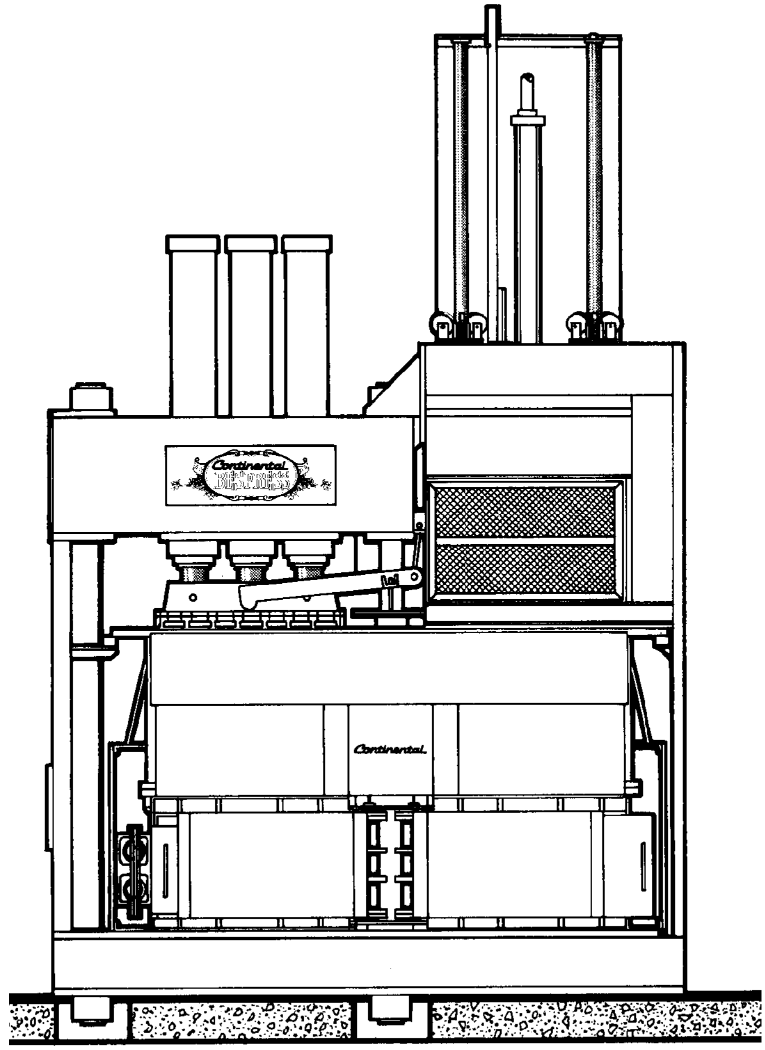
Cotton Bale Presses At Gins, 1960 - 2004



Gino J. Mangialardi, Jr.
and
W. Stanley Anthony

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COTTON BALE PRESSES AT GINS, 1960 - 2004[1]

Gino J. Mangialardi, Jr.
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W. Stanley Anthony[2]

ABSTRACT

This paper reviews and compiles most of the significant developments and research conducted on bale presses for cotton gins since about 1960. It describes the design and operation of various types and models of bale presses, and gives an appraisal of press designs and adjustments that may be most useful at current cotton gins. The compiled information and recommendations should prove useful to ginners, scientists planning future ginning studies, and engineer's selecting cotton bale press designs and types for commercial gins.

INTRODUCTION

Increased production of Upland cottons with the advent of the Whitney and Holmes tooth gin stands in 1792 created a major problem in packaging the ginned lint. Until 1810, ginneries usually had only one gin stand and packaged the ginned lint in bags that varied from 125 to 350 lb in weight. The bags were hooked on frames constructed around holes in the floor and tied out in the basement. Workers tramped lint down into the bags with their feet or wooden pestles (Bennett, 1962).

Wooden and iron screw cotton presses were tried by 1799. After 1810, wooden screw presses gained favor and were used extensively. Some still operated in 1903. Animal sweeps provided power for the pressing. These presses were usually placed outdoors and were often provided with small sheltering roofs. A few of the old gins employed a pit beneath the press, where the bale was tied out. Other early gins with outdoor presses did not use a pit and tied out at ground level (Figure 1).

After 1854, when the use of steam power at cotton gins became prevalent, animal power was seldom used. After about 1860, many gins used steam engines and moved the presses into ginning buildings.

Some early presses retained the iron and steel screws. Others began to employ steam plungers. By 1878 these plungers were being used above the cotton boxes for mechanical tramping and packing (Figure 2). These presses required an operator to rake the ginned lint from the lint slide into the box and then to manually operate the steam piston tramper by means of a rod-controlled valve.

Cotton bales of various densities and weights were used. Square bales came to 500 lb average and round bales came to a standard of 250 lb weight. From 1940-1960, standard and high-density presses at gins began to be widely used. These bales weighed about 500 lb and were packaged at densities of about 24 and 32 lb/ft^3, respectively.

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[1]For publication by The Cotton Foundation, Memphis, TN, and The Cotton Gin and Oil Mill Press.

[2]Agricultural Engineer (Retired) and Supervisory Agricultural Engineer (Retired), respectively, U. S. Cotton Ginning Research Unit, Agricultural Research Service, USDA, Stoneville, MS 38776.

A detailed history of packaging ginned lint (1795-1961) is described by Charles A. Bennett in a journal “Cotton Ginning Systems & Auxiliary Developments” (Bennett, 1962). Bale Packaging System

Bale packaging is the final step in processing cotton at the gin. The packaging system consists of a battery condenser, lint slide, lint feeder, tramper, bale press, and bale tying mechanism. This system may be supplemented with systems for bale conveying, weighing, and wrapping. The bale press consists of a frame, one or more hydraulic rams, and a hydraulic power system. Tying subsystems may be entirely manual, semi-automated, or fully automated.

Bale presses are described primarily by the density of the bale that they produce, such as low density (flat or modified flat) or universal density (gin or compress). Other descriptions include up-packing, down-packing, fixed box, and doorless. Regardless of description, they all package lint cotton so that it can be handled in trade channels and at textile mills (Anthony et al., 1994).

Battery condensers have a slow-turning, screened or perforated metal-covered drum on which the ginned lint forms a batt. The batt is discharged between doffing rollers to the lint slide. Conveying air supplied by a vane-axial or high-volume centrifugal fan passes through the screen on the drum and is usually discharged out one end of the drum through an air duct. The discharged air then goes to dust abatement equipment and then into the atmosphere.

The lint slide is a sheet-metal trough (approximately 54-in. wide) that connects the battery condenser to the lint feeder on the tramper. It is installed at an angle of 33°-45° to ensure movement of the lint without rolling the batt. The length of the lint slide is based on the capacity of the ginning system and the time required to turn the press between bales.

The lint feeder is a device for moving lint from the lint slide into the charging box of the press. There are three basic types of feeders: (1) revolving paddle kicker, (2) belt feed used in conjunction with the kicker, and (3) lint pusher. All of these devices should deposit lint into the charging box with a fast but gentle action, without breaking up the batt as it is received from the condenser. A smoother lint sample will result if this can be accomplished.

The purpose of the tramper is to initially pack the lint into the press box to reduce the press box volume required. Mechanical and hydraulic trampers are available. Regardless of type, care should be taken to prevent contamination of lint beneath the tramper by hydraulic fluid or grease from the tramper mechanism. Motors that have 10-15 hp and that are equipped with a fail-safe brake are usually used on mechanical trampers. Motors used on hydraulic trampers vary from 25-75 hp.

Four types of gin presses have been used; each type is named according to the bale it produces – flat, modified flat (bales to be sent for recompression to become compress universal density bales), gin standard, and gin universal. Today all of the bales produced at gins in the United States are gin universal density.

After the bale is compressed to a given density or press platen separation, ties are applied around the circumference of the bale to restrain the lint within prescribed dimensions. Bale ties are normally either wire or flat, cold-rolled steel bands, or plastic, and are placed at intervals along the length of the bale. Usually, six or eight ties per bale are used. The ties can be applied manually or with a semi-automated tying system. In order to reduce labor requirements, bale tying systems are rapidly being automated.

OBJECTIVE

This paper reviews and compiles most of the significant developments and research conducted on cotton bale presses for cotton gins since about 1960. It describes the design and operation of various types and models of bale presses, and gives an appraisal of press designs and adjustments that may be most useful at current cotton gins. The paper describes up-packing and down-packing presses; flat (low density), standard density, high density, and universal density types; and some accessories used with cotton baling systems. Materials from the review are arranged chronologically. The complied information and recommendations should prove useful to ginners, scientists planning future ginning studies, and engineer's selecting cotton bale press designs and types for commercial gins.

DEVELOPMENTS

Hardwicke-Etter Standard Density Press

The Hardwicke-Etter Standard Density Press is an all-steel up-packing unit with an automatic ball-bearing tramper (Figure 3). It produces a bale of standard density (about 24lb/ft^3) (Hardwicke-Etter Co., Undated A).

Hydraulic pressure locks for the doors give positive locking. The unlocking operation opens all press door simultaneously, making the entire bale accessible for tying out and handling.

The press is mounted on large ball-bearings around a 7-in. cold-rolled steel shaft. Platen and sills are solid steel plates supported by 7 in. shafting on each side. Press boxes are 20 in. by 54 in., made of special steel and perforated for air escape. There are three 9½-in. diameter hydraulic rams which can press an average bale in less than a minute. The dogs release after the rams start up. Hydraulic cylinders have by-pass type heads to prevent rams from being pumped out of the cylinders and allow fluid to flow back into the supply tank.

Hardwicke-Etter Automatic Stationary Box Baling Press System

This Hardwicke-Etter Hi-Duty 175-ton stationary box baling press system is designed for maximum automation. Its automation can include full automatic sequencing, complete automatic strapping, and automatic bale ejection. There is manual loading of bale covering material (Hardwicke-Etter Co., 1970).

Controls automatically stop the "SFH" mechanical tramper when a predetermined weight is reached. Then, below floor level, the box rotates, the bale is compressed while the tramper begins charging the other box, and the straps are automatically tied around the finished bale. Only then does the baling chamber door open and eject the bale. This is done at a capacity of up to 30 bales per hour. The system is designed for various types of bale coverings including completely covered fiber packaging to reduce fiber contamination.

Hardwicke-Etter's Hi-Duty presses are up-packaging (Figure 4) or down-packaging (Hardwicke-Etter Co., Undated B). They use a rotary-type pump to press a bale in less time than that required by the plunger type. The pumps are made in single or double types that are adaptable to various size ginning plants.

Hardwicke-Etter Universal Density "Fixed-Box" Press

Hardwicke-Etter's "Fixed-Boxed" Universal Density Press operates with its SFH tramper and pneumatic lint pusher (Figure 5). The SFH tramper was designed for all baling operations. It is a mechanical tramper which features 6-in. face width herringbone gears in a non-lubricating gear box (Hardwicke-Etter, 1975).

