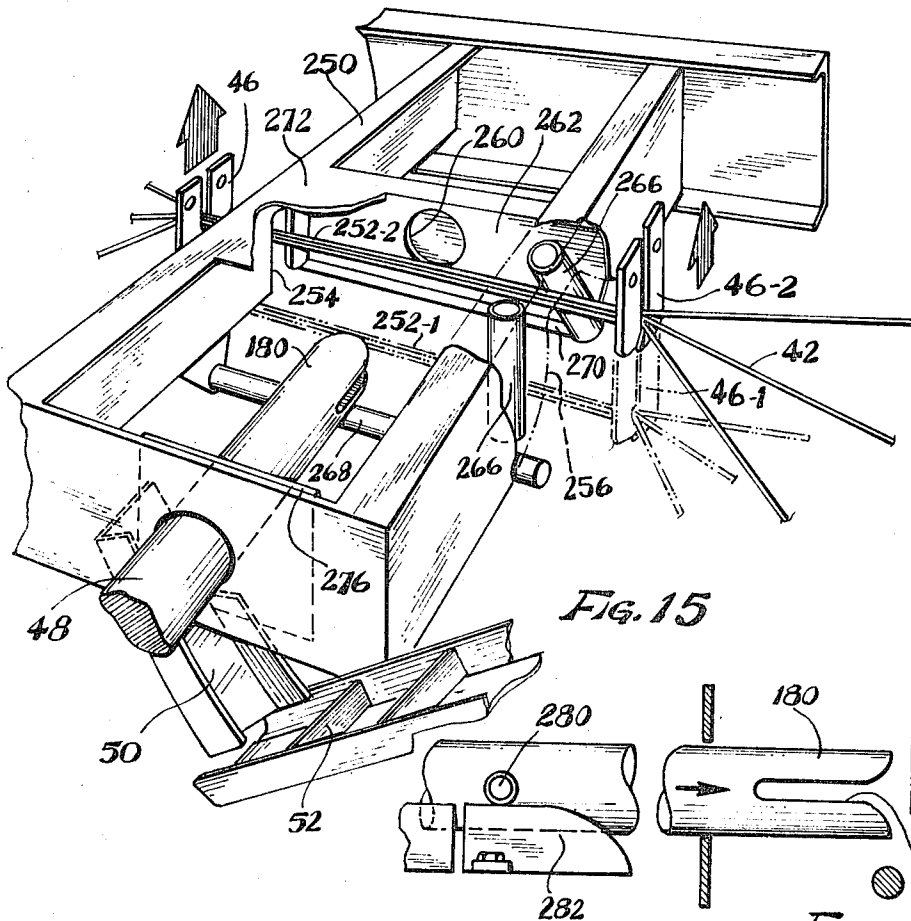


FIG. 19

FIG. 18

INVENTOR.
VICTOR J. THOMSON
BY
Warren T. Jessup
attorney

May 26, 1970

V. J. THOMSON

3,513,522

UNBALING MACHINE

Filed April 3, 1967

8 Sheets-Sheet 8

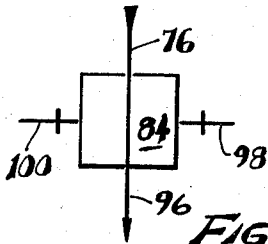


FIG. 20

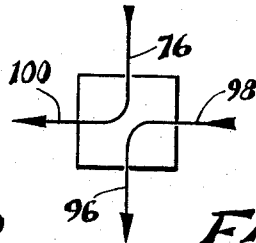


FIG. 21

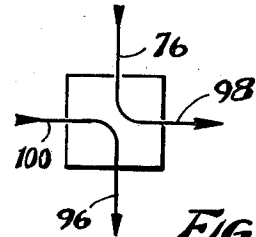


FIG. 22

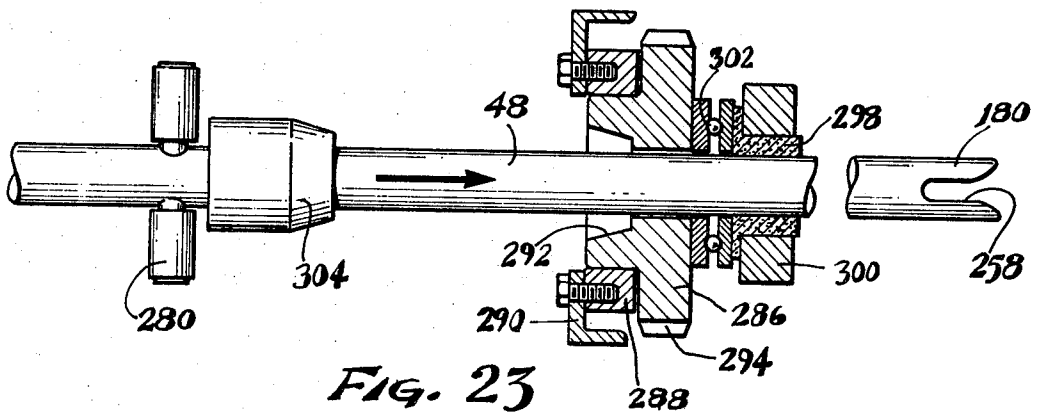


FIG. 23

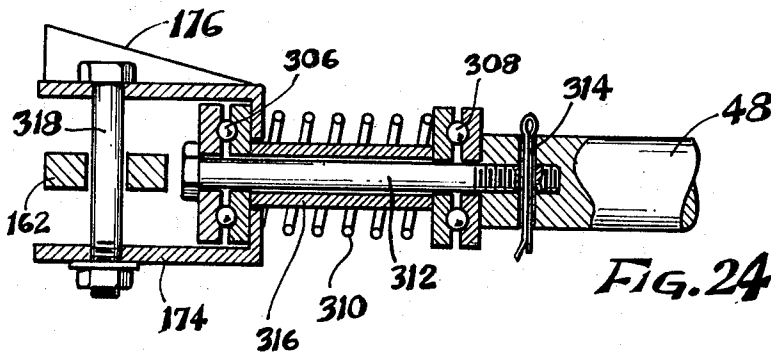


FIG. 24

INVENTOR.

