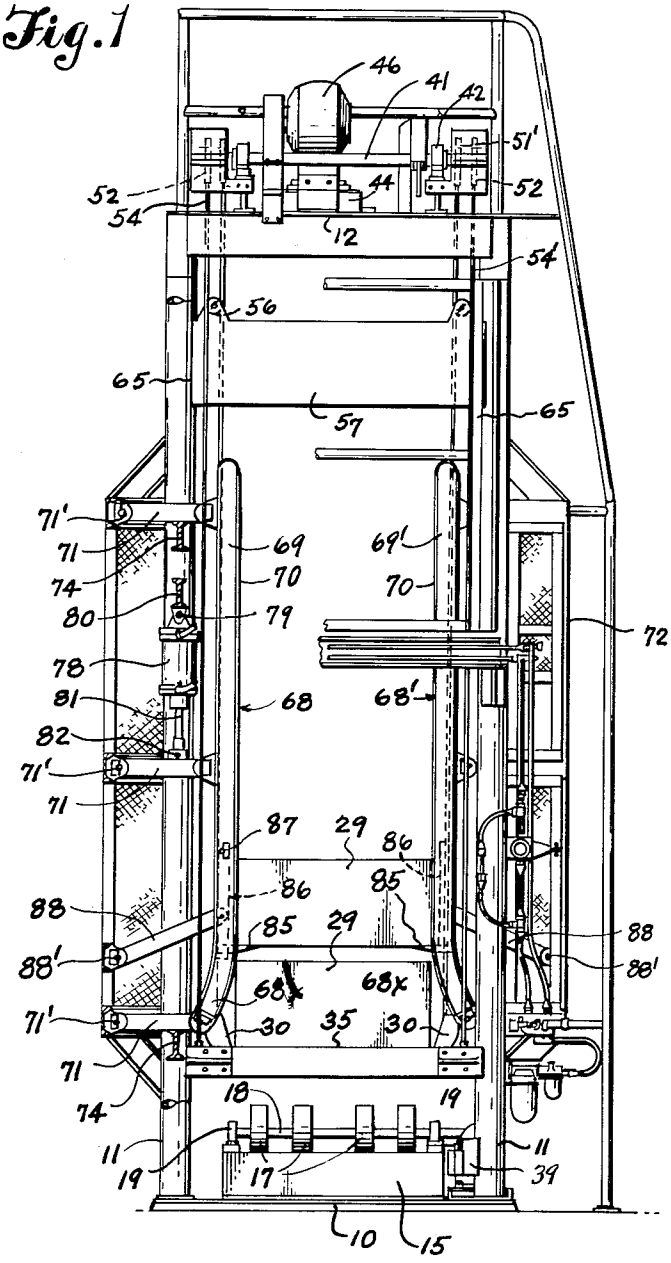
May 22, 1962 G. E. LAMB ETAL 3,035,716

BALE STACKER

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Fig. 1



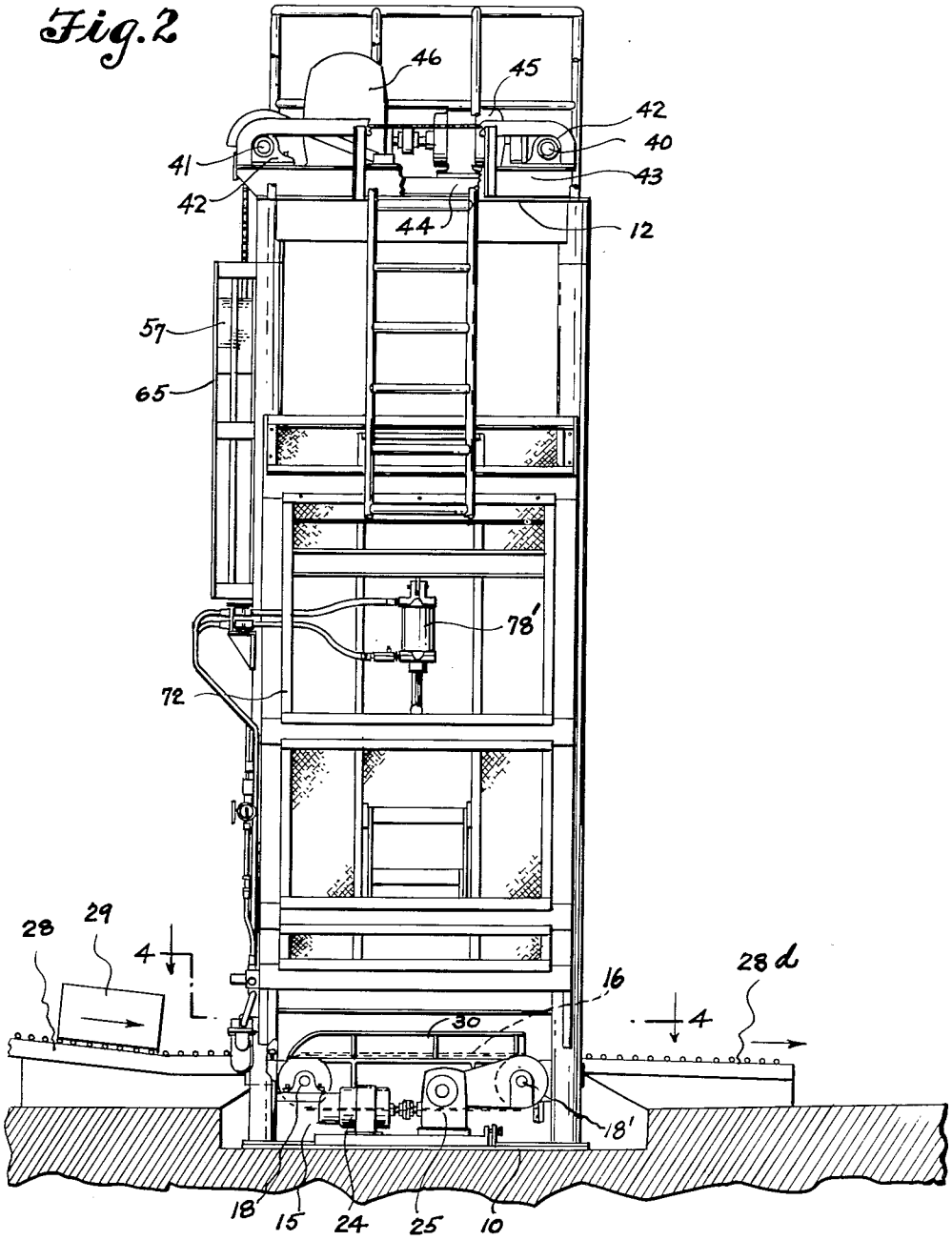