Fiber is moved into the press box with the Hardwicke-Etter pneumatic lint pusher (Figure 6). The lint pusher works in synchronization with the tramper. It folds the lint into the charging chamber and delivers it into the press box with each stroke of the tramper.
The hydraulic system for the press uses two 12-in. diameter rams with operating pressures to 5,000 psi. Nominal box size is 20 in x 54 in. The press is automatically rotated by a fluid drive gear-head motor. It uses a door locking system which is hydraulically controlled but is an integral part of the doors. Doors are hydraulically powered open. The unit is designed for adaptation of an automatic strapping mechanism. Press dogs are automatically activated.

Hardwicke-Etter Automatic "Hi-D" Compress

The Hardwicke-Etter Automatic "Hi-D" Compress is fully automatic but a manually operated model was available (Figure 7) (Hardwicke-Etter Co., Undated C). Manufacturer's tests show that this "Hi-D" compress could apply 2 million lb of force that results in a bale density in the press of 62 lb/ft^3.

Hardwicke-Etter's "Hi-Ds" use three 12-in. diameter rams that require 150 gallons of oil to deliver a ram stroke of 104 in. (Figure 8). Their operational tests show that this stroke will press a bale to a thickness of 16 in. This is accomplished in 2 cycles. During the first cycle, 138 gallons of oil are required to move the rams 96 in. Four low-pressure hydraulic pumps with a combined capacity of 170 gallon per minute complete the first cycle in 50 seconds

The second cycle begins when the pressure reaches 2,000 psi. At this point, two high-pressure pumps (each with a capacity of 65 gal/min) unload. The final 8 in. of ram travel is activated by two additional high-pressure pumps (each with a capacity of 20 gal/min) in 20 seconds. Total pressing time is about 70 seconds.

The box size is 20 in. by 54 in. In one test, a 570-lb bale was pressed to 15 in. in the 20-in. x 54-in. press box and tied out at a thickness of 20 in. The packaged bale had a density of 46 lb/ft^3.

Murray Flat Bale Press

The Murray Company of Texas, Inc. manufactured four types of its up-packing standard flat bale press (The Murray Company of Texas, Inc., Undated D). They used a motor driven Atlas Tramper with solenoid operated air brake.

Type No. 1 press turned manually. Type No. 2 has an electrical press turner with start and stop push buttons. Type No. 3 had the electrical press turner with automatic braking arrangements and positive lock-in attachments to safeguard tramper operation and ram travel. On these three type presses, door locks had to be pumped up manually.

The Type No. 4 press had features that sped up its operation. There was automatic sequence of the pressing cycle. An automatic bale-size mechanism sensed the amount of lint cotton in the press. When bale weight was attained, the tramper automatically stopped; a warning horn sounded and the press turned itself, locked into position, re-started the tramper, started the pump for raising the ram, and stopped the ram at the top of travel. The sequence re-cycled automatically. There were safety devices for protection of personnel and equipment.

Murray "POS" Press

An advance by the Murray Company was its Model "POS" Press (The Murray Company of Texas, Inc., Undated E). This was a double-box, down-packing press that was developed with improvements and special features to meet demands created by higher capacity ginning (Figure 9). Features included hydraulic door locks, an automatic door trip mechanism to get positive dog action, automatic ram stop at the top position, and deep boxes. It had a double-acting cylinder with a 10-in. diameter piston and an 8 3/8 in. ram, fitted in a 10-in. diameter cylinder with leak-proof double gland. It operated with a double chain ball bearing tramper unit.

Murray PCD Press

Murray's PCD Press was a heavy duty, 3-ram, down-packing gin compress (The Murray Company of Texas, Inc., Undated F). This press was designed with 20 in. by 54 in. boxes fitted with swinging doors, and produced bales with an average density of 25-27 lb/ft^3. The approximate size of the finished bale was 21 by 27 by 55 in. for a 525 lb bale. Features of the PCD Press include hydraulic door locks, automatic dog trip mechanism, automatic ram stop, and press lift. The three double-acting hydraulic rams are built to operate on 2,750 psi.

Murray PCX Up Packing Presses

One Murray "PCX" 20-in. by 54-in. model used three long hydraulic rams, 9⅜-in. diameter, to furnish sufficient power for compressing the bales to achieve 24 to 27 lb/ft^3 final density (The Murray Company of Texas, Inc. Undated G). It was a double-box, up-packing press which operated with a long stroke, double chain ball bearing tramper unit. A safety press and tramper lock prevented the tramper from operating when the press is turned or standing off center.

Murray PCX up-packing presses were also manufactured in both 20 in. by 40 in. and 20 in. by 54 in. box sizes but operating with one extra-long 17⅜-in. diameter hydraulic ram (The Murray Company of Texas, Inc. Undated H). Features of these presses include hydraulic door locks with combination pump and tank, and the safety press and tramper lock. The press is assembled with a motor driven Atlas Tramper. The complete heavy duty, double chain, sealed ball bearing tramper includes box enclosure, lint pusher mechanism, lint gate, steel tramper sills and steel supporters.

Murray "PHD" Model Press

The Murray Company of Texas, Inc. developed the "PHD" Model Press with one ram for standard density and with two rams for high density pressing (The Murray Company of Texas, Inc., Undated I). This press is the up-packing type with all steel 20 in. by 54 in. boxes (Figure 10).

Normal maximum operating pressure is 3,500 psi. Each ram has a diameter of 17⅜ in. and an area of 237 in^2. Pressing time is rated at 90 seconds to produce high density bales with return of rams to down position being 40 seconds. Approximate size of completed high density bale is 21 in. by 21 in. by 55 in. and its average density is 34 to 40 lb/ft^3.

Murray PHC Standard Density Press

Murray's Stationary Box PHC Baling Press is a standard density type that contained the same amount of storage area as its standard PCX Press (The Murray Company of Texas, Inc. Undated J). There are no rotating boxes above floor on this PHC Model. It has a capacity up to 30 bales per hour. There are hydraulic door locks with electric pump. Features include positive action dogs, automatic ram stop, motor driven tramper with solenoid operated air brake, and 17⅜-in. diameter ram and cylinder. Complete automatic cycling was available.

Murray PHC/PHC-X Universal Density Press

The Murray PHC and PHC-X Universal Density Presses are of the stationary box type, and the rotating portion is beneath the floor (Maquinas Piratininga, S. A., Undated K; Murray-Carver, Inc. 1981). Two 12-in. diameter rams are standard (Figure 11). The presses can be fully automatic. For processing naked bales, the PHC press system can be automated from lint slide to weigh station. This includes tramping, press rotation, bale pressing, door opening, bale strapping, ram lowering, bale ejection and transport and door closing.

PHC-X Presses are built automatic initially or by modifying the PHC Press. These options include automatic bale strapping system and automatic bale ejection and transport system. Murray PHC and PHC-X Presses have capacities up to 40 bales per hour. Both use the Murray Altas Power Miser Tramper. The Murray 50/75 hp hydraulic pump, delivering 192 gallons per minute is standard. Other special duty hp units are available.

Murray PHX Up-Packing Double Box Press

The Murray PHX Up-Packing Double Box Press makes universal density bales (Figure 12). It is designed to produce bales with a minimum density of 28 lb/ft^3. The press has hand-operated swinging doors with hydraulic locks, automatic press dogs, and a steel turning deck. The standard Murray 50 hp hydraulic pump delivers 150 gallons per minute. A special duty 100 hp unit delivers 340 gal/min for higher capacity (Murray-Carver, Inc., 1982)

The Murray system can be automated from the lint slide to the weight station. These include the tramper, press rotation, bale pressing, ram lowering, bale ejection, and transport for processing naked or dressed bales. This press has a capacity of up to 25 bales/hr, using the Murray Atlas Tramper.

Synthetic Fiber Industry Presses

Some of the Murray presses were manufactured especially for the synthetic fiber industry. One was the Automagic Stationary Box Baling Press (Murray-Carver Division, North American Rockwell, Undated L). It was developed for both natural and synthetic fiber baling. This press had two 9⅜-in. diameter rams and casings, and was suitable for pressing capacities of from 100 to 325-tons of compressive force. There were many automatic features which included automatic strapping with a longitudinal strap. It used an Atlas heavy duty tramper. There were no rotating boxes above the floor.

Murray also manufactured its Automatic Telescoping Box Baling Press (The Murray Company of Texas, Inc., Undated M). It was available as a single ram, 100-ton press or double ram, 150-ton press. Features included telescoping fiber board boxes (automatic top box feed) and automatic strapping. Its capacity was over 20 bales per hour.

Murray Tramper and Lint Pusher Mechanism

Murray's Atlas Tramper was designed to take the load brought by Murray's Triple Crown and high capacity 142-18 gins (Murray-Carver, Inc., 1980). It is equipped with two heavy (14-ton tensile strength) matched-length chains. The tramper stroke is 82 in. with a delayed action at the top of the stroke. This delay allows a charging period for high capacity.

The lint pusher unit folds cotton into the charging box and feeds it into the press box with each stroke of the tramper. It is air operated and electrically controlled with double cushioned air cylinders, lubrication unit and water trap.

Murray High-Speed Pumping Units

The Murray pumping units are generally in 25, 75, and 150 hp sizes (The Murray Company of Texas, Inc., Undated N). The 25-hp pumping unit with a 60 gallon tank capacity has a capacity of 38 gallons per minute at 1,170 rpm. This provides a working pressure that is suitable for flat bale presses only.

The 75-hp pumping unit provides a total capacity of 127 gal/min with solenoid-operated controls. This gives a working pressure that is suitable for use with either a standard density or high density press. This pumping unit has a 400 gallon tank base.

The 150-hp pumping unit produces a capacity of 254 gal/min with solenoid-operated controls. This provides a working pressure that is suitable for high-density presses. It is manufactured with a 700 gallon tank base.

Lummus Double Box Presses

The Lummus Cotton Gin Company manufactured its early double box presses as both down-packing and up-packing units (Lummus Cotton Gin Co., Undated O). They were supplied with a LCG Automatic Tramper.

A down-packing press sat on the floor and required no special foundation (Figure 13). It used an 8¾ in. or 10 in. double-acting hydraulic ram. The press lifted mechanically and revolved on ball bearings. They were equipped with automatic press dogs. A simplified operating valve assembly was conveniently located on the end of the press.

The down-packing unit used an 8¾-in. or 9½-in. diameter, single acting hydraulic ram. It could be installed with lower boxes in a pit so as to discharge bales at the gin floor level.

A LCG Automatic Mechanical Tramper was heavy duty and suitable for any double box press manufactured at that time. It had a specially designed revolving paddle which fed cotton into the press without tearing the batt. It was equipped with mechanical gears and ball bearings.

Lummus High Density/Standard Density Presses

The Lummus High Density Press has 20 in. by 54 in. boxes and is equipped with three 14 in. hydraulic rams operating at peak pressure of 4,200 psi. (Figure 14) (Lummus Cotton Gin Co., Undated P). Minimum densities of 32 lb/ft³ are obtained with lint cotton.

Safety inter-locks are provided so that the tramper foot and ram platen remain locked clear of the revolving boxes until the boxes are securely locked in place. End baling doors open and close automatically when side baling doors are opened and closed. Spring-loaded dogs hold the stock well below the tops of the revolving boxes.