VICTOR J. THOMSON

BY

Warren T. Jessup
attorney

1

3,513,522

UNBALING MACHINE

Victor J. Thomson, Rancho Felicia, Box 275,
Santa Inez, Calif. 93460

Filed Apr. 3, 1967, Ser. No. 627,687

Int. Cl. B23p 19/04

U.S. Cl. 29—200

16 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for the cutting and removal of tie bands about a bale of hay or the like comprising, cutting means to effect substantially simultaneous severance of the tie bands, gathering means to effect gathering of the severed tie bands, removal means to grasp the gathered tie bands and effect their removal from the hay bale or the like, discharging means to effect disposing of the removed tie bands from the removal means, and operating means to effect sequential automatic operation of the cutting means and the gathering means and the removal means and the discharging means.

BACKGROUND OF THE INVENTION

This invention resides in the field of machines which break the bonds or ties that wrap up bundles or packages and then remove and discharge the ties from the machine, leaving the bundle opened and accessible for use. It is here illustrated as applied to bales of hay, although it obviously applies to other bundles of material wrapped in a generally similar manner.

For the owner or caretaker of small herds of livestock, it is a relatively simple matter to cut the three spaced baling wires which are wound tightly about a bale of hay, pull the wire from the hay by hand, and discard it. The hay then may be separated into individual feeding bundles or flakes and distributed to the stock as desired. For small herds, less than a bale a day, or at most but a few bales per day, need to be opened.

In large feeding yards, however, as for example where dairy cattle are kept, hundreds of bales per day must be broken open and distributed to the cattle. In large feed yards this is done by stacking the hay bales adjacent a conveyor. The bales are loaded successively one by one onto the conveyor. As they move along, it is the full-time duty of one or more men to snap the baling wires, pull them loose from the hay, and dispose of the wires. The conveyor carries the broken bales into a feed mill where the hay is ground up and mixed with other nutrients prior to distribution to the cattle.

The present invention is adapted to the already existing conveyor line which feeds the moving hay bales into the feed mill (or to any other disposition desired). It takes the place of the one or more men who, hour after hour, are now required to snip the baling wires and remove them from the hay.

As will be readily seen hereinafter, the present invention is especially adapted to the severing and removal of tie bands which extend longitudinally around the bundle, i.e., in the same direction as that in which the bundle is being moved along the conveyor line. It will be readily evident, however, that the features of the present invention are adaptable to other types of bindings.

SUMMARY OF THE INVENTION

The present invention consists of a framework adapted to be placed over a hay-conveying track. The frame carries a plurality of cutters, preferably in the form of pairs of shearing blades, which are automatically actuated to snip the wires (usually three) which longitudinally bind the hay bales. Thereafter, and in automatic

2

succession, pairs of jaws or hooks come in from each side and gather the three severed wires together at the top of the bale. Thereafter, a shaft is projected laterally of the feed line. This shaft has a kerf which receives the severed wires. As soon as the kerf has received the wires, the shaft is automatically rotated to serve as a reel, which winds in the wires from both ends and wraps them around the shaft. The shaft is then retracted; the wound bundle of wires is wiped from the end of the shaft, and dropped into a disposal conveyor.

All of the above operations are effected without stopping the hay bale in its steady transit along the conveyor line.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the complete unbalancing machine, showing a bale of hay in the machine and with the baling wires in the process of being wound around the reel, prior to final removal from the bale;

FIG. 2 is a perspective schematic view of the hydraulic system which automatically and successively brings about the several operations carried out by the unbalancing machine;

FIG. 3 is a plan view looking down on a portion of the machine, specifically on the cam-operated hydraulic valves which control the sequencing of the machine;

FIG. 4 is an end elevation taken along the line 4—4 in FIG. 3;

FIG. 5 is a fragmentary perspective view, showing certain portions of the machine and the manner in which a bale of hay moves therethrough;

FIG. 6 is an end elevation, looking generally from left to right in FIG. 5;

FIG. 7 is a top plan view, looking down on the portion of the machine shown in FIG. 5, with certain of the details being omitted in the interest of clarity;

FIG. 8 shows an alternative form of sensing means which may be substituted for the sensing means shown in FIGS. 5, 6, and 7;

FIG. 9 is a perspective view, generally similar to FIG. 5, but showing other portions of the machine and their relationship to the bale of hay, the tie bands of which are about to be broken;

FIG. 10 is a fragmentary sectional plan view taken on line 10—10 in FIG. 9;

FIG. 11 is a fragmentary perspective view showing the shears or cutters which sever the tie bands or wires.

FIG. 12 is a fragmentary perspective view illustrating the relationship between the cutters and the gathering mechanism which gathers the wires together after they are severed by the cutters;

FIG. 13 is a fragmentary elevational section taken in the direction of the arrow 13 in FIG. 12;

FIG. 14 is a partial perspective view looking downstream in the movement of the hay bale and showing the gathering hooks or jaws after they have gathered the severed wires into a common bundle;

FIG. 15 is a fragmentary perspective view, partially broken away, showing the details of the wire-removing shaft or reel, just prior to engaging the severed and gathered tie wires;

FIG. 16 is a fragmentary elevation showing further details of the gathering reel;

FIG. 17 is a fragmentary elevational view, similar to FIG. 16 and showing the parts in a different position of operation;

FIG. 18 is a fragmentary plan view, looking down on certain of the parts shown in FIGS. 16 and 17;

FIG. 19 is a fragmentary perspective showing the manner in which the gathered wire bundle is wiped from the shaft or reel;

3

FIGS. 20, 21 and 22 are diagrammatic sketches illustrating the functional positions of the hydraulic control valves that control the operating sequence of the machine;

FIG. 23 is a fragmentary elevational view partially sectioned showing further details of the wire removing reel;

FIG. 24 is a fragmentary elevational view partially sectioned showing the outboard end of the wire removing shaft or reel.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the invention is illustrated in the drawings.