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Fig. 2




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Fig. 3

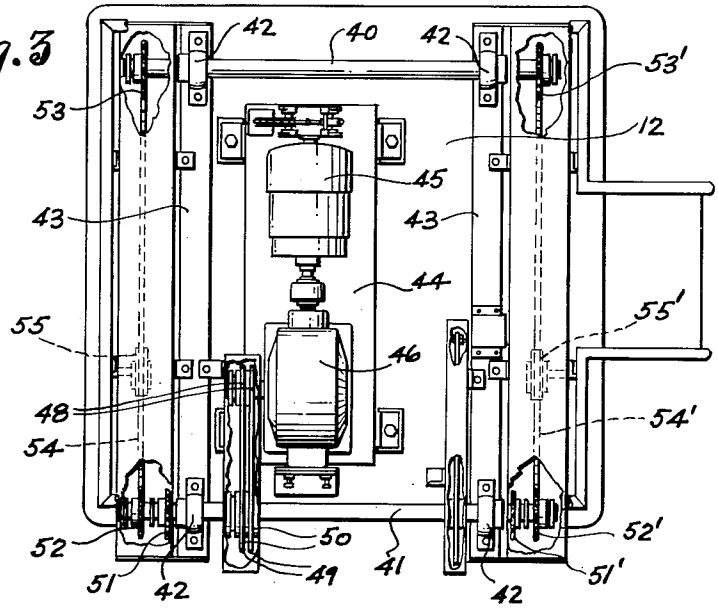
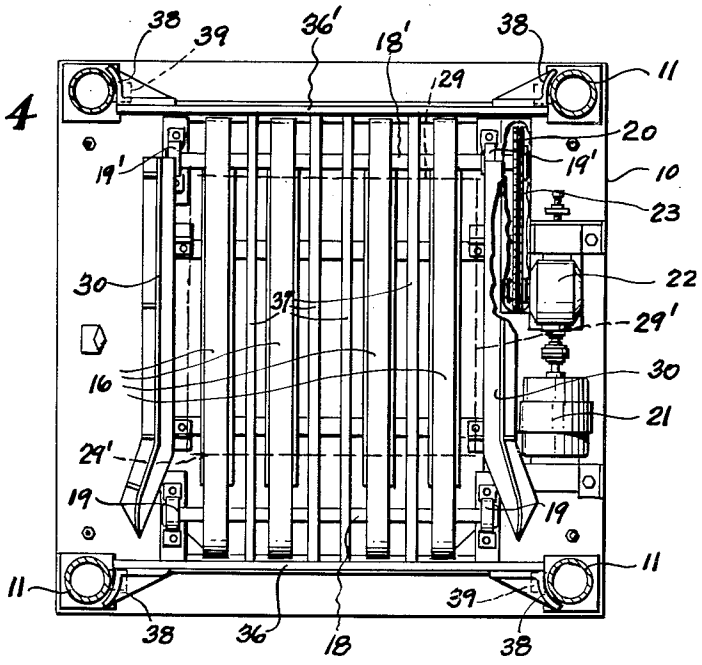