The Lummus Standard Density Press has 20 in. by 54 in. boxes and is equipped with one 14-in. diameter ram operating at 3,500 lb pressure. Minimum densities of 24 lb/ft³ are obtained with cotton.

Lummus Auto-Pak Double Box Presses

Lummus Auto-Pak Double Box Presses are manufactured as two-story, up-packing or one-story, down-packing units (Figure 15). Optional features include bale weight control, power turning, automatic air operated latch, and automatic ram travel stops and retract control. These double-box presses also include the Lummus Total Enclosed Tramper and self contained hydraulic door locks as standard equipment (Lummus Industries, Inc., Undated Q).

Lummus Auto-Pak presses are available with either 27 in. by 54 in. or 24 in. by 54 in. boxes. There is also a 24 in. by 48 in. down-packing version. The bales are produced at densities of 12-15 lb/ft³.

Lummus Dor-Les Baling Presses

Lummus Industries, Inc. manufactured both down-packing and up-packing "Dor-Les" baling presses (Figure 16) (Lummus Industries, Inc., Undated R). Elimination of doors reduced maintenance, and allowed access to the bale for manual or automatic wrapping and strapping. Options provided fully automatic operation. The optional automatic strapping was available with up to 1 longitudinal and 11 cross straps.

A right-angle drive mechanical tramper was used. About 300 tons of compressive force was produced by one 14 in.-diameter ram. The press (with options) produced up to forty-five 500-lb bales per hour. One pumping unit was standard, but optional auxiliary units could increase production.

Lummus Single Box Presses

Lummus Industries, Inc. manufactured single box presses about 1983 (Lummus Industries, Inc., 1983). They marketed three types of units. One was a two-story, up-packing unit designed for baling fibrous materials into small packages where shipping and storage space was a premium. It was available with a 20 in. by 41 in. box. It was convertible to one or two rams. One version used a single-acting 14-in. diameter ram that produced 323 tons of compression force. A second version consisted of two single-acting 14-in. diameter rams that produced 646 tons of compression force.

One Lummus single-box press was a two-story, up-packing, heavy-duty press designed for baling fibrous materials to medium density (Figure 17). It was used for operations where capacity of double-box press was not required and top loading was desired. It was available with either a 24 in. by 48 in. box or a 27 in. by 54 in. box. Its single-acting 9½-in. diameter ram produces 79 tons of compression force. A standard model "A" pumping unit gave ram travel time of one minute, 50 seconds on the compression stroke.

A third single-box type was its Auto-Pak one-story, down-packing press. It was designed for baling fibrous materials to moderate densities. It was available with either 27 in. by 54 in. box or 24 in. by 48 in. box. One double-acting 10 in.-diameter ram produced 88 tons of compression force.

Lummus Lift-Box Dor-Les Press

The Lummus Lift-Box Dor-Les Press is a Universal Density Press (Figure 18). It is designed for installations producing up to 22 bales per hour. The box "lifts" off the bale and out of the way during final compression and bale tying (Lummus Industries, Inc., Undated S).

It is a down-packing press. Thus, it can be installed on a floor level slab. Options include (1) special bale dolly, (2) powered bale, (3) bale wrap system, (4) semi-automatic wire tying system, and (5) hydraulic or mechanical tramper.

Lummus E. E. Dor-Les Press

The Lummus E. E. Dor-Les Press is designed to be "energy efficient" (Figure 19). It uses a single 14-in. diameter-ram. Features include a super high capacity lint feeder and a totally enclosed right-angle geardrive tramper. A unique follow block and platen design enables square knot type wire to be applied manually and semi-automatically. Automatic strapping and wire tying systems are also applicable to the variable shut-height system (Lummus Industries, Inc., 1984).

Lummus Swinging Single Universal Density Press
This single-box, U.D. press was designed for the small to intermediate ginner (Figure 20). It produces up to 15 bales per hour. Both tramping and baling strokes are provided by a single-acting, up-packing ram, operating in sequence with a large, pivoted charging door (Lummus Industries, Inc., 1985).

The baling box construction is unique and unconventional. Replacing the usual hinged doors are four walls, pivoted at their bottom edges and held vertical during tramping and initial compression by hydraulic cylinders. During final compression the pressure on the wall cylinders is reduced. This allows the four walls to pivot open at the top, relieving the side friction normally generated by the baling stroke.

Bale ties are applied through slots in the side walls, the ram backs off to tension the ties. The side and end walls relax their hold as the sliding side wall is hydraulically powered clear of the bale. The ram descends, ejecting the bale. Then, the sliding wall closes, the hydraulic cylinder retracts to re-form the baling box, and another cycle begins.

Lummus-Gerrard Chutes System
The Lummus-Gerrard Chutes System is a bale tying system that is adaptable to any style of press. These include Lummus presses that are new or old, single-box or double-box, up-packing or down-packing, with or without doors (Lummus Industries, Inc., 1982).

Installation consists of two vertical mounts with multiple locating holes that easily adjusted to fix shut height. Chute guides are located on threaded rods to adjust for any strap pattern.

In the operation, formed end of bale ties are fed against drive wheels. As soon as the bale is compressed, the ties are powered simultaneously through upper platen openings, around the chutes, to return through lower platen slots. Locking of the pre-formed ends leaves the tied joint on top of the bale, but visible for inspection. The feed mechanism is raised by a pneumatic cylinder to clear ejecting bale. For door-type presses, return chutes are also raised. When the bale is clear, the mechanism lowers, and the press is ready for the next set of ties to be inserted.

Lummus C-30 Horizontal Waste Baler
Lummus Industries, Inc. has marketed the C-30 Horizontal Waste Baler for compacting fibrous waste. The baler was manufactured by International Baler Corporation (Lummus Industries, Inc., Undated T).

In continuous operation, this machine can produce three to four bales per hour. The bales are 31 in. by 30 in. by 54 in to 56 in., and weigh 450-500 lb depending on the material being baled. Bales are held by 4 ties or straps.

The C-30 can be left to run unattended until the tie-off, at which time the pushbutton controls are operated. A completed bale is automatically ejected as a new bale is formed.

Continental Eagle Corporation

The original Continental Gin Company has undergone several mergers and name changes over time. It has operated under the name Continental Gin Company, Continental/Moss Gordin Gin Company, Bush Hog Continental Gin, Continental Gin, Continental Murray Ginning Systems, and Continental Eagle Corporation. After its merger with Murray Carver, Continental Eagle continued to manufacture Murray's Atlas Tramper and Lint Pusher Mechanism, the Murray PHC PHC-X Stationary Box Press (Figure 9) and the Murray PHX Up-Packing Double Box Press (Figure 10).

Continental Box Down-Packing Press

No excavation is necessary for installation of the Continental Box Down-Packing Press. This press is illustrated with the E-J Mechanical Tramper (Figure 21). The press boxes are the standard 27 in. by 54 in. press size. The boxes are slightly tapered, being a little larger at the bottom than the top (Continental Gin Company, 1960).

The press uses a double acting hydraulic cylinder and piston assembly that consists of a 10-in. diameter piston with five rings on an 8¾-in. diameter plunger (ram). Its retainer dog assemblies are automatic in operation. They are automatically locked in position for retaining the cotton while tramping and free when the box is turned to the pressing position.

The vertically hinged doors are equipped with heavy duty hydraulic locks. The hydraulic locks are operated by a few strokes of the hand pump. The locks are opened by a release valve lever on top of the pump.

Continental/Moss-Gordin Smooth-Flow Tramper Feed

Continental's Smooth-Flow Tramper Feed air lifts cotton into the press box (Figure 22). It does not need paddles, kickers, or pushers. This is a vacuum action that is designed to also keep the press area free of flying lint. The Tramper Feed was used with Continental's Comet Ginning System capacities of up to 20 bales per hour (Continental/Moss-Gordin Gin Company, Undated U).

Continental/Moss-Gordin Fixed-box Press

Continental built its first "fixed-box" press in 1961. It eliminated the rotating press deck and put the revolving boxes downstairs, below floor level (Figure 23). The fixed-box press is available in four models: 27 in. by 54 in. flat bale, 20 in. by 54 in. standard density, 20 in. by 54 in. high density, and 20 in. by 41 in. high density (Continental/Moss-Gordin Company, Undated V).

The Fixed Box Press was designed to handle the press operation of the highest capacity gin plant. Features included 1) unique locking devices, 2) retainer "dogs" held by follow block pressure, 3) upper platen extend full width of press, 4) hydraulic tramper an integral part of press design, 5) fully automatic or semi-automatic versions, and 6) provisions for automatic strapping.

Continental Gin's Uni-Den Twin Ram Press

Continental Gin's Uni-Den Twin Ram Press is a universal density press (Figure 24). It operates with a high capacity hydraulic tramper and pusher feed. Field tests were made on the Uni-Den in

1973 in the Mississippi Delta. The Uni-Den cycle time is matched to the gin plant capacity, up to 40 universal density bales per hour. It is available with automatic strapping, or bales can be hand strapped with Bale-Lock and Titan Ties or wire (Bush Hog Continental Gin, Undated W).

Continental-Murray Model 800/Uni-Den Press

The Continental-Murray Model 800/Uni-Den Press is designed to handle over 50 bales per hour (Figure 25). It uses a single 18-in. diameter ram (Continental Eagle Corporation, 1987). The Model 800's cycle time is matched to a gin plant capacity, as few as 8 bales per hour to more than 50 bales per hour. The Model 800 Hydraulic Tramper/Pusher Feeder offers capacity in excess of 50 bales per hour. A Model 820 Chain Tramping System offers economy at capacities of 20 to 25 bales per hour.

Features offered with the Model 800 Press include hydraulic power units, press operating consoles, press console monitoring light system, optional and accessory equipment, and a bale bagging and conveying system.

Continental Eagle 8400 Uni-Den Baling Press

An 8400 Uni-Den Up-Packing Press is designed for plants with production capabilities up to 25 bales per hour (Figure 26). It is a 20-in. by 54-in. double-box, turntable, universal density press. The 8400 Uni-Den uses an 18-in. diameter ram and is designed for the same floor space as existing flat bale up-packing presses. Features include a pre-wired press console with bale weight indicator for semi-automatic operation and a standard 450 gallon hydraulic pumping unit. Also available are hydraulic tramping, pneumatic pusher-feeder or hydraulic pusher-feeder, and an optional bale bagging and conveying system (Continental Eagle Corporation, 1990).

Continental/Bespress

The Continental Bespress is a 20 in. by 54 in. double-box, down-packing, universal density press (Figure 27). Densities of its bales are 28 lb/ft^3. No press pit is required. Its capacity is up to 24 bales per hour. The press uses three 12-in. diameter double-acting hydraulic cylinders and 10 ½ in. diameter rams. Other features include hydraulic tramping system, pneumatic pusher feed, hydraulic power unit with 600 gallon reservoir, hydraulic powered press rotator, hydraulic door locks, control console mounted on the press, and an optional bale bagging system (Continental Eagle Corporation, 1988).