In the drawings, 20 represents an elongate guide means or conveyor in the form of a shallow channel or trough. It consists of a flat bed 22, a pair of low sidewalls 24, and a pair of intermediate runners 26. Bales of hay, one of which is shown at 28, are moved to the left in FIG. 1, along the channel 20, by means of a conveyor chain 30, having upwardly extending barbs 32 that dig into the body of the hay 28 and thus find sufficient securement to impel it along the conveyor trough 20.

Mounted transversely over the trough 20 is the unbalancing machine 34 of the present invention. It consists of a frame having a plurality of adjustable legs 36, which carry a number of movable frames located directly over the conveyor trough 20. One of these is a vertically movable cutter frame 38, which carries the cutting means positioned transversely with respect to the trough 20. These cutting means take the form of three pairs of shearing blades 40, one pair for each of the tie bands or wires 42 which longitudinally encircle the hay bale 28. There is another vertically-movable frame 44 which carries the gathering hooks or jaws exemplified at 46. There are two pairs of such jaws which cooperate to gather together the three severed tie wires 42, so that they can be wound around a rotating reel 48. As the tie wires 42 are wound around the reel or shaft 48, they are drawn from around the bale 28. When the winding is completed, the shaft 48 is retracted (to the left in FIG. 1). The wound bundle of wires is then wiped from the shaft, dropped into a short conveying trough 50, and thence conveyed by a power conveyor belt 52 to a trash barrel 54.

The cutting, gathering and removal of the wires 42 is effected automatically and in sequence by hydraulic cylinders controlled by a series of valves 56 which are in turn controlled by cam shafts 58 and 60 driven by a small electric motor 62. The sequencing is automatically started by the sensing of the presence of the tie wires 42 by electric or magnetic sensors mounted in the bed 22 of the trough 20.

Once a hay bale 28 enters the machine 34, its continued forward motion is achieved solely by being pushed from the bales behind. This is because it is necessary to raise the bale 28 away from the hooks 32 in order to give clearance for removal of the tie wires 42. Otherwise, the friction on the wires 42 as they are removed by being reeled around shaft 48 would be extremely high. This lifting of the bale 28 is achieved by raising the runners as shown at the incline 64. The runners or interior rails 26 are so positioned laterally that they do not coincide with either of the two side wires 42, preferably falling inside of the respective wires.

As the bale 28 is pushed through the machine by the following bales, it is guided into position by side guide plates 66 and upper guide plate 68. An overheight sensor (not shown) is mounted and supported just forwardly of the upper guide plate 68 to sense when a bale 28 approaches that is too high for the machine. This sensor, which may take the form of an appropriately actuated microswitch, serves to stop the conveyor chain 30 in the event that too large a bale tries to enter the machine.

4

The fact that the bale 28 must be pushed through the machine by the following bales, means that there exists no gap from one bale to the next. Therefore, the sensing of the leading edge of a given bale cannot feasibly be done mechanically. For this reason it has been found necessary to employ magnetic or electric sensors which sense the leading edge of the baling wire 42, rather than a mechanical sensor to sense the physical leading edge of the bale.

Turning to FIG. 2, the hydraulic system which powers the various sequential operations in the machine of FIG. 1 will now be described.

Numeral 70 represents a positive displacement, hydraulic (oil) pump driven by any suitable motive means, such as an electric motor. The pump 70 receives oil from a sump 72, through a filter 74, and delivers it to a distribution pipe 76, via a heat exchanger 78. The numeral 80 represents a safety by-pass or dump valve which opens at a predetermined pressure to dump the oil back into the sump 72 by way of a return pipe 82. Valve 80 operates when there is a downstream stoppage of flow in the line 76, which would otherwise damage the system by a build-up of excessive pressure. Such stoppage occurs even in normal operation when a piston bottoms, or reaches the end of its travel.

Oil from the pipe 76 is fed serially through four valves 84, 86, 88, and 90, and thence back to the sump 72 by way of a return pipe 92. Each of the valves, 84 for example, has fundamentally three positions, determined by the position of an actuating rod 94. When the rod 94 is in its mid-position, oil is directed from the inlet pipe 76 directly through the valve to the outlet pipe 96. When the rod 94 is moved to the left in FIG. 2, a flow path is created from the inlet pipe 76 through the pipe 98, and simultaneously another and separate flow path is created from the pipe 100 to the outlet pipe 96. When the rod 94 is moved rightward of its mid-position in FIG. 2, a flow path is created from the inlet pipe 76 to the pipe 100, and a separate independent path is created from the pipe 98 to the discharge pipe 96. These three modes of operation of the valve 84 (which is exemplary of all of the valves 84, 86, 88 and 90) are shown schematically in FIGS. 20-22. FIG. 20 illustrates the mid-position described above. FIG. 22 illustrates the second position described above with the rod 94 moved to the left. FIG. 21 illustrates the last, third position, described above, with the rod 94 moved to the right.

Each of the valves 84, 86, 88 and 90 controls a respective hydraulic cylinder-and-piston arrangement to extend and retract a piston rod depending on the position of the actuating rod 94. The valve 84 is the cutting means valve. When its control rod 94 is moved to the left, oil flows from the inlet pipe 76 to the pipe 98, through the biased diversion valve 102, thence to the upper end of a cylinder 104, where it causes a piston inside the cylinder 104 to extend a piston rod 106 downwardly. The piston rod 106 is secured to the frame 38 shown in FIG. 1. Thus, when the rod 94 is moved to the left, the frame 38 is caused to move downward and bring the cutting means into engagement with the top of the hay bale 28.