Fig. 4




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Fig. 5

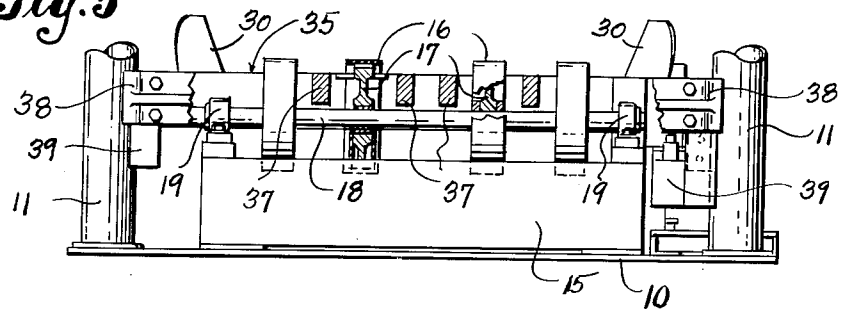



Fig. 6

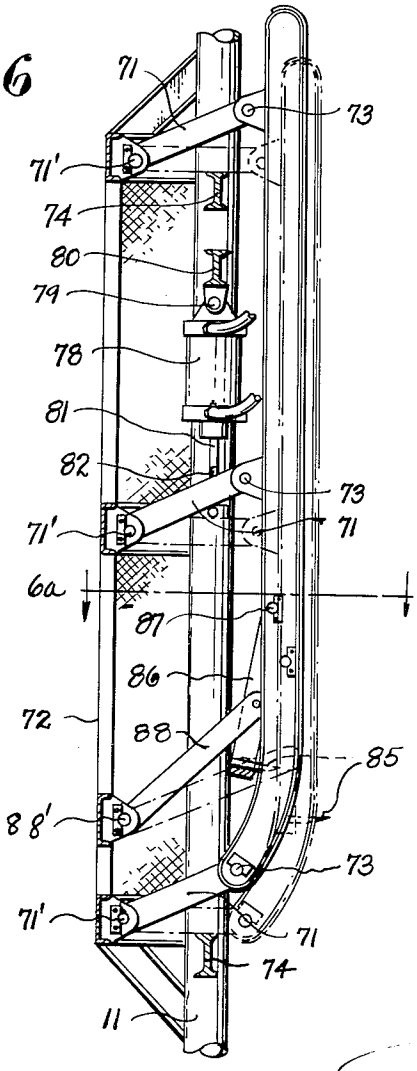
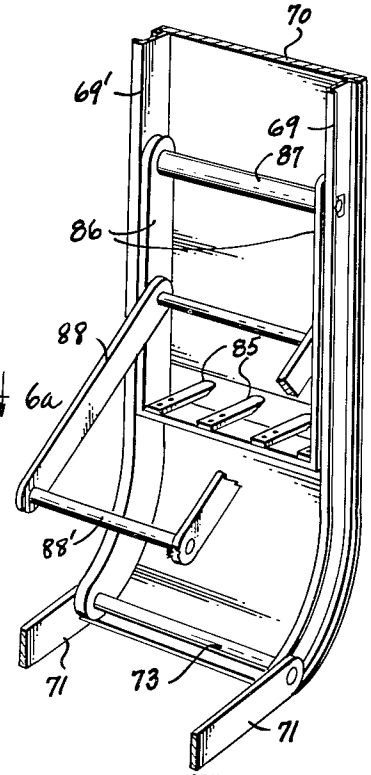