Continental Automatic Strapping

Continental/Moss-Gordin has used the Signode Automatic Strapping System on its fixed box press. It gives speed up to 30 bales an hour. The stationary upper box design made it possible to build the automatic strapping system into the door of the baler, eliminating the time required for indexing the Signode strapping mechanisms (Continental/Moss-Gordin, 1967).

On this baler, (1) the tramper stops when a pre-determined weight is reached, (2) there is rotation below floor level, (3) compression takes place while the other box is charged, (4) there is strapping from five heads built into the door, and (5) ejection is hydraulically-powered. The five strap-feeding mechanisms, which share a common drive controlled by a revolution counter, produce straps of equal length and of equal tension. Each seal magazine has a capacity of 300 double-notch Nestack seals and the battery of strap dispensers provides enough for a full shift's operation.

Bush Hog Continental Gin has also used the Continental/Jenglo, a semi-automatic cotton bale typing machine using pre-formed bale tie wires. It was available for most make presses (Bush Hog Continental Gin, Undated X).

The Continental/Jenglo used 8 ties. When the bale is pressed and the doors open, all 8 wires are bent 90° down on both sides. The wires are pulled around the bale and the ends pressed into the bottom follow block where the wires are latched at center of bale. Completing the sequence, the arms of the tying unit are raised and the bale is placed on a bale cart (or conveyor) all automatically. One person can operate the press and load the ties.

Continental/Murray Bale Bagging Conveying System

The Continental/Murray Bale Bagging and Conveying System is used in today's modern gin plant. It is designed for up-packing presses (Figure 28). An automatic sampler and the single control console (1) can be placed in one compact area, which allows two people to handle production up to 50 bales per hour. The system enables the use of bags made from various materials, including spiral-sewn burlap and polypropylene (Continental Eagle Corporation, 1988b).

The tilting table eliminates the constant impact of a 500-lb bale on the motor driven bale cart (2) which delivers the finished, strapped bale from the automatic universal density press to the bagging and weighing station. The cart travels in a straight line along a recessed track and is powered by a 1/3 hp, right-angle gear motor with a 115 volt travel supply line.

The bale cart's tilt table automatically positions the bale for the overhead bagging ram (3) without the need of outside hydraulic and pneumatic lines. The overhead bagging ram pushed the bale through the bagger (4) which has been covered with a bale bag and onto the scale platform (5). At this position the bagged bale is weighed, tagged and classed.

The discharge conveyor is a powered belt conveyor which drops the bale into an upright position in front of the bale pusher (7). The bale pusher makes room for the next completed bale and is capable of pushing up to ten finished bales on the bale skid plate (8). The skid plate is usually located outside the gin building near the storage or loading area.

Gullett Cotton Presses and Trampers

The Gullett Gin Company developed the "Trusteel" Up-Packing and Down-Packing Presses (Figure 29). They were double box, revolving presses. Features included swinging doors, self-centering ram head, heavy duty Triplex press pumps, steel press floor, automatic dog release, automatic door lock, automatic self-centering device, automatic floor lock, end door lifters, hydraulic ram, and tramper. Press floor and gin floor were on the same level. The presses were of heavy steel construction (Gullett Gin Company, Undated Y).

The doors locked when the doors were slammed. Turning a wheel opened them. An automatic self-centering device operated in connection with the dog release mechanism. This prevented the dogs from releasing cotton in the box until the press was on dead center over the ram head. Automatic door lock worked in unison with the self-centering device and held the boxes in position during packing and pressing operations. Release for the revolving box was by light pressure of the foot.

Consolidated Up-Packing Presses

Consolidated HGM Corporation has marketed two universal density up-packing baling presses that had been developed by Murray-Carver, Inc. These are the PHC/PHC-X Stationary Box Press (Figure 11) and the PHX Double Box Press (Figure 12) (Consolidated HGM Corporation, Undated Z, Undated BB).

Consolidated Down Packing Press

Consolidated HGM Corporation also manufactured a down-packing press (Figure 30). There is a double-acting, 17-in. diameter ram with 5,000 lb/in² maximum operating pressure. The double 4 in. by 30 in. reinforced top and bottom sill weigh 5.5 tons each. There is a 7-in. diameter high tensile steel center and outer straining rods. Features include automatic bale ejector and console with automatic PC control. A hydraulic or Atlas tramper is available (Consolidated HGM Corporation, Undated AA).

Gerrard Wire Tie Systems

Gerrard and Company developed wire tie systems for universal density gins (Gerrard and Company, Undated CC). It is a chute system that Lummus Industries, Inc. has adapted to some of its presses.

Gerrard also developed the Car-Lok® bale tie (Gerrard Wire Products Co., Undated DD). By flattening the wire, Car-Lok® attempts to combine the advantages of steel wire and flat band into one unique bale tie. It is usable for hand or platen tying. The two ends of the wire are curved. These ends are snapped together and the expansion of the bale locks Car-Lok® in place.

Signode Automatic Bale-Strapping Systems

Signode Corporation has marketed Automatic Bale-Strapping Systems (Signode Corporation, 1982). Continental/Moss-Gordin has used the system in its gin plants.

The Model M361 Power Strapping Machine is the heart of the system. After a bale has been compressed, the door or doors (if any) of the press are opened. The operator at the control panel pushes the start button. Then, the carriage assembly bearing two (or more) Model M361 strapping heads moves laterally to a predetermined position at the far end of the bale. The heads feed steel straps around the bale and seal them. Entirely automatically, the carriage assembly then moves laterally, pausing on the way to apply additional straps. All straps are pulled to the same tension and are of the same length. When the carriage returns to its home position and the press ram is withdrawn, the bale expands and the straps grow tight. The strapped bale is ready for ejection. In the typical two-head configuration, two 900-lb coils of material can strap about 350 bales before re-loading is necessary.

Signode Corporation also developed the Model M361B-SA Strapping System for uppacking baling presses. It was stated to be an efficient low-cost strapping system (Signode Corporation, 1981). It used one strapping head that applied 8 straps to universal density bales. Its standard strapping dispenser held a 100 lb coil. Strap spacing allowed manual or automatic sampling.

Continental Air Systems Fibra-A-Baler

Continental Air Systems markets the Fibr-A-Baler, a self-contained horizontal baler which produces a 28 in. by 45 in. by 55 in. bale (Continental Air Systems, 1985). In textile applications this size bale will weigh from 500 to 700 lb, depending on density. The bale weight of other products will vary depending on product compressibility. The baler can be fed by Continental Air Systems Fibr-A-Filter, cyclone or belt conveyor. It can be equipped with dust controls when needed.

The operator applies six quick-lock wire ties around the bale by inserting wires through slots in the top of the end door, pushing them through guide tracks around the bale and then snap locks ends together. The bale is formed in a laying down position (27-in. high).

International Bale Corporation Horizontal Mote Baler

International Bale Corporation developed the original C-30 Horizontal Mote Baler which was used in many gin plant installations (see Lummus C-30 Horizontal Waste Baler).

It also developed the C-54 Automatic Mote Baler which produces standard flat bales (International Bale Corp., Undated EE). It was designed also for baling linters and gin trash. Its features include automatic cycling and dust control. Bale size is 27-in. width, 45-in. length, and 54-in. height. The Model C-54 AWT is an auto tie baler.

Lummus 20 in. x 41 in. Gin Compress

The Lummus Cotton Gin Co. developed the 20 in. by 41 in. automatic gin press for baling cotton, linters and other fibrous materials (Figure 31) (Lummus Cotton Gin Co., Undated FF). Optional bale weight control automatically stopped the tramper when a pre-determined bale weight was reached, boxes revolved, tramper started, and the rams started on upward travel. The press produced bales of cotton weighing 450 – 600 lb.

With one 14-in. diameter ram, the press produced bales of from 24 to 32 lb/ft³ density. With two 14-in. diameter rams, it produced bales of from 32 to 40 lb/ft³ density. There were heavy duty hydraulic door locks for safety and easy operation.

A "B" Pumping Unit provided capacities of up to 20 bales per hour with one 14-in. diameter ram and up to 14 bales per hour with two 14-in. diameter rams. Hydraulic power was supplied by two rotary pumps with a total capacity of 85 gallons per minute.

There were several safety features. The hydraulic system was equipped with relief valves which unload the system when a predetermined pressure is reached. A safety device in the automatic turning system prevent the power turning of the press when either the tramper foot is below the top of baling doors, or when the rams are not completed down and clearing the bottom of the press. Limit switches prevent the rams from moving up, and prevent the tramper from operating when the press is not in latched position. There is the optional power turning device which automatically turns the press. The press is turned, stopped and locked in position, and the tramper starts automatically.

Continental Eagle Model 930 Magnum Baling Press

The Model 930 Magnum is a universal density press manufactured by Continental Eagle Corporation (Figure 32). It is designed for 35 bales per hour and higher gin operations. The press has no doors forming the compression box and has no dogs. Dogs are not needed because the tramper precompresses the cotton (Continental Eagle Corporation, 1994).

Bales are formed in the lower box utilizing an 18-in. diameter, single-acting ram which can provide up to 636 tons of force. A top ram with 12-in. diameter bore provides the resisting force during bale formation.

Continental Eagle Model 950 Press

A Continental Eagle Model 950 is a double box down-packing universal density (28 lb/ft^3 bales) press (Figure 33). There are no doors and no dogs. It is designed for high capacity in excess of 45 bales per hour with a box size of 20 in. by 54 in. An optional slip box 20 in. by 41 in. box size is available for high density bale requirements (Continental Eagle Corporation, 1999).

The 950 press is equipped with two 12-in. diameter press rams, hydraulic tramper, hydraulic pusher, large service platform, and hydraulic pumping systems. A Jenglo semi-automatic bale tyer and separate bale bagging systems are available for the model 950 and slip box 20 in. by 41 in. presses.

RESEARCH

Compressive and Resilient Forces

In 1939 there were 324 compress establishments in the United States. They compressed low density “square” or “flat” gin bales to “standard density” or “high density” and then stored the bales until they were marketed (Wright and Bennett, 1940). Bales were compressed by steam-cylinder, hydraulic, and geared-mechanical types of presses. By 2005, these “compresses” had eliminated their “compress” function and were only warehouses.

Observed pressures applied for standard-density compression by steam-cylinder presses ranged from 744 to 1,637 lb/in^2 of bale surface in contact with the press platen. This represented a total pressure on the cotton bale of from about 625 to 1,375 tons.

A new system for compressing and baling cotton was studied about 1970 by the Cotton Ginning Research Laboratory, ARS, USDA, Stoneville, Miss. (Mayfield et al., 1970). The system included a set of compression rollers to reduce the thickness of the cotton batt on a lap-winder compression and packaging system. The degree of compression and the change in fiber properties resulting from compression between rollers under pressures were determined. From the study it was concluded that the number of rollers and the batt thickness significantly affected the compression accomplished by the compression rollers on the system. No significant damage to fiber quality by the compression rollers was detected.

An experiment was conducted about 1976 to evaluate the force required to compress lint cotton in a model bale press, with a cross-sectional area of 144 sq. in. (Anthony and McCaskill, 1976). This work helped to establish a basis for studies to be conducted with full-size press systems. The study showed that density was positively correlated to compressive force while moisture was negatively correlated. Density was over four times more important than moisture content, as judged by standardized partial regression coefficients.