When the frame 38 has come fully into engagement with the bale 28, the piston rod 106 is forced to stop. This causes a buildup of pressure in the cylinder 104, which opens the by-pass valve 102 and diverts further oil flow from the pipe 98 to the pipe 108. Oil then flows simultaneously into the outboard ends of a pair of shear-operating cylinders 110, which are connected respectively to reciprocating bars 112 that actuate respective halves of the shear pairs 40. Thus, after the valve 102 is opened, pressure is applied to extend the respective piston rods 114 and cause reciprocation of the bars 112, which in turn causes the three pairs of shears 40 to close and sever the tie wires 42. The shears 40 had previously been brought into cutting position over and around the tie wires 42 by the downward movement of the frame 38.

At the appropriate time in the sequencing of the system, the actuating rod 94 is moved to the right. This causes oil to flow from the inlet pipe 76 to the pipe 100 and thence into the bottom of the cylinder 104 through the valve 116. When the piston rod 106 has fully raised the frame 38, the build-up of pressure in the cylinder 104 causes the valve 116 to open, applying pressure to the pipe 118. This sends oil into the inboard ends of the cylinder 110 retracting the piston rods 114 and opening the shears 40.

During the time that oil is being supplied to the pistons 104 and 110, the downstream valves 86, 88, and 90 have also been receiving oil. This is because, whether the valve 84 is in the position shown in FIGS. 20, 21, or 22, there is always a flow of output oil into the pipe 96 to serve the downstream valves 86, 88, and 90 (as long as the pistons have not bottomed).

The function of the valve 86 is to allow the frame 44 to be lowered into engagement with the hay bale 28, so that the jaws 46 can gather the wires 42 together. To this end, at the appropriate time in the sequencing, the actuating rod 122 is moved to the right, allowing oil to flow from the pipe 96 into the pipe 124, where it causes the piston rod 126 to retract downwardly. This removes support from a plate 128 forming a portion of the frame 44, allowing the frame 44 to lower by gravity into engagement with the hay bale 28. This is fortified by the compression spring 130. Still later, at the appropriate sequencing time, the rod 122 moves to the left, causing oil to flow from the pipe 96 into the pipe 132. This now extends the piston rod 126 upwardly and raises the frame 44.

The valve 90 controls operation of the twin hydraulic cylinders 134 which are mounted to the frame 44. These cylinders actuate the gathering jaws 46, which draw the three wires 42 into a common position where they may be reeled onto the shaft 48. To this end, at the appropriate time in the sequencing, the push rod 136 is moved to the left, causing oil to flow from the pipe 138, into the pipe 140, where it enters the cylinders 134 and extends their respective piston 142 inwardly. The rods 142 are connected respectively to vertical rocker arms 144, to lower ends of which the jaws 46 are mounted. During this operation, return oil from the cylinders 134 flows through the pipe 146, thence through the check valve 148 and pipe 150, back to the valve 90 and outlet pipe 92. The function of the check valve 148 will be described hereinafter.

At an appropriate time in the sequencing of the cycle, the shaft 48 is extended into engagement with the wires gathered between the jaws 46, so as to reel in the same and thus draw the wires 42 off the bale 28. This is effected through movement of the actuating rod 152 to the right. This causes oil to flow from the pipe 154 into the pipe 156, thence into the cylinder 158, where it causes the piston rod 160 to retract, and through the linkage arm 162 advances the shaft 48.

The precise timing between the engagement of the reel 48 with the severed wires 42, and the release or opening of the jaws 46 is rather critical. For that reason the latter operation is controlled by the former in the following way.

After the valve 90 has caused the hooks 46 to engage the severed wires 42, the rod 122 of valve 86 is moved into position to cause oil flow from the input 96 to the outlet pipe 132. This causes the piston 126 to raise the frame 44, lifting the jaws 46 and with them the engaged wires 42. The gathered or bundled wires 42 are now in line with the shaft 48. At this point the actuating rod 152 is moved to the right and the actuating rod 136 is also moved to the right by their respective operating cams, to be described hereinafter. Movement of the rod 136 to the right opens an oil path from the pipe 138 to the pipe 150 and from the pipe 140 to the pipe 92. Oil cannot flow through the path thus created, however, because the valve 164 is closed and the check valve 148 prevents flow around the valve 164, which had occurred during the advance or closing of the jaws 46.

In the meantime, flow of oil proceeds from the pipe 154

to the pipe 156 into the cylinder 158, where it retracts the piston rod 160. The oil on the other side of the piston then flows through the pipe 166, back to the valve 88, out the pipe 168, where it encounters the blockage created in the valve 90 by virtue of the closed position of the valve 164. This causes a by-pass or dump valve 170, which normally permits flow of oil from pipe 168 to pipe 138, to open, as pressure is built up, and divert the oil flow into the pipe 172, from which it is dumped back into the sump 72. This hydraulic condition continues as the piston rod 160 continues to retract into the cylinder 158, i.e., move to the right in FIG. 2. This movement, through the linking arm 162 projects or advances the reel shaft 48 toward the wires held in the jaws 46.