Fig. 6a




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Fig. 8

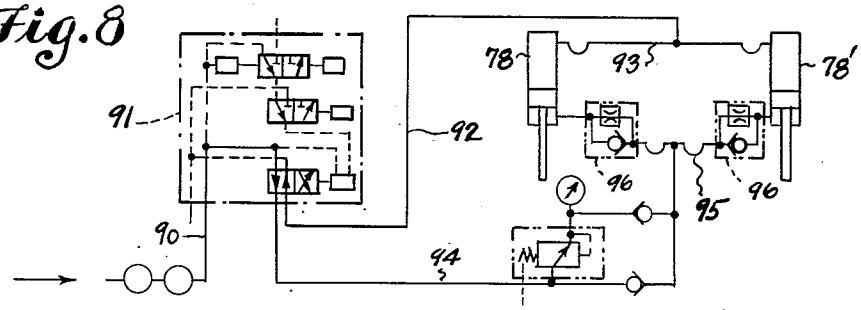



Fig. 7

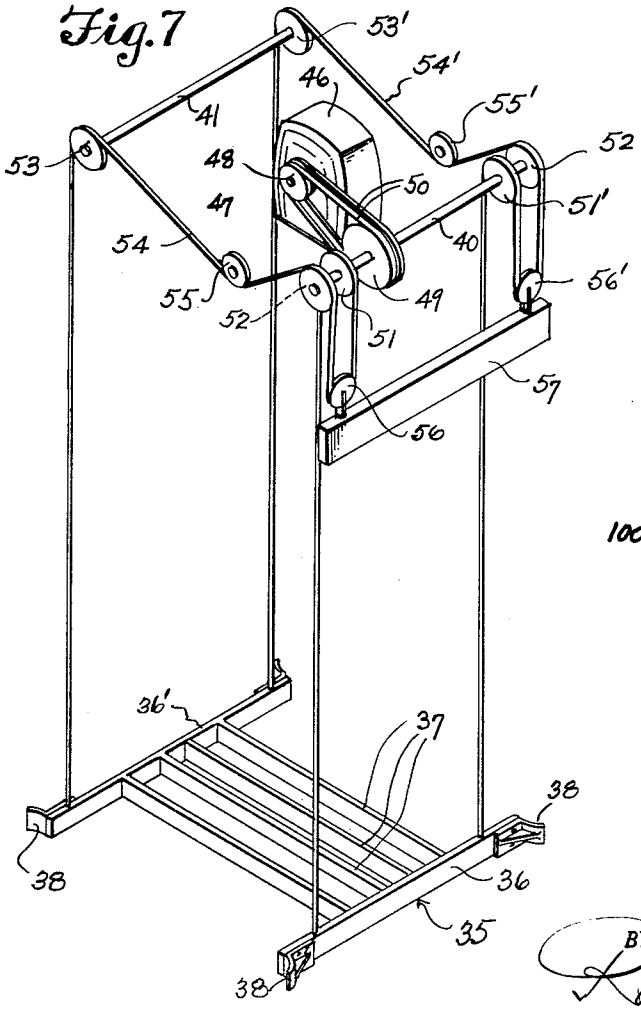
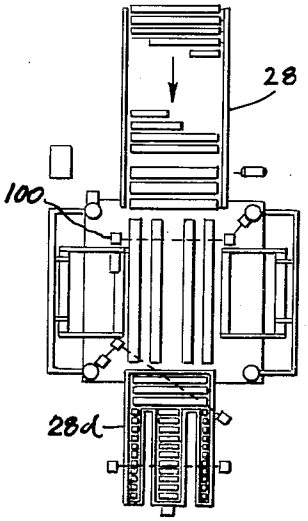



Fig. 9




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3,035,716

# BALE STACKER

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8 Claims. (Cl. 214—6)

This invention relates to improvements in bale or package stacking mechanisms. More particularly it relates to a mechanism to which bales of substantially uniform size may be successively delivered and therein assembled in stacked relationship for removal and handling as stacks of a predetermined number of bales.

It is the principal object of the present invention to provide a stacking mechanism for pulp bales, or the like, that is fully automatic in its operations and by which bales, delivered successively thereto, may be arranged therein in stacked relationship and then, when a stack of a predetermined height has been formed, or when the stack comprises a predetermined number of bales, it will be automatically advanced from the machine.

It is a further object of the present invention to provide a machine of the character above stated wherein the stacks are built up by the successive addition of bales to their lower ends and wherein mechanisms of novel kind and combination operate to lift and support a forming stack for the ready addition of bales to its lower ends as they successively enter the machine.

It is also an object of this invention to provide means whereby bales are caused to be arranged evenly in vertical alignment upon their assembly with the stack.

Still further objects and advantages of the present invention reside in the details of construction and combination of its various parts, and in the automatic mode of operation of the machine, as will hereinafter be fully described.

In accomplishing the above mentioned and other objects of the invention, we have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein:

FIG. 1 is an elevation of the stacking mechanism of this invention, as seen from the bale receiving side; some parts being broken away for explanatory purposes.

FIG. 2 is an elevation of the machine, as seen from the right hand side of FIG. 1.