Another experiment with the small-scale press indicated that repetitive compression of lint cotton to constant density requires less compressive force as the number of compression cycles increase. The largest decrease occurs between the first and second compression cycles. The resilient forces exerted by lint cotton also decreased as the number of compression cycles increased. The practical importance of repetitive compression with constant pressure lies in the reduction of bale-tie breakage as well as in providing a means to allow the platen separation to decrease to the predetermined distance necessary for automatic tying (Anthony, 1977).

The resilient forces exerted by two cotton varieties, Stoneville 213 and Pima S-2, were compared over several levels of moisture content, quantity of cotton, and restraint density. Results indicated that varietal effects were significantly less than those of other factors. Thus, it was concluded that bale-packaging systems may be designed with little emphasis on cotton varieties (Anthony, 1978).

Anthony and McCaskill (1973) investigated the forces required to compress cotton in three types of bale presses. They developed the mathematical relationships between compression force, moisture and density. Force of over 375 tons is required to compress cotton sufficiently to produce universal density bales.

One 1976 experiment suggested that differences in the compressive and resilient forces required to package lint, first-cut linters, and second-cut linters decrease as density increases. The compressive and resilient forces associated with linters were substantially less than those associated with lint. Design parameters for packing systems for linters may be designed accordingly (Anthony and Simcox, 1977).

Anthony (2001) developed a method to reduce the force required to compress cotton over 30%. The method consisted of replacing existing flat platens with a series of parallel U-shaped platens that pre-formed the bale and applied normal compression only at the top of the U-shaped platens. The cotton is allowed to recede into the 2-in. deep platen and thus compressed to a lower density, thereby requiring less force.

<u>Lint Moisture Content</u>

Cotton is usually dried, cleaned, ginned and packaged at a moisture content well below its eventual equilibrium moisture content in storage. The moisture content and other physical responses of cotton to environmental conditions vary depending primarily upon the surrounding atmosphere (Hearle and Peters 1960; Griffin 1974).

When the humidity of the storage environment is higher than the humidity within the bale, the bale will gain moisture until it equilibrates with the environment. As the bale gains or loses moisture during storage, the weight of the bale changes. The rate of moisture gain is significantly influenced by the density of the cotton bale. Modified flat bales have a lower density (14 lb/ft^3) than universal density bales (28 lb/ft^3) and gain moisture more rapidly (Anthony 1982b). The rate of moisture gain is also influenced by the type of bale covering. The rates of moisture gain for bales covered with polypropylene, burlap, and extrusion-coated polypropylene are similar. Bales of cotton ginned at less than 5% lint moisture, covered with polypropylene, and stored for over 60 days at high humilities (75-80%) will absorb about 10-15 lb of water, which will increase the lint moisture up to 7 or 8%.

Several studies were conducted by the Cotton Ginning Research Laboratory, USDA/ARS, Stoneville, Miss, during 2000-2001 to determine if moisture applied before packaging caused fiber degradation during subsequent storage. Water was sprayed over the top of the fiber as it came down the lint slide. The bales were then packaged at universal density and placed in either tripled polyethylene bags, woven polypropylene bags, or fully coated woven polypropylene bags, and then stored at atmospheric conditions (Anthony, 2003).

Conclusions were that care must be exercised in spraying water on cotton fiber at the lint slide to avoid fiber damage. The color of cotton degraded during storage at universal density when water was added to bring levels above 7.5% (wet basis), regardless of bale covering materials (Figure 34). The more impermeable the bale covering, the less water can be added.

During the early 1950’s, drying tests at Stoneville, MS, showed the need for a drier control system based on continuous moisture measurement at the gin (Griffin and Mangialardi, 1961). The first attempt at continuous lint moisture gauging was in the lint delivery system of a 20-saw laboratory gin in 1954. A resistance-type meter was used as a moisture measuring instrument for lint cotton passing between electrodes. The electrodes were thin brass cylinders placed so that the lint batt passed between them with the upper electrode floating on the batt.

The next year, heavier electrodes were fabricated and installed in the laboratory’s three-stand gin plant. The signal electrode was composed of three 2-in.-wide aluminum bands on a wooden core, working against a grounded aluminum electrode. These electrodes rotated at a peripheral speed equal the linear speed of the batt moving from the lint (battery) condenser to prevent breaking the batt.

In a 2001 experiment, a multiple electrode, resistance-type moisture sensor located in the bale press tramper was able to accurately predict the moisture content of lint to which no moisture was added after ginning. However, it was adequate to predict the moisture of cotton when varying amounts of moisture had been added after ginning. When a resistance-type moisture sensor installed before moisture restoration by humidified air was used in conjunction with another installed after moisture restoration, the system was able to accurately predict (± 0.24%) lint moisture content as measured by the oven method. Data were collected within the range 4.2 to 7.5% wet basis (Byler, et al., 2003).

Bale Press Types

Prior to about 1945, there were four rectangular and one round bale type produced at gins or compresses (Bennett et al., 1945; Bennett, 1962; Wright et al., 1945). The four rectangular bales produced were the gin low-density (12 lb/ft^3), compressed standard-density (23 lb/ft^3), compressed high-density (32 lb/ft^3), and gin standard-density (23 lb/ft^3). Each of the rectangular bales weighed 500 lb. The round bale was 35-in. long and had a diameter of 22-in. It weighed 250 lb and had a density of 32 lb/ft3.

The USDA researched the field conversion of these low-density gin presses for standard-density pressing (Bennett et al., 1945). The conversion was not a simple job and was found feasible only where extensive shop facilities and skilled mechanics were available to the ginner.

Before shipment to consuming establishments, a major part of the cotton was pressed to higher density at compresses to permit more economical transportation (Wright et al., 1945). Usually the bales were compressed to standard density for shipment to domestic mills, and to high density for export shipment.

The round bales were completely covered with burlap bagging during the final pressing operation. The bales did not require ties for holding them intact because the layers of cotton were tightly wound. Most of these bales were purchased directly from the producers by cotton merchants who shipped the bales to foreign spinners.

Four types of gin presses have been used since about 1960, each type named according to the bale it produces. These are flat, modified flat, gin standard, and gin universal. Modified flat bales are bales that were sent for recompression to become compress universal density bales (Anthony et al., 1994).

The bales produced by these presses are different in size and density. The length, width, and thickness for the flat, modified flat, gin standard and gin universal bale types are 55, 28, and 36-48 in.; 55, 25, and 36-48 in.; 55, 20-21, and 30-36 in.; and 55, 20-21, and 26-30 in.; respectively. Corresponding bale densities are about 12, 15, 22, and 28-30 lb/ft^3.

A low-density flat bale press was converted to a modified flat bale press by reducing the press box width by three in. This could be done by bolting finished 2x6 in. or 2x8 in. lumber to the inside walls (National Cotton Council, 1972).

The long-term goal in 1970 was to have only one type of bale-gin universal density. About 90% of the bales produced at gins in the United States in 1992 were gin universal density. Virtually all bales were pressed to universal density in 2005.

Bale Ties

The material used to restrain cotton bales in the U.S. has evolved to the 2004 practice of using steel strap (1%), steel wire (75%) and plastic strap (24%).

A study was conducted about 1997 to determine the force required to restrain cotton bales with six and eight bale ties with bale packaged in a universal density bale press (Anthony, 2000).

Platen separations of 19 and 21 in. and tie lengths of 85 and 89 in. were used. One-half of the bales were stored in a controlled environment (70 °F and 70% relative humidity) and the others stored at atmospheric conditions. The bales were stored for 120 days. Forces in the 0.031 x 0.75 in. steel straps used to restrain the bales increased for about 60 days and then remained relatively constant. The six-tie pattern typically exerted about 20% more force on the straps than did the eight-tie pattern. It was concluded that design forces for the bale ties for six-tie patterns must be at least 20% greater than for the eight-tie pattern.

About 1976 the bale tie forces exerted by modified flat and gin universal density bales were evaluated in separate studies at Stoneville, Miss. Six bale ties were used on the modified flat bale and eight ties on the universal density bale. Bale tie forces were measured as a function of lint moisture content, bale circumference and platen separation. The maximum force exerted on one tie was 19% of the total force exerted by all ties on a modified flat bale and 15% on a universal density bale (Anthony and McCaskill, 1978).

The maximum force per tie ranged from 1,115 to 1,430 lb for modified flat bales, and from 2,130 to 2,645 lb for gin universal density bales. It was noted that manufacturers of bale presses and bale restraint materials should consider the platen separation and bale circumference variables in the design of packaging systems since they govern the resilient forces exerted by lint cotton. Resilient forces vary directly with platen separation and inversely with bale circumference.

The change in bale tie force and thickness are a function of storage climate was reported by Anthony (2005). He showed that bale thickness and tie force changed as fiber moisture content changed due to exposure to different humidity. Changes were sufficient to break bale ties.

Because the cotton industry is plagued by broken bale ties each year, the National cotton Council has recommended six guidelines for preventing broken ties on universal density bales. Four of their main ginning techniques for reducing high stresses on bale ties include maintaining a lint moisture content between 5 and 8% at the press box, hold platen separation (shut height) to 19 or 20 in., make sure lint distribution on the condenser drum remains uniform, and provide tie lengths of no greater than 87 to 89 in. (plastic strap 86 in. maximum). Two additional recommendations for reducing stresses on ties are to rotate wire knots to the ball (sample side) of the bale and to recess ties into the flat side of the bale (Simpson and Anthony, 1998).

Forces exerted against bale strapping can exceed the break strength of the seal strap connection in some cases. Friction seals were developed by Signode Corporation to allow slight and controlled slippage at the seal to lengthen the tie, reduce the force load and prevent breakage. An experiment evaluated the performance of the friction seals (Anthony, 1986). One of the bales was also dropped from a height of 12 ft to apply additional forces to the bale straps. The seals allowed the straps to slip as much as 1¾ in. without breaking. The seals performed well and should aid in the reduction of bale strap failure. A standardized matrix to help resolve the causatives of bale tie failure was developed by Anthony (1997).

A portable device was developed about 1997 to enable replacement of broken bale ties after initial packaging at the gin. The device recompressed the bale only in the area of the defective ties to allow replacement of individual or multiple ties. It could be operated by one person and repair bales in 5 – 10 minutes. It could be installed on a trailer or positioned with a forklift to meet operational needs. The low-cost device can provide a solution to replacing bale ties at the gin or in subsequent shipping or storage operations (Anthony, 1998). A faster, higher capacity bale tie replacement device was developed for more rigorous use (Anthony, 2005).

Air Jet Feeder

A bale press lint feeding device based on air jet conveying principles was tested at the South Plains Cotton Ginning Research Unit, Lubbock, Texas, during the 1968 and 1969 ginning seasons (Baker, 1970). The conveying surface was 54-in. wide and 44-in. long and contained 87 air jet openings spaced 4 in. apart. The openings were 6-in. long and arranged in a staggered pattern.

An air jet feeder with 0.03-in. size openings operated satisfactorily. It performed the conveying operations just as well as one using 0.075 in. openings but did so with approximately 40% less air volume. At tramper speeds of six and nine strokes per minute, the air jet feeder satisfactorily handled 8 and 12.5 bales per hour, respectively.