The upper surface of the clevis 174, which connects the arm 162 to the shaft 48, carries a cam or wedge 176, positioned to engage the actuator 178 of the valve 164. As the jaws 180 of the shaft 48 engage over the wires 42 held in the jaws 46, but before the piston rod 160 has bottomed, the cam 176 comes into engagement with the actuator 178 and opens the valve 164. This permits oil to flow from the pipe 138 into the pipe 150, through the valve 164, pipe 146, and into cylinders 134, to commence retraction or opening of the jaws 46. An instant thereafter, just as the jaws 46 are beginning to open, the piston rod 160 bottoms, with the jaws 180 fully engaged around the wires 42. This causes a momentary pause in the retraction or opening of the jaws 46, but does not otherwise affect the operation of the system. Simultaneously the shaft 48 starts its rotation, as will be described hereinafter. An instant thereafter the actuating rod 152 is moved to its mid-position, causing oil to flow directly from pipe 154 to pipe 168.

As noted above, as the shaft 48 becomes fully extended, with the jaws 180 in engagement with the wires 42, the shaft 48 is caused to rotate by a drive mechanism which will be described hereinafter. While the shaft 48 rotates, reeling in or winding the wires 42 around the jaws 180, the jaws 46 complete their opening operation. Shortly thereafter the actuating rod 136 is moved to its mid or neutral position with the jaws 46 in open position.

At the appropriate time in the sequencing, the actuator 152 is moved from its mid-position to the left, causing oil to flow from the pipe 154 to the pipe 166, thence into the cylinder 158 and causing retraction, i.e., movement to the left of the shaft 48. Such movement automatically declutches the shaft from its rotating drive, explained hereinafter. As it completes its leftward movement under the drive of the cylinder 158, the shaft 48 reaches a position where a plate wipes off the coil of wire wound around the jaws 180, as will be described more in detail hereinafter.

Structural details of the system described above will now be given in connection with the other figures in the drawing.

FIGS. 3 and 4 illustrate the physical arrangement of the valves 84, 86, 88, and 90. Valve 84 will be used as an exemplar. The actuating rod 94 is linked to the valve 84 by a connecting link or lever 182. The rod 94 is moved to the right in FIGS. 3 and 4 by a pair of cams 184 and 186, adjustably mounted on the cam shaft 60. The rod 94 is moved to the left in FIGS. 3 and 4 by means of a pair of cams 190 and 192, adjustably mounted on the cam shaft 58. Both cam shafts are driven by an electric motor 62, through a sprocket and chain drive shown at 198. Two cams, for example 184 and 186, are used at each position in order to adjust the dwell time of the cam against the cam follower wheel 200 and thus adjust the time during which the rod 94 is held to one side.

The actuating lever 182 is biased to mid-position, shown in full line in FIG. 4, by means of a central biasing spring located in the valve 84 itself.

The cam drive motor 62 is started by a sensing mechanism which will be described hereinafter. It is turned off by a tab (not shown) mounted to the shaft 58, which

de-energizes the motor 62 after the shaft 58 (and also the shaft 60) have completed one full revolution. It is desired that the motor 62 stop precisely at a position immediately before the valve 84 is actuated by the rod 94. To insure this precision stopping, the shaft of the motor 62 is provided with a brake 202, which is energized to brake position the moment the motor 62 is de-energized. Thus, the system always comes to rest in exactly the same position.

A cycle of operation is started by the sensing of the forward edge of a bale of hay 28. Such sensing will now be described in conjunction with FIGS. 5, 6, 7, and 8.

Referring to FIG. 5, there is shown a hay bale 28 being advanced in the direction of the arrow 204 by being pushed from behind by the following bale 28a. It will be recalled that the bale 28 has been elevated above the drag hooks 32 by the rails 64 in order to give adequate clearance for the removal of the tie wires 42. It is to be understood that there is another bale of hay (with wires now removed) immediately in front of the bale 28 shown in FIG. 5. This, however, has not been shown in order that the details of the mechanism may be seen. FIG. 5 also shows the drive motor 206 which powers the conveyor chain 30 through a suitable sprocket and chain linkage.

As a bale 28 is advanced (to the left in FIG. 5), the leading edge of the tie wires 42 comes over a pair of sensors 208 positioned immediately therebelow. Such sensors are known in the art and have the function of responding electrically whenever any conducting material is brought into proximity therewith. Two sensors 208 have been shown to sense the two outer wires 42. A third sensor to sense the middle wire 42 could be added if desired by simply offsetting the drive chain laterally from the center of the bale. When any one of the sensors 208 has responded to indicate the presence of wires 42 within their respective spheres of influence, the output is sent through an "or" gate 210. From an output line 212, through suitable relays, this sensing starts the drive motor 62 that sets in operation the cam shafts 58 and 60, that effect the hydraulic cycle described hereinbefore.

An alternative sensor is shown in FIG. 8, consisting of a transverse elongate housing 214 which is biased lightly against the top of the hay bale 28 by suitable supporting springs 216. Within the housing 214 are three sensors spaced to intercept the respective three tie wires 42. When a wire has been sensed, a suitable "or" gate is energized to place a signal on the output lead 212 and start the cycling motor 62.

Structural details of the wire cutting means are shown in FIGS. 9, 10, and 11. The cutter frame 38 is mounted for vertical reciprocation in a stationary frame 220. To this end, the frame 38 has a pair of braced vertical side members 222, each of which carries a pair of pulley-like wheels 224 that ride against a circular rail 226 (FIG. 10) secured to the inner face of the stationary frame 220. As noted hereinbefore, the vertical position of the frame 38 is controlled by a piston rod 106 actuated from a hydraulic cylinder 104.

The lower end of the frame 38 is articulated, as shown at 228, so that the lower portion of the frame 230 can swing back and forth longitudinally, thereby permitting the cutting shears 40 to advance longitudinally once they have become embedded in the hay bale 28, as the frame portion 230 is pressed down against the bale by the action of the cylinder 104. In this way the cutting action of the shears takes place while the bale 28 continues to move forward along the trough 20.

After a shearing has taken place and the cylinder 104 has raised the frame 38 so that the shears 40 are clear of the bale 28, a return spring 232 returns the frame portion 230 rearwardly against a stop 234.