FIG. 3 is a plan or top view of the stacking mechanism showing the gearing means for lifting and lowering the elevator.

FIG. 4 is a horizontal section, taken substantially on the line 4—4 in FIG. 2, showing the bale conveyor and its driving mechanism as mounted on the base plate of the main frame structure.

FIG. 5 is a side view, with parts in section, of the elevator in its lowered position, and the stack discharging conveyor.

FIG. 6 is a vertical section of a part of the main frame structure, and showing the stack aligning and stabilizing frame structure that forms one side of the stacking guideway. Also showing the actuating cylinder as applied there to control this frame structure.

FIG. 6*a* is a perspective view of the lower end portion of the stack aligning frame of FIG. 6.

FIG. 7 is a schematic showing, in perspective, of the elevator lifting and lowering means.

FIG. 8 is a schematic showing of the various control valves and electrical devices employed in the automatic control system by the mechanism.

FIG. 9 diagrammatically illustrates the disposition of various electrical devices in the machine for controlling its operation.



Referring more in detail to the drawings:

In its present preferred form of construction, the stack forming mechanism of this invention comprises a rigid main frame structure that is preferably fabricated from metal tubing, angle iron rails and sheet metal plates. This structure has a flat, substantially square sheet metal base plate **10**, to each of the corner portions of which the lower ends of vertical, tubular posts or columns **11**, of equal diameter and height, are welded or otherwise securely fixed. Mounted upon the upper ends of these four corner posts, and welded or otherwise fixed thereto, is a horizontally disposed top plate **12**. This plate **12** supports thereon, as shown in FIG. 3, the motors and certain gearing which will presently be described, for driving the elevator operating mechanism.

In the lower end portion of the main frame structure is a rectangular frame **15** that rests flatly upon and is fixed rigidly to the base plate **10**, symmetrically within the four corner posts **11**. Supported horizontally on this platform is a belt conveyor mechanism comprising a plurality of parallel, laterally spaced continuous belts **16** mounted for travel about belt wheels **17—17'** of equal diameter that are fixedly mounted, respectively, on cross-shafts **18—18'**; these shafts being horizontally disposed and rotatably supported on the platform at their opposite ends in bearings **19—19'**, as has been shown in FIGS. 4 and 5. It is further shown in FIG. 4 that an electric motor **21** is mounted on the base plate **10** at one side of the platform **15** and is operatively connected through a speed reduction mechanism **22** and sprocket chain belts **23** with shaft **18'** for driving the conveyor. This conveyor is herein designated as the "stack discharging" conveyor.

Explanatory to this invention, it will here be mentioned that the bales or packages that are to be stacked by this mechanism are successively delivered thereto by a conveyor mechanism of any suitable kind such as, for example, that which has been designated in FIG. 2 by reference numeral **28**. The bales, herein designated by reference numeral **29**, are uniform in dimensions and are squarely delivered from the driven conveyor **28** onto the driven conveyor belts **16** and are moved thereby to a location substantially centered in the machine with reference to its corner posts **11**, as indicated by the dash line indication of a bale at **29'** in FIG. 4. The bales as delivered by conveyor **28** are received between guide rails **30—30** that are fixed to and along opposite sides of the elevator frame, presently described and which have end portions in outward divergence, as shown in FIG. 4, for easier reception of the incoming bales. Upon the advancement of each bale to this centered location, the conveyor belts **16** are stopped by means, later disclosed, and the bale is then caused to be lifted into a stack forming guideway located vertically and centrally within the main frame structure. This guideway and parts related thereto will presently be described in detail.

The means provided for successively lifting the bales **29** into the guideway comprises a frame or platform designated in its entirety in FIGS. 5 and 7 by numeral **35**. This comprises a horizontally disposed rigid grid structure formed across the bale receiving and bale discharge sides thereof, respectively, by cross-members **36—36'** which are joined rigidly in parallel relationship at opposite sides of the elevator frame and intermediate the sides by a plurality of horizontal bars **37**; these being disposed at the same level between the belts **16**, above and across the shafts **18—18'**. At their opposite ends, the cross-members **37—37'** of this frame are equipped with guide shoes **38** which are shaped to conform to the inside faces of the corner posts **11** as observed in FIG. 4 and which shoes have sliding contact with the posts to guide the frame **35** in its vertical travel. When in its

fully lowered position, as shown in FIGS. 2 and 5, this frame is supported by resting upon blocks **39** that are fixed to the lower end portions of posts **11** and its support is such as to dispose the top edge surfaces of its frame parts and cross-bars just slightly below the plane of the top runs of the belts **16** that comprise the stack discharge conveyor as will be understood by reference to FIG. 5. The frame **35** will herein be designated as the "elevator."