Energy Requirements and Costs

From 1962 to 1964, information on power requirements and energy consumption was obtained for the 10 specified functions performed in cotton gins, including packaging. The packaging system comprises the battery condenser, tramper, press, and press pump. Seventeen high-capacity gins were evaluated in the Midsouth, West Texas, and California. Presses used in all gins studied were of the flat-bale type. Both up- and down-packing presses were represented (Wilmot and Watson, 1966).

Average connected loads for packaging ranged from 45 hp in the Midsouth to 75 hp in California. Energy consumption per bale for packaging averaged 1.56, 1.34, and 1.41 kilowatt-hours in the Midsouth, California, and West Texas, respectively.

The energy required to package cotton bales in modified-flat and gin-universal-density packaging systems was surveyed in the Mississippi-Arkansas-Louisiana area for six ginning systems, from 1973 to 1978 (Anthony et al., 1980). Presses of the gin-universal-density systems used over eight times more electrical energy than that used by the presses of the modified flat systems (2.17 and 0.27 kwh/bale). The hydraulic trampers required nearly six times more energy than that used by the mechanical trampers (1.32 and 0.23 kwh/bale).

SUMMARY AND CONCLUSIONS

Bale packaging is the final step in processing cotton at the gin. The packaging system consists of a battery condenser, lint slide, lint feeder, tramper, bale press, and bale typing mechanism. This system may be supplemented with systems for bale conveying, weighing, and wrapping. The bale press consists of a frame, one or more hydraulic rams, and a hydraulic system. Tying systems are generally semiautomatic or fully automated.

In the past, bale presses have been described primarily by the density of the bale that they produced, such as low density (flat or modified flat) or universal density (gin or compress).

Today, virtually all bales packaged at gins are of one type, gin universal density, which has a lint density of about 28 lb/ft^3. The bale has a length, width, and thickness of 55, 20-21, and 26-30 in., respectively, and a net weight of about 480 lb. Other descriptions of bale presses include up-packing, down-packing, fixed box, and doorless. Regardless of description, they all package lint cotton so that it can be handled in trade channels and at the textile mill.

In 2005, ginning rates at cotton gins ranged generally from 18 to 45 bales per hour although some gins produce over 100 bales per hour and use two press systems. At some of the higher rates, gin owners utilized two bale presses in their packaging system since a press is limited to about 60 bales per hour. Three manufacturers currently market gin bale press systems that meet the needs of gin plants. These are Consolidated HGM Corporation, Lubbock, TX; Continental Eagle Corporation, Prattville, AL; and Lummus Corporation, Savannah, GA. Several other companies are available for support services.

Care must be exercised in adding water at the lint slide to avoid fiber damage. Color of cotton will degrade during storage at universal density when moisture level is raised above about 7.5% (wet basis), regardless of bale covering materials. The more impermeable the bale covering, the less water can be added.

Six or eight ties are used on the universal density bale. Guidelines for preventing broken ties are maintain a lint moisture content between 5 and 8% at the press box, hold platen separation (shut height) to 19 or 20 in., make sure lint on the condenser drum remains uniform, and provide tie lengths of no greater than 87 to 89 in. (86 in. for plastic strap). Additional recommendations for reducing stresses on ties are to rotate wire knots to the ball (sample side) of the bale and to recess ties into the flat side of the bale. Friction seals are used on bale strapping to allow slight and controlled slippage at the seal to lengthen the tie, reduce the force load and prevent breakage.

The cost of a bale packaging system must be balanced against the needs of the gin. Initial and operating costs, and labor requirements, and safety features must be considered. A semi-automatic bale tying and handling design would be desired at the higher ginning rates.

DISCLAIMER

Mention of a trade name, proprietary product or specific equipment does not constitute a guarantee or warranty by the U. S. Department of Agriculture and does not imply approval of a product to the exclusion of others that may be suitable.

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Figure 1. Old Cotton Gin and Outdoor Wooden Screw Press.

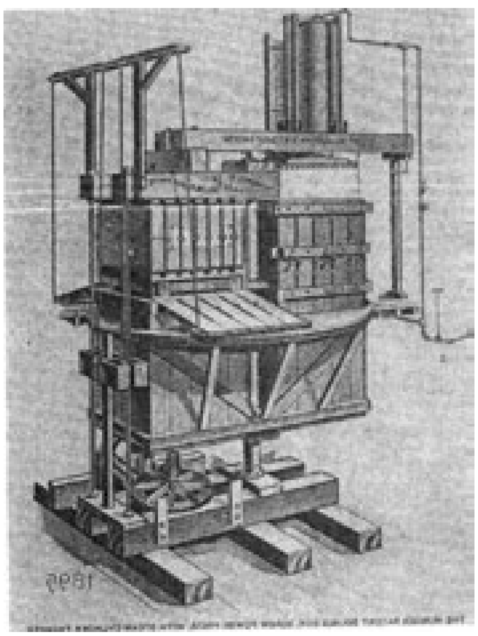

Figure 2. Munger Double-box Press
with Steam Tramper and Iron Screw.

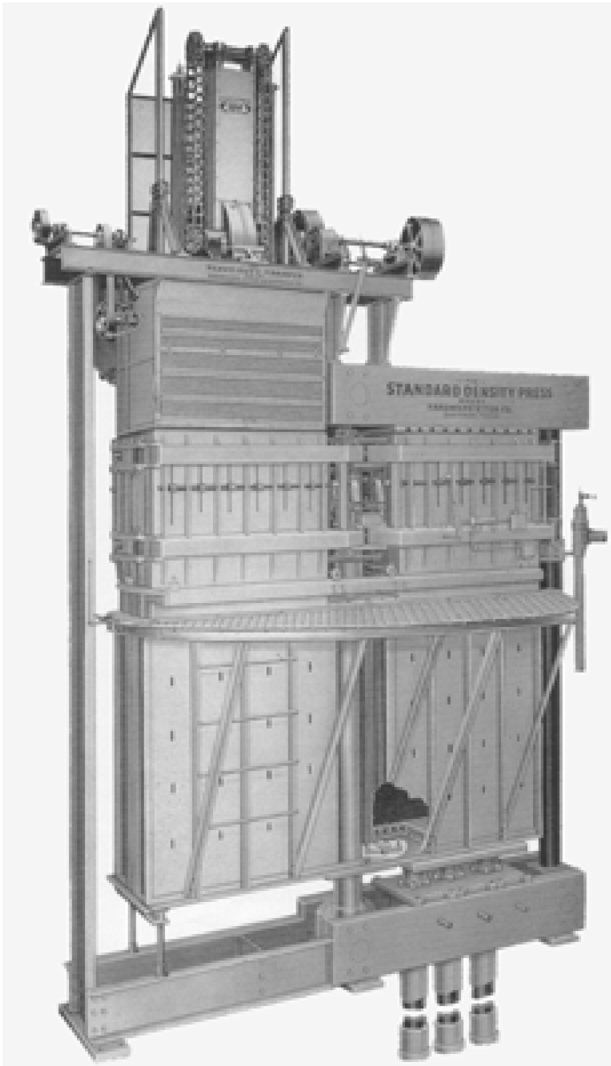

Figure 3. Hardwicke-Etter Standard Density Press.

Figure 4. Hardwicke-Etter Hi-Duty Up-Packing Press.

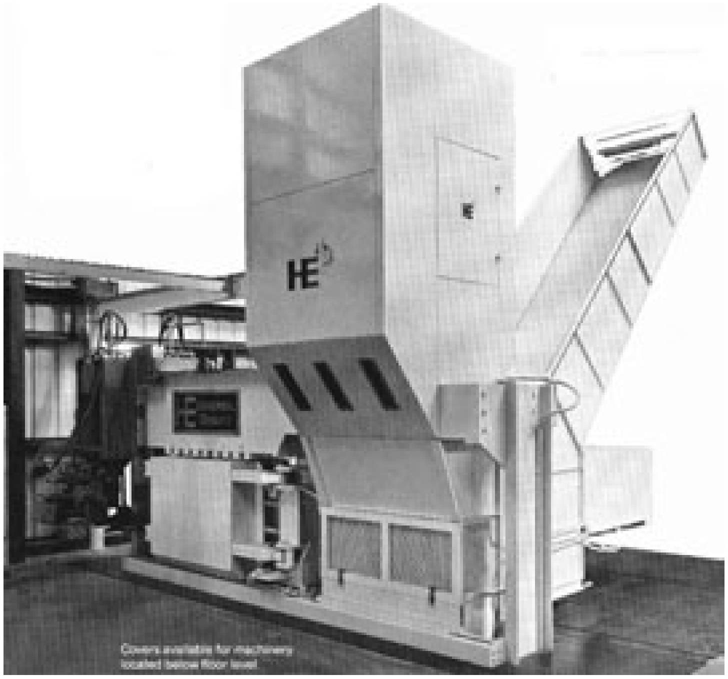

Figure 5. Hardwicke-Etter “Fixed-Box” Universal Density Press with SFH Tramper and Pneumatic Lint Pusher.

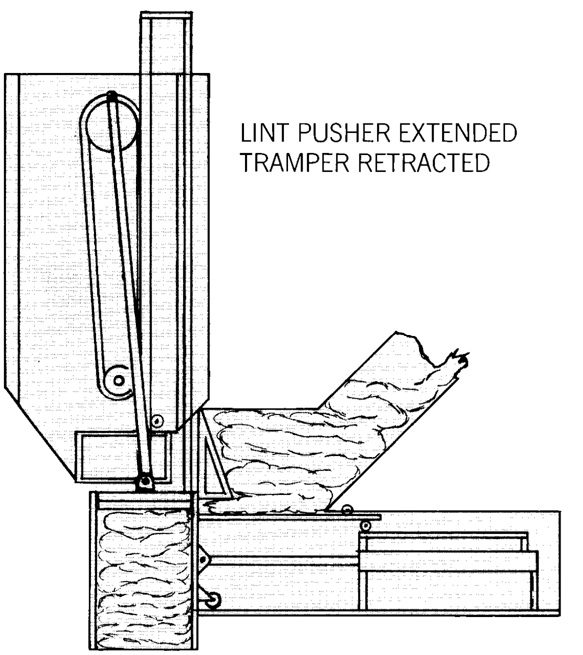

Figure 6. Hardwicke-Etter’s Pneumatic Lint Fiber Pusher.