The shearing details are shown in FIG. 11. After the

frame portion 230 has been pressed firmly against the hay bale 28 by the cylinder 104, the build-up of pressure in the cylinder, as noted previously, opens the valve 102 to by-pass the oil into the pipe 108 and thence into the cylinders 110. This extends the respective piston rods 114, moving that bar 112 which is foremost in FIG. 11, to the right, and moving the counterpart (rearmost) bar 112 to the left. The former movement pivots the foremost shearing blades 40 in a clockwise direction (FIG. 11), while the latter movement pivots the counterpart blades 40 in a counterclockwise direction. Between them, each pair of blades thus embraces and snips a respective tie wire 42.

After the wires 42 have been severed, the valve 84 (FIG. 2) is actuated to raise the frame 38 and then open the shears 40, as described hereinbefore.

While this has been taking place, the valve 86 has been actuated to apply oil to the cylinder 125, lowering the piston rod 126 and allowing the frame 44 to drop onto the hay bale 28. The details of the wire gathering mechanism are shown in FIGS. 12, 13, and 14. The frame 44 includes at the base thereof a pair of transverse horizontal cross bars 236 which carry shoes 237 that actually rest on the hay bale 28. The bars 236 are in the form of inwardly opening channel members having circular interior rails 238 (FIG. 13) on which ride pulley wheels 240 mounted on a carriage 242. There are four such carriages 242, one for each of the gathering hooks 46, and each has three pulley wheels 240, as shown in FIG. 14. Also as shown in FIG. 14, there are four hooks 46 divided into two cooperating pairs, i.e., an upstream pair and a downstream pair. The upstream pair 46 is mounted to respective carriages 242 that ride within the upstream channel member 236. The downstream pair 46 is mounted to carriages 242 that ride in the downstream transverse member denominated 236a in FIG. 12.

Four arms 144 are pivotally mounted at 244 to the respective four carriages 242. Two of the arms, denominated 144a in FIG. 14, are connected together by a cross plate 246a, to which is connected the piston rod 142 of one of the hook-driving cylinders 134. The other pair of arms, denominated 144b in FIG. 14, is connected to a similar plate 246b, driven by the piston rod 142 of the other hook cylinder 134. Thus, when the cylinders 134 are supplied with oil in the manner described hereinbefore, both pairs of jaws 46 close simultaneously, engaging between them the three bale wires 42. It will be seen in FIG. 14 that the two pairs of jaws 46 are spaced longitudinally so that the three wires are bundled closely together in the region between the longitudinally-spaced jaws. It is in this region, where the wires are bundled together, that the reel shaft 48 engages the wires and winds them off the bale 28. The reel shaft 48 has been omitted from FIG. 14 in order not to obscure a showing of other parts of the assembly.

The manner in which the bale wires 42 are removed from the bale after they have been severed will now be described, with reference to FIGS. 15, 16, 17, 18, and 19.

In FIG. 15, 250 represents a stationary portion of the machine frame. It is mounted transversely of the hay trough 20 and located between the two longitudinally-spaced pairs of jaws 46, as shown. After the wires 42 have been severed, the hook pairs 46 come in, gathering the wires between them into a bundle of three, shown at 252. At the time the hooks are in the position shown in phantom at 46-1, the wires are at 252-1.

When oil is applied to cylinder 125 (FIG. 2), the frame 44 rises and raises the hooks 46 to the position shown at 46-2 in FIG. 15. To accommodate this raising, the frame 250 is relieved as at 254 and 256.

Next, the shaft 48 is advanced (to the right in FIG. 15) until the jaws 180, formed by the diametric slot or kerf 258 in the end of the shaft, engage over the wires 42. As this takes place, the very end of the shaft (at the right in

FIGS. 16 and 17) passes through a hole 260 formed in a vertical deflection plate 262. Just as the shaft 48 completes its rightward traverse and comes to the position shown in FIG. 17, it engages a clutch, to be described hereinafter, which causes it to rotate in the direction of the arrow 264. Since the bundle of three wires 42, now shown at 252-2 in FIG. 15, is fully engaged in the kerf 258, the wires 42 are reeled from both ends around the shaft 48, as shown in FIG. 17. This action pulls the wires from around the bale 28.

The function of the plate 262 through which the shaft 48 passes is to prevent the wires from going off the end of the shaft during the winding operation. It also aids in insuring that the slot 258 will engage all of the wires 42. An instant before winding starts, the jaws 46 have been opened or separated, thus freeing the wires 42 for the winding operation. As the winding proceeds, the obliquely-mounted guide rollers 266 serve to guide the two side wires 42 around the corner formed by the relief or notch 256 and thus minimize dragging friction.

As the winding proceeds, the hay bale 28 continues to advance so that by the time the severed ends of the wires are being taken up, they are almost beneath the shaft 48 itself. At this point, guidance is provided in the form of horizontally-mounted rollers 268 and 270 (FIG. 17), to which the wires 42 have shifted, from rollers 268 and 270.

The hydraulic sequencing system leaves the shaft 48 in extended position long enough to insure that the wires will be fully wound around the reel shaft 48. To insure completion of winding so that the loose or severed ends will also be bent around into the bundle 278 (FIG. 19), a guide plate 272 is mounted horizontally across the frame member 250, immediately above the shaft 48. The plate 272 deflects the ends of the wires into the bundle as the winding is completed.

Following the winding operation, the shaft 48 is retracted through a hole 274 in a transverse plate 276, which wipes the wire bundle 278 off the end of the shaft, as shown in FIG. 19, and drops it into the trough 50.