The means herein employed for lifting the elevator from the fully lowered position of rest to dispose a bale **29** received thereon within the stacking guide presently described, comprises an electric motor and gearing which is best shown in FIGS. 2 and 3 to be mounted on the top plate **12** of the main frame structure.

It is shown in FIG. 3 that cross-shafts **40** and **41**, are mounted horizontally and in parallel relationship on plate **12** adjacent the stack discharging and bale receiving sides respectively, of the frame structure; being rotatably mounted near their opposite ends, in bearings **42** which are fixed upon rails **43—43** that are fixed to and extend across plate **12** at opposite sides thereof. Also, supported on plate **12**, in its central area, is a platform **44** on which an electric motor **45** is mounted. This motor has a driving connection, with a reduction gearing contained in a gear box **46**, mounted on platform **44**. This reduction gear mechanism has a drive shaft equipped with dual sprocket wheels **48**, in alignment with dual sprocket wheels **49—49** fixed on shaft **41** and chain belts **50—50** operate about these aligned sprocket wheels, to provide a driving connection between motor **45** and shaft **41**.

Fixed to the opposite ends of cross-shaft **41**, outside its supporting bearings **42—42**, are sprocket wheels **51** and **51'**, and at the outside of these are sprocket wheels **52—52'**. These latter wheels **52—52'** are aligned with sprocket wheels **53** and **53'** fixed on cross-shaft **40**. All these sprocket wheels being of the same diameter.

Extended over the aligned sprocket wheels **52** and **53** and **52'** and **53'**, respectively, at opposite sides of the frame as shown in FIG. 7, and then downwardly are continuous sprocket chains **54** and **54'**. At their opposite ends these chains are fixed, respectively, to the opposite ends of the cross-members **36—36'** of the elevator, as best shown in FIG. 7.

Between the shafts **40** and **41** the chains **54—54'** pass beneath idler sprocket wheels **55** and **55'** which are supported from the main frame structure below the level of the shafts **40—41**. The vertically extended end portions of the two chains, **54—54'** at the stack discharge side of the machine, pass upwardly over the wheels **53—53'** and thence beneath the sprockets **55—55'** and over the sprockets **52—52'**, then downwardly and about sprocket wheels **56—56'** that are attached to opposite ends of a counter weight **57**, thence pass upwardly over the wheels **51—51'** and finally downwardly for their attachment to the elevator as shown. Through this chain belt arrangement, the raising and lowering of the elevator is effected. Furthermore, the level position of the elevator is maintained and the weight normally sustained thereon is counterbalanced by the weight **57**.

It is shown in FIG. 2 that the counter weight **57** is suspended by the chains **54—54'** for vertical travel in a guide frame **65** fixed to the bale receiving side of the main frame structure.

Bales entering the machine are successively received on the elevator **35** and are successively lifted thereby between upwardly extending and laterally spaced frames **68—68'** supported within the main frame structure, as has been shown in FIG. 1. With the lifting of the elevator **35**, a bale **29** that has been received thereon will be moved between the laterally curved lower end portions **68***x* of the coacting guide frames.

Each guide frame, as shown in FIG. 6 and as applied vertically within the main frame structure, comprises a pair of coextensive opposite edge rails **69—69'** joined by



a suitable facing plate **70**, as shown in FIG. 6*a*, extended to the full length of the frame. Each frame is supported at upper and lower ends and also intermediate its ends by paired links **71** which normally are horizontally disposed and which are pivotally mounted at their outer ends as at **71'** in frame structures **72** that are rigidly fixed to and which extend laterally from opposite sides of the main frame structure. At their inner ends these paired links are pivotally connected to the corresponding guide frame as at **73**. When these stack guiding frames **68—68'** are in their normal, lowered positions, as shown in FIG. 1, the upper and lower sets of links **71** rest, near their inner or swinging ends, on rigidly fixed, horizontal beams **74** that extend between corner legs of the main frame structure. The lower ends of the frames are laterally curved, as shown, in order to provide a wider entrance into the space between frames for easier reception of a lifted bale **29** between them.

The two coacting guide frames, **68—68'** are adapted to be lifted and swung outwardly through a limited arc as indicated in FIG. 6, by reason of the supporting linkage; lifting and outward swinging being accomplished by means of vertically disposed air powered cylinders **78—78'** that are pivotally fixed at their upper ends, as at **79**, in FIG. 6, to horizontal cross-beams **80** that extend between corner posts of the main frame structure. These cylinders have piston rods **81** extended downwardly therefrom and pivotally fixed, as at **82**, to the medial set of supporting links of these frames. When operating air is admitted to the lower ends of the cylinders, the frame mounting links are caused to swing upwardly and the frames to be moved upwardly and outwardly accordingly. With the release of air from the lower ends of these cylinders, the frames swing downwardly and inwardly toward normal position, against the bales stacked between them.