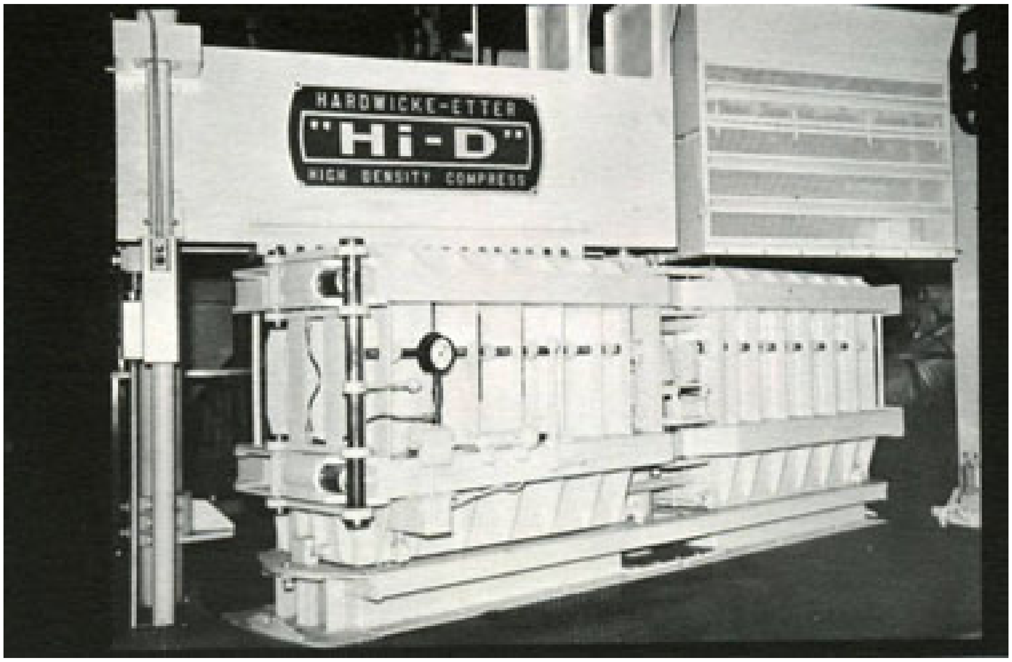

Figure 7. Hardwicke-Etter “Hi-D” High Density Compress.

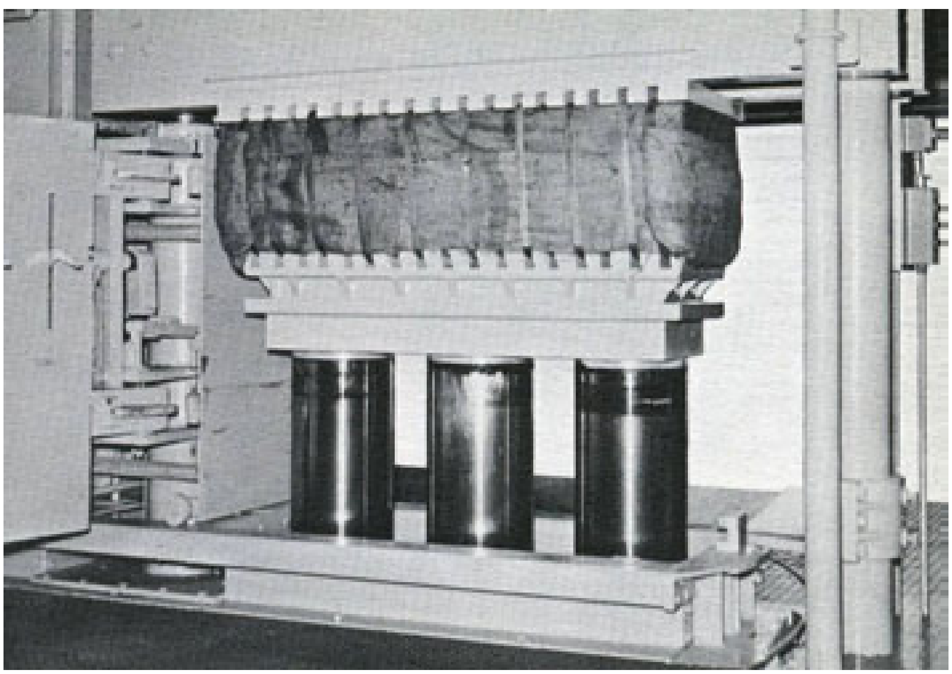
Figure 8. Hardwicke-Etter Automatic “Hi-D” Compress in operation.

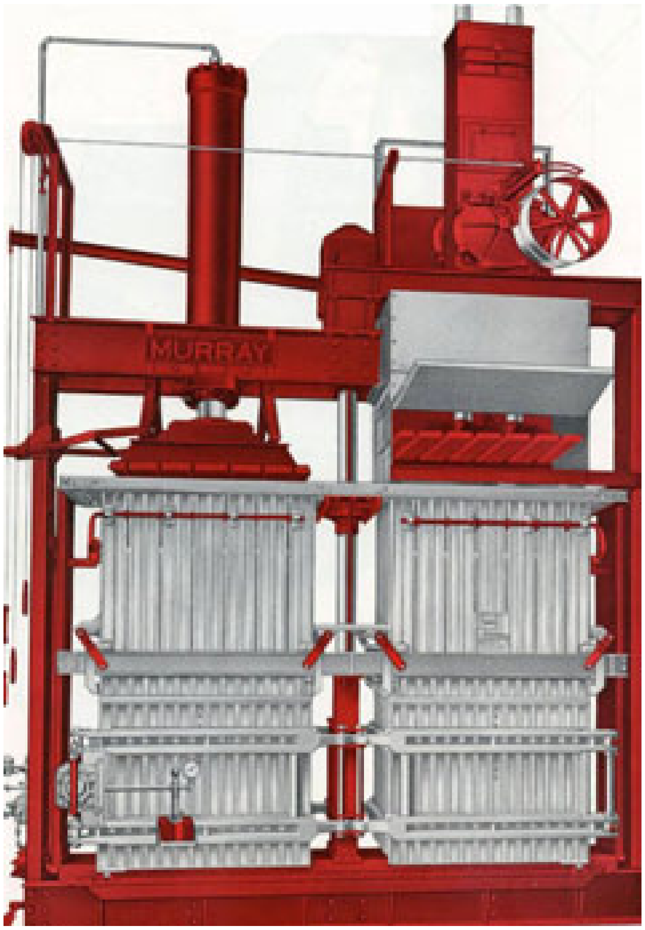

Figure 9. Murray “POS” Double Box Down-Packing Press.

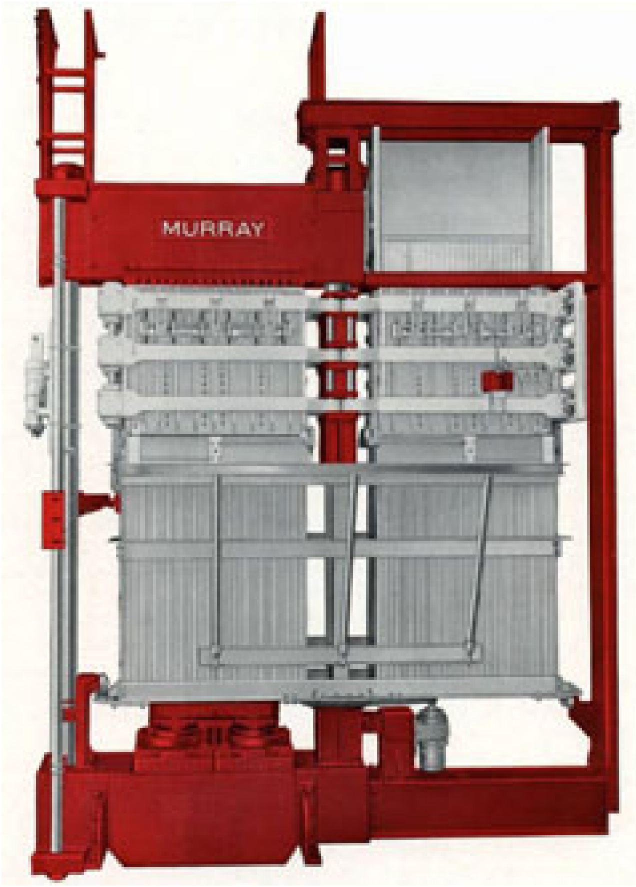

Figure 10. Murray PHD Model Two Ram Up-Packing High Density Press.

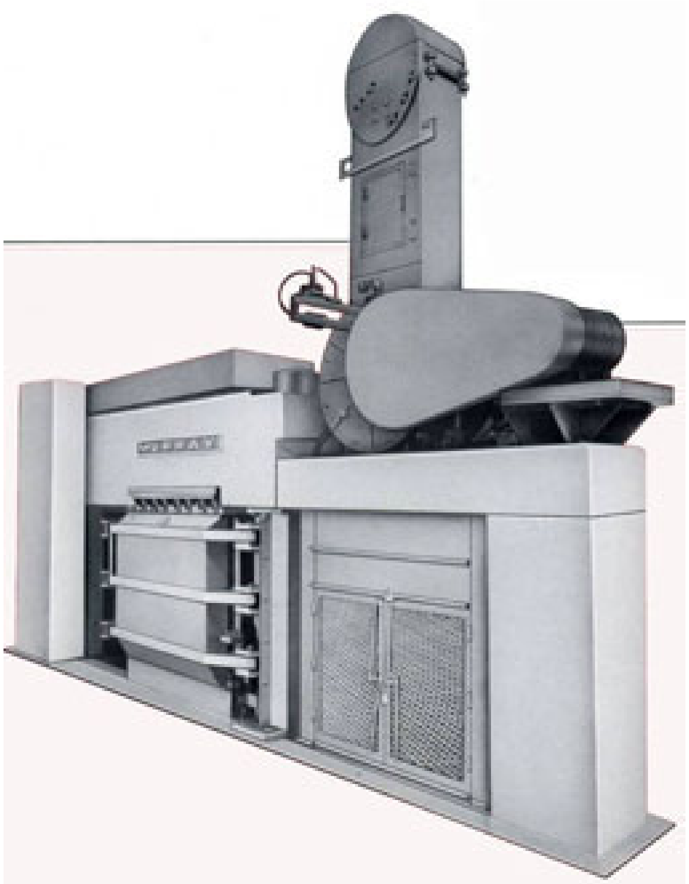

Figure 11. Murray PHC Stationary Box Universal Density Press.

Figure 12. Murray PHX Up-Packing Double Box Universal Density Press.

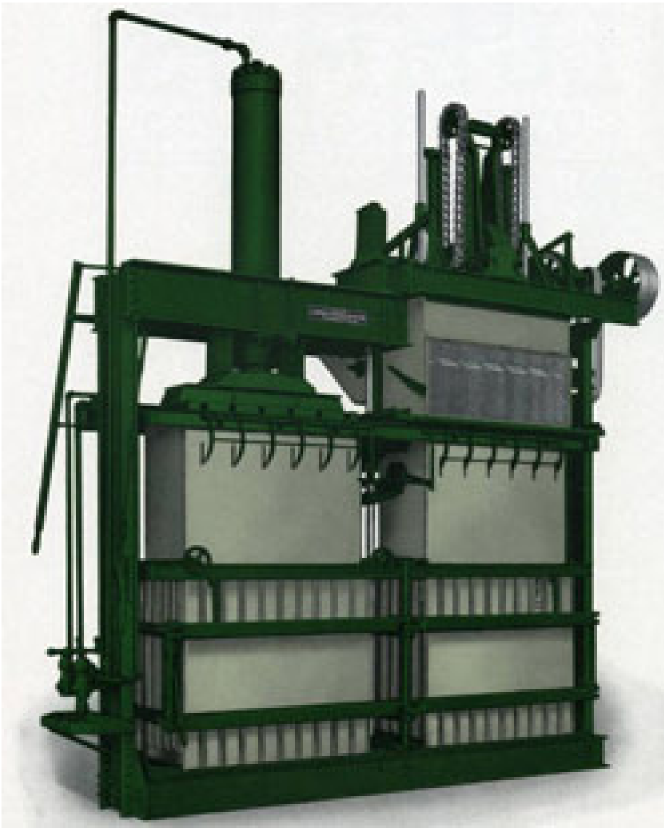

Figure 13. Lummus Double Box Down-Packing Press with LCG Automatic Tramper.