It is vital that the shaft 48 come to rest in a position such that the kerf 258 is horizontal, so that it will be properly oriented to engage the next bundle of wires 252 at the next cycle. To this end a pair of radial studs 280 are provided on the shaft 48, which project into engagement with a tapered trough 282. Thus, no matter what the angular position of the shaft 48 may have been when it was disengaged from its clutch, the studs 280 will engage the sloping or cam surface at the edge of the trough 282 and the shaft will be cammed into horizontal position, shown in FIG. 16. To accommodate a dead-center position, where the studs 280 might be exactly vertically oriented as the shaft is retracted, the trough 282 is flexibly mounted to the frame by means of a rubber grommet 284. Thus, if the studs do engage the tip of the trough 282 in a vertical position, one side of the trough will deflect slightly, upsetting the dead-center relationship and allowing the shaft to be cammed slightly to one side, whereupon the normal cam action takes place and rotates the shaft into a horizontal position as shown in FIG. 16.

The rotary drive mechanism for the reel shaft 48 is shown generally in FIG. 1 and in detail in FIGS. 23 and 24.

As seen in FIG. 23, the shaft 48 passes through a clutch driving member 286 independently journaled in its own bearing 288 secured to a fixed frame member 290. The clutch driving member 286 has an internal, conical clutching surface 292, on one face thereof, and on the outer periphery is provided with gear teeth 294. The gear teeth 294 are engaged by a driving pinion driven by any suitable source of power, such as a motor 296 (FIG. 1).

For added support, the shaft 48 is also journaled in a pair of spaced sleeve bearings 298 held in stationary frame members 300. The right-hand member 300 (FIG.

23) also serves as an axial back-up for the clutch member 286, through a thrust bearing 302.

A conical clutch member 304 is fixed to the shaft 48 in such a position that, as the shaft 48 is moved to the right (FIG. 23), the clutch surfaces 292 and 304 engage just after the jaws 180 have embraced the wires 42 and the end of the shaft has entered the hole 260. The motor 296 is energized at all times that the machine is in operation, so that the moment that clutch engagement occurs at 304/292, the shaft 48 starts to rotate, as explained hereinbefore. This rotation continues until the surface 304 separates from 292 as the shaft is retracted to the left (FIG. 23).

Details of the mounting of the left-hand end of the shaft 48, shown generally in FIGS. 1 and 2, are shown specifically in FIG. 24. To the end of the shaft 48, shown in FIG. 24, is secured a pair of spaced thrust bearings 306 and 308, between which resides a compression spring 310, that serves as the clutch spring for the surfaces 304/292. The thrust bearings 306 and 308 are held to the end of the shaft by an axial bolt 312 anchored by a cotter pin 314. A spacer sleeve 316 serves the double function of forming a separator between the two bearings 306 and 308 and protecting the spring 310 from abrasion as the bolt 312 rotates.

In operation, the linkage arm 162 moves to the right in FIG. 24, thus moving the clevis 174 also to the right by virtue of the pivot bolt 318. This moves the shaft 48 to the right until the clutch surfaces 304/292 (FIG. 23) come into engagement. Further appreciable rightward movement of the shaft 48 is prevented at this point, but the arm 162 and clevis 174 continue to move to the right a slight distance, causing the face of the clevis 174 to further compress the spring 310. This places a resilient thrust on the shaft 48 through the bearing 308, and thus constitutes the clutch spring which holds the clutch surfaces 304/292 in engagement.

RÉSUMÉ OF OPERATION

The operation of the unbalancing machine will now be briefly reviewed.

A bale of hay 28 is pushed into the unbalancing machine by the following bales driven by the drive hooks 32. When the forward end of the bale comes over the sensors 208 (FIG. 5), the cam drive motor 62 (FIGS. 1 and 3) is started, driving the two cam shafts 58 and 60, which actuate the four hydraulic valves 84, 86, 88 and 90. (FIGS. 2 and 4). The frame 38 is driven downward by the action of the drive cylinder 104 (FIG. 1), placing the shearing cutters 40 in position to sever the tie bands or wires 42 (FIG. 11). The cylinders 110 then actuate the bars 112 to close the scissors-like cutters 40 and sever the wires 42. The valve 84 is then moved to position to raise the frame 38 away from the hay bale and open the cutters.

The valve 86 is actuated to allow the frame 44 to drop down onto the hay, digging the jaws 46 slightly into the hay and placing them in position to gather the wires, as shown in FIG. 12. The arms 144 are then moved inwardly by the cylinders 134, causing the jaws 46 to gather the three wires 42 into a bundle (FIG. 15). The valve 86 is then actuated to lift the bundle of wires up from the hay bale, as shown in solid lines in FIG. 15.

The shaft 48 is advanced (to the right in FIG. 2) by the application of hydraulic oil to the cylinder 158 from the valve 88. This causes the jaws 180 to embrace the bundle of wires 42 (FIGS. 15 and 16). As the shaft 48 advances, the cam 176 (FIG. 2) actuates the valve 164 to allow oil to flow into the cylinders 134, opening the jaws 46. Just as the shaft 48 reaches the rightward extent of its travel, the clutch surface 304 engages the surface 292 (FIG. 23). The constantly rotating drive gear 286 causes the shaft 48 to rotate, reeling in the wires 42 from both ends, as shown in FIG. 17. After sufficient time has elapsed to complete the reeling, the valve 88 is actuated to retract

11

the shaft 48. The bundle of wires 278 (FIG. 19) is wiped off as the shaft draws back through the plate 276. The wire bundle 278 slides down the trough 50 to be ultimately discharged into the trash barrel 54 (FIG. 1). The cam shaft 58 then actuates a switch, cutting off power to the motor 62, and energizing its locking brake 202.

A cycle is thus complete and the machine is at rest until the leading edge of another bale 28 is sensed by the sensors 208 to institute another cycle.

Whereas the present invention has been shown and described herein in what is conceived to be the best mode contemplated, it is recognized that departures may be made therefrom within the scope of the invention, which is, therefore, not to be limited to the details disclosed herein, but is to be afforded the full scope of the invention as hereinafter claimed.