Operating in conjunction with the upward and downward swinging movement of each of the stack guiding frames **68—68'**, are bale supporting fingers **85** which are fixed to the lower ends of swingingly mounted frames **86**, see FIG. 6*a*, that are disposed within the lower portions of the frames **68—68'** to swing outwardly and inwardly relative thereto. These swinging frames **86**, as disposed in the laterally spaced guide frames, are at the same horizontal level and each is supported from the corresponding guide frame for swinging action by a horizontal shaft **87** extended through its upper end portion. Normally each frame **86** is disposed in such position that the bale supporting fingers **85** project inwardly beyond the inside surface of the guide frame, as shown in FIG. 1. Pivotally connected to each of the swinging frames **86** are the inner ends of paired links **88** which extend outwardly and downwardly therefrom and which, at their outer ends are pivotally connected to the corresponding laterally extended frame structure **72**, as at **88'** in FIG. 6. The linkage and connections as above described are such that when the guide frames **68—68'** are caused to be swung upwardly and outwardly, the finger mounting frames **86** will be caused to swing outwardly to a greater extent and the fingers **85** are thereby caused to be drawn outwardly from bale or stack supporting positions, as indicated by the full line showing of these parts in FIG. 6.

Operating air is delivered to the opposite ends of the air cylinders **78** under solenoid valve control, as diagrammatically illustrated in FIG. 8 and as explained below.

It is indicated in FIG. 8 that the two air cylinders **78—78'** are supplied with operating air from a supply line **90** under control of a four way solenoid valve **91** having an outflow pipe connection **92** with a pipe **93** that connects at its ends with the upper ends of the air cylinders, and having another pipe connection **94** to a pipe line **95** which is connected at its opposite ends, respectively, to the lower ends of the air cylinders. Pressure regulators **96—96** are interposed in these latter con-

nections to definitely establish the lifting power that can be applied to the air cylinders.

Assuming that the present stacking mechanism is constructed as described and that the parts are in their normal positions for bale reception, the operation for the stacking of bales, as successively delivered onto the conveyor belts **16** from the conveyor **28** is as follows: With the belts **16** being driven, an entering bale **29** received thereon from conveyor **28**, between the diverging end portions of the opposite side rails **30—30** is moved by the conveyor belts **16** to the centered position indicated in FIG. 4. As the bale moves into this position, it interrupts a light beam of a photo electric cell **100**, shown in FIG. 9, this operates through conventional means to stop the motor **24** and the conveyor belts **16**, and to simultaneously start motor **45** to move the elevator **35** upwardly and cause this first bale to be received between the diverging lower end portions of the stack guiding frames **68—68'**. Simultaneously with this operation, air is admitted to the lower ends of the paired air cylinders **78—78'** which then operate to cause the laterally spaced stack guiding frames **68—68'** to be swung upwardly and outwardly and the finger equipped frames **86—86** to move upwardly therewith and by reason of the frame movement to be swung outwardly, to a greater extent than the stack guide frames, thus to clear the fingers **85** from the path of travel of the bale being lifted. It is of importance that the pressure of operating air admitted to these cylinders is so established by the pressure regulators that they will not, by themselves, lift the guide frames if a single bale or a stack is supported by the fingers. To do this, they must be supplemented by the lifting power of the elevator motor **24**. Therefore, at the start of any stacking operation, beginning with the machine empty, that is, with no bale supported by the fingers **85**, between the stacking guides, the guide frames will swing outwardly with the lifting of the first bale and the fingers will be moved into the clear and the bale will be lifted by the elevator to a height well above the level of the then retracted bale supporting fingers **85**. When the bale elevator **35** reaches a predetermined top position, as established by the position of the stack height limit switch, it actuates a reversing switch and immediately starts lowering. This effects the reversal of the solenoid valve **91** which controls the air cylinder operation and the guide frames **68—68'** are thus dropped back to normal positions. This dropping action of the guide frames causes the frames **86—86** to swing inwardly and their fingers **85** to be disposed in bale supporting positions for the support of the lowering bale thereon between the lower end portions of the stack guiding frames. When the empty elevator reaches its fully lowered position, as in FIG. 2, a switch is actuated thereby and the motor **24** is stopped.