What is claimed is:

1. Machine for unbaling hay and the like, adapted for association with elongate guide means along which a bale of hay may be moved, said machine comprising:
 - cutting means for severing a plurality of tie bands encircling the bale;
 - means for gathering together the tie bands after severance by said cutting means and prior to removal from the bale, said gathering means moving said tie bands so that at least a portion of each tie band is in substantially the same location.
2. Machine for unbaling hay and the like, adapted for association with elongate guide means along with a bale of hay may be moved, said machine comprising:
 - cutting means disposed transversely with respect to said guide means in position to sever tie bands longitudinally encircling the hay bale;
 - movable frame means on which said cutting means are mounted; and
 - means for moving said frame means toward and away from the hay bale, thereby to bring said cutting means into and out of engagement with the bale.
3. Machine in accordance with claim 1, including:
 - removal means for removing severed, gathered tie bands from the hay bale.
4. Machine in accordance with claim 1, wherein said gathering means comprises at least one pair of opposed jaws, and
 - means for closing said jaws about the severed tie bands, thereby to gather the same together.
5. Machine for unbaling hay and the like, adapted for association with elongate guide means along which a bale of hay may be moved, said machine comprising:
 - cutting means for severing a plurality of tie bands encircling the bale;
 - means for gathering together the tie bands after severance by said cutting means and prior to removal from the bale;
 - said gathering means comprises two pairs of opposed jaws, one pair being spaced longitudinally of the other pair with respect to said elongate guide means, said jaws being mounted to close and open by movement transverse of said guide means,
 - means for closing said pairs of jaws, thereby to gather therebetween the severed tie bands,
 - reel means mounted for rotation about an axis transverse of said guide means and intermediate said two jaws pairs,
 - means for moving said reel means axially into engagement with the gather tie bands, and
 - means for rotating said reel means thereby to wind the severed and gathered tie bands around said reel means, removing same from the hay bale.
6. Machine in accordance with claim 2, wherein said moving means for said frame means comprises hydraulic cylinder and piston means, and
 - including means for actuating said cutting means in response to build-up of hydraulic pressure in said cylinder and piston means to a predetermined point.

12

7. Machine in accordance with claim 2, wherein said movable frame means is mounted for movement parallel to said elongate guide means, whereby said frame means and said cutting means mounted thereon may move longitudinally while engaged with the bale, thereby obviating the necessity of halting the bale in its movement along said elongate guide means during the severance of the tie bands.

8. Machine in accordance with claim 3, wherein said removal means comprises:

reel means engageable with the severed, gathered tie bands, and

means for rotating said reel means, thereby to wind the tie bands around said reel means.

9. Machine in accordance with claim 3, including:

first hydraulic means for actuating said cutting means, second hydraulic means for actuating said gathering means,

third hydraulic means for actuating said removal means, valve means for supplying fluid respectively to said three hydraulic means,

cam-operated means for actuating said valve means to successively:

(1) actuate said cutting means to sever the tie bands,

(2) actuate said gathering means to gather the tie bands, and

(3) actuate said removal means to remove the severed gathered tie bands from the hay bales.

10. Machine in accordance with claim 5, including:

means responsive to said reel moving means for opening said pairs of jaws after said reel means has engaged the severed tie bands.

11. Machine in accordance with claim 9, including

pump means for supplying hydraulic fluid under pressure, said respective valve means being connected in series, so that hydraulic fluid is supplied from said pump means to the valve means for said cutting means, thence to the valve means for said gathering means, and thence to the valve means for said removal means.

12. Machine in accordance with claim 9, including:

first frame means to which said cutting means is mounted, for moving said cutting means into cutting engagement with the tie bands,

second frame means to which said gathering means is mounted for moving said gathering means into gathering position with respect to the tie bands,

fourth hydraulic means for effecting movement of said first frame means,

fifth hydraulic means for effecting movement of said second frame means,

said cam-operated means effecting, successively, application of hydraulic fluid,

(1) to said fourth hydraulic means and to said first hydraulic means,

(2) to said fifth hydraulic means,

(3) to said second hydraulic means, and

(4) to said third hydraulic means, thereby to successively cut, gather, and remove tie bands from the hay bale.

13. Machine for unbaling hay and the like, comprising: cutting means for severing at least one tie band encircling the hay bale,

reel means engageable with the severed tie band, and means for rotating said reel means, thereby to wind the tie band around said reel means.

14. Machine in accordance with claim 13, wherein:

said reel means has a diametric slot at one end thereof in which the tie band may be engaged, and

means for effecting relative movement between said reel means and the tie band, whereby they are brought into engagement with each other, so that upon rotation of said reel means the tie band is wrapped around said reel means.

13

15. Machine in accordance with claim 13, including:
means for effecting removal of tie bands wrapped
around said reel means.
16. Machine in accordance with claim 14, including:
means for positioning said diametric slot in alignment
with the tie band, whereby upon engagement between
said reel means and the tie band, the latter enters
into said slot.

14

361,235 4/1887 Potts ----- 130—1
719,168 1/1903 Wright ----- 130—1
2,589,673 3/1952 Cobb ----- 83—89
2,782,004 2/1957 Harrigan ----- 29—427
2,820,282 1/1958 Schneider.
3,092,350 6/1963 Thompson ----- 242—78
3,269,870 8/1966 Abramson ----- 29—427
3,293,734 12/1966 Buckley ----- 29—427

References Cited

UNITED STATES PATENTS

215,617 5/1879 Higgins ----- 130—1
219,463 9/1879 Green ----- 130—1

10 THOMAS H. EAGER, Primary Examiner

U.S. Cl. X.R.

83—89, 909; 130—1; 242—78