With the delivery of the next bale from the conveyor **28** onto the fully lowered elevator **35** the elevating operation, as above described, repeats itself, except in this instance, the air cylinders do not, by themselves, lift the guide frames and the finger supported first bale remains in supported position until the bale then being lifted engages it and causes it to be moved upwardly thereon. The power of the two air cylinders, as thus supplemented by the elevator motor, then operates to move the frames **68—68'** upwardly and outwardly and with this movement to cause retraction of the fingers **85** from opposite sides of the guideway space. The two bales are then lifted to the upper limit of travel, as controlled by the previously mentioned limit switch, and as the elevator again starts downwardly, the finger frames are caused to swing inwardly to support the two bales of the then forming stack, in the guideway. This bale lifting procedure is repeated with the lifting of each bale into the guideway until the stack, upon reaching a predetermined height or a predetermined number of bales as indicated by a counter, energizes a relay which operates to hold the cylinder controlling valve **91** energized and retains the fingers **85** out of the guideway so that, when the elevator again lowers, the formed stack of bales will be lowered with it onto the conveyor belts **16**. Incident thereto, it is also provided that the relay will by-pass the effect of the interruption of the light beam of the photo-electric cell and the motor **22** for driving the belts **16** will again be started and the lowered stack will be moved thereon from the machine onto a discharge conveyor shown at **28*d*** in FIG. 2 to a position for easy pick up by fork lift truck or the like. The relay is de-energized by the outwardly moving stack, and the stack mechanism is again in readiness to accumulate its next stack.

This mechanism is fully automatic in its operations and although designed to handle pulp bales of uniform dimensions it applies equally well to other packages of proper dimensions.

It provides a practical, and economical mechanism for accumulating a predetermined number of bales or packages in a stack for easy conveyance to and their packing in conveyors for shipment, or storage without necessitating manual handling.

Another feature of importance resides in the fact that as the stack guiding frames swing outwardly and inwardly against the bales as being stacked, they bring them into even vertical alignment and thus facilitate the conveyance, wrapping and close packing of stacks in storage.

Changes in size, proportions, and materials of construction can be made without departing from the spirit of the invention.

What we claim as new is:

1. A bale stacking mechanism of the character described comprising a main frame structure, a vertical guideway provided therein, an elevator mounted in said main frame structure for travel between a low level position and a higher level position, means for delivery of bales successively onto said elevator, said guideway comprising vertically disposed, laterally spaced and movably mounted, opposite side frames, a plurality of horizontal frame supporting links of substantially equal length pivotally attached at their opposite ends respectively, to said laterally spaced frame and to said main frame structure, vertically suspended finger frames pivotally mounted by each of said laterally spaced frames, a plurality of fingers mounted in fixed relationship on each finger frame and extending in substantially a horizontal plane, a finger actuating link for each finger frame pivotally mounted at one end on said main frame structure and pivotally connected at its opposite end to said finger frame intermediate the upper and lower ends thereof, and power means for effecting swinging of said frame supporting links in timing with the elevator movements.

2. The mechanism of claim 1 wherein the frame supporting links for said laterally spaced frames are adapted to swing about their outer end pivotal mountings through definitely limited arcs to establish the maximum and minimum width of the guideway into which the bales are successively lifted by the elevator.

3. The bale stacking mechanism of claim 1 wherein said power means for effecting the swinging of said frame supporting links comprises, for each frame, an air cylinder supported in the main frame and having its piston rod operatively connected with one of the frame supporting links to effect the raising and lowering of the laterally spaced frames.

4. A bale stacking mechanism as in claim 1 including means operable by the lifting of a stack of predetermined height, to hold the laterally spaced frames and finger frames from returning to stack supporting position and thus permit lowering of the stack with return of the elevator to its loading level, for removal of the stack of bales from the machine.

5. The mechanism of claim 3 wherein said air cylinders are operatively connected with a source of operating air

through an air control valve mechanism, and means is provided whereby said valve mechanism is operated in accordance with upward travel of said elevator to effect movement of the laterally spaced frames apart and to effect their movement toward each other, when the elevator reaches its upper limit of travel.

6. The mechanism of claim 5 wherein the last mentioned means operates in conjunction with the elevator powering means to return the elevator from its upper level to its lower loading level.

7. The mechanism of claim 4 wherein a conveyor is disposed to receive the lowered stack of bales from the elevator as it reaches its lower loading position, and wherein power means is set in motion, incident to the disposition of the stack on said conveyor, for driving the conveyor for removal of the stack from the machine.

8. The mechanism of claim 4 wherein a conveyor is



disposed to receive the lowered stack of bales from the elevator as it reaches its lower loading position, and wherein power means is set in motion, incident to the disposition of the stack on said conveyor, for driving the conveyor for removal of the stack from the machine.

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