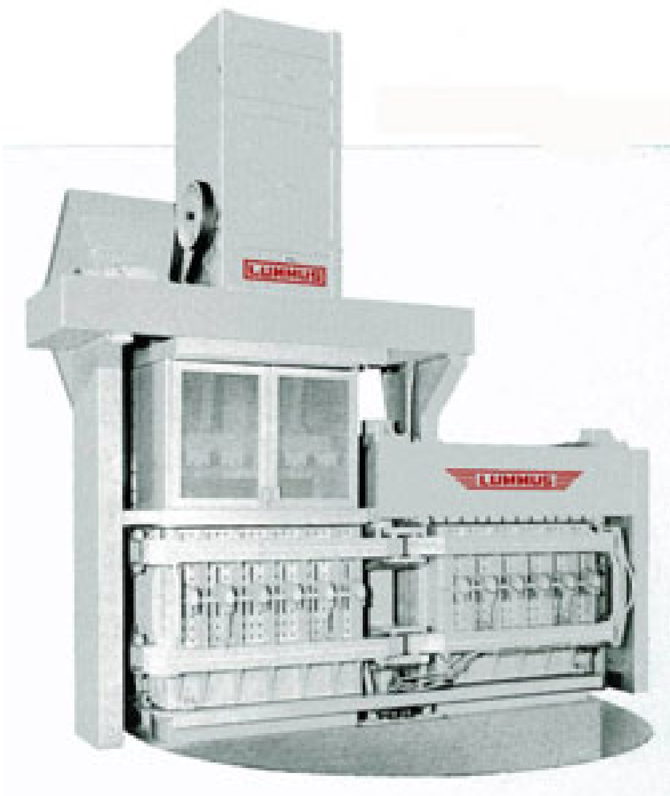

Figure 14. Lummus High Density Press.

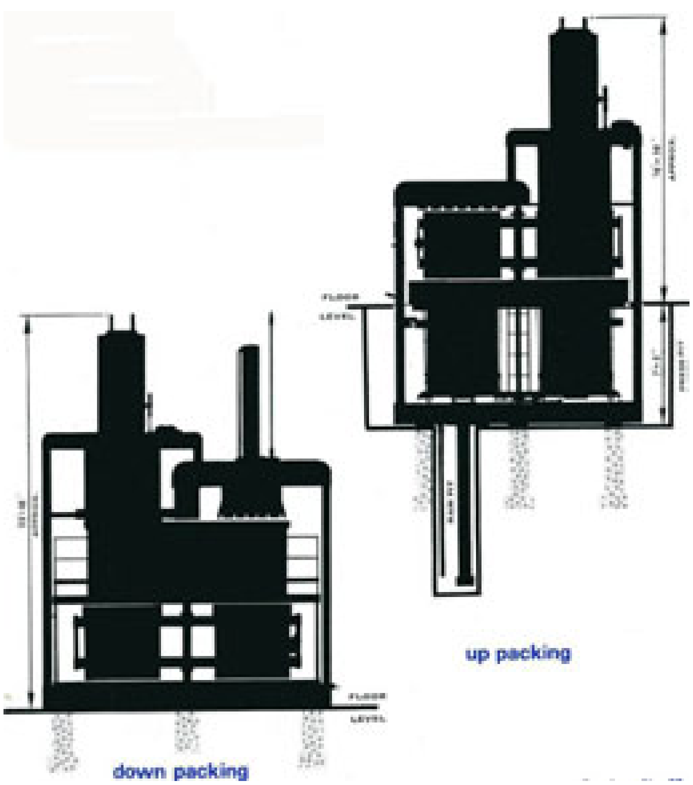

Figure 15. Lummus Auto-Pak Double Box Presses.

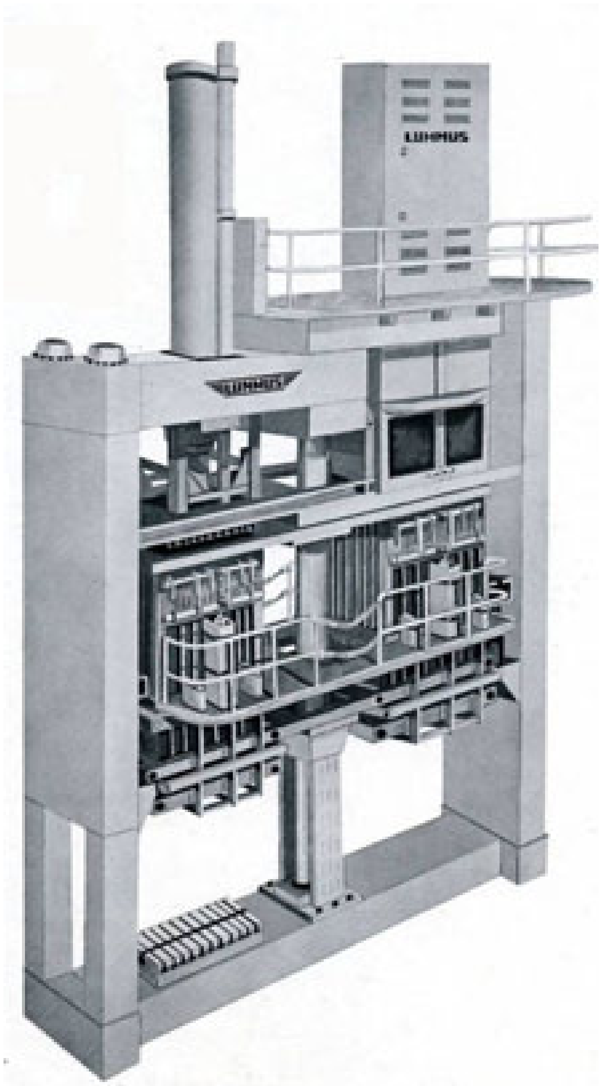

Figure 16. Lummus Down-Packing “Dor-Les” Baling Press.

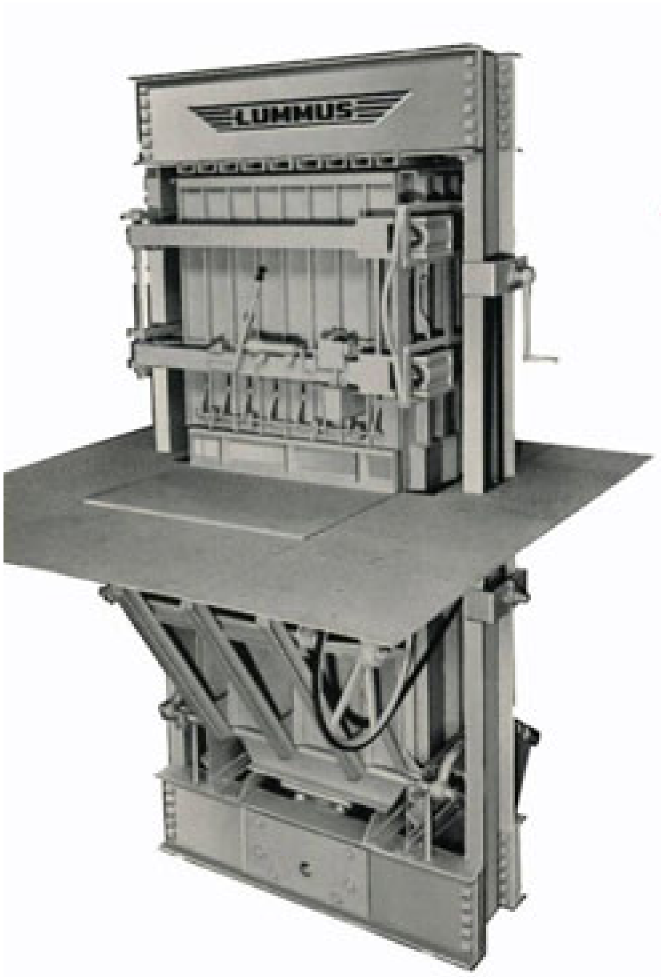

Figure 17. Lummus Two-Story Up-Packing Single Box Press.

Figure 18. Lummus Lift-Box Dor-Less Universal Density Press.

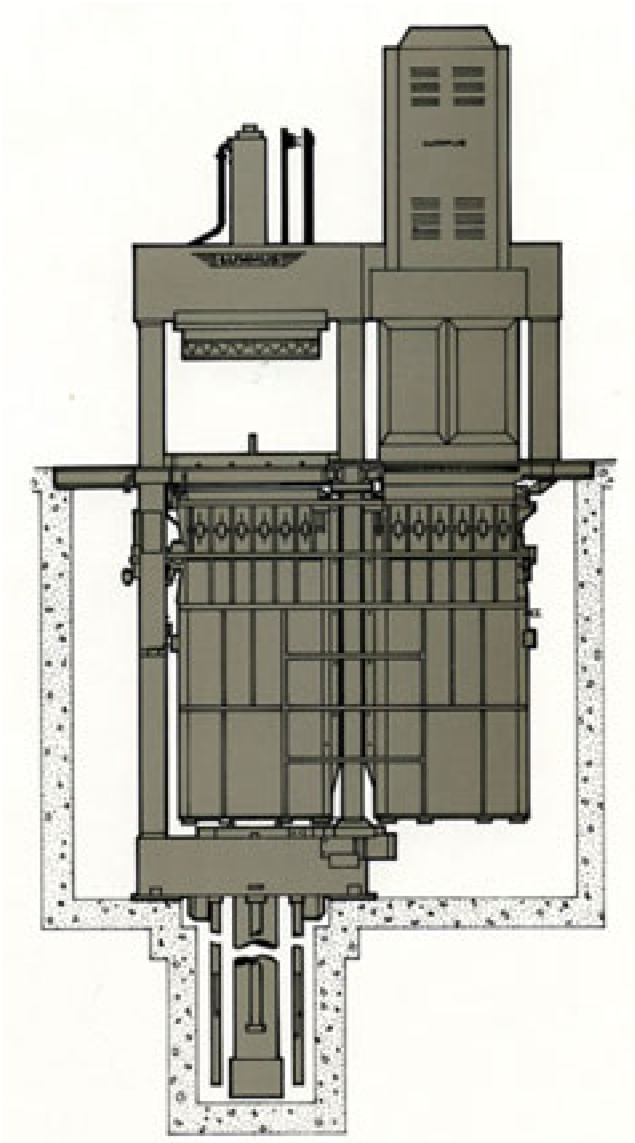

Figure 19. Lummus E. E. Dor-Less Press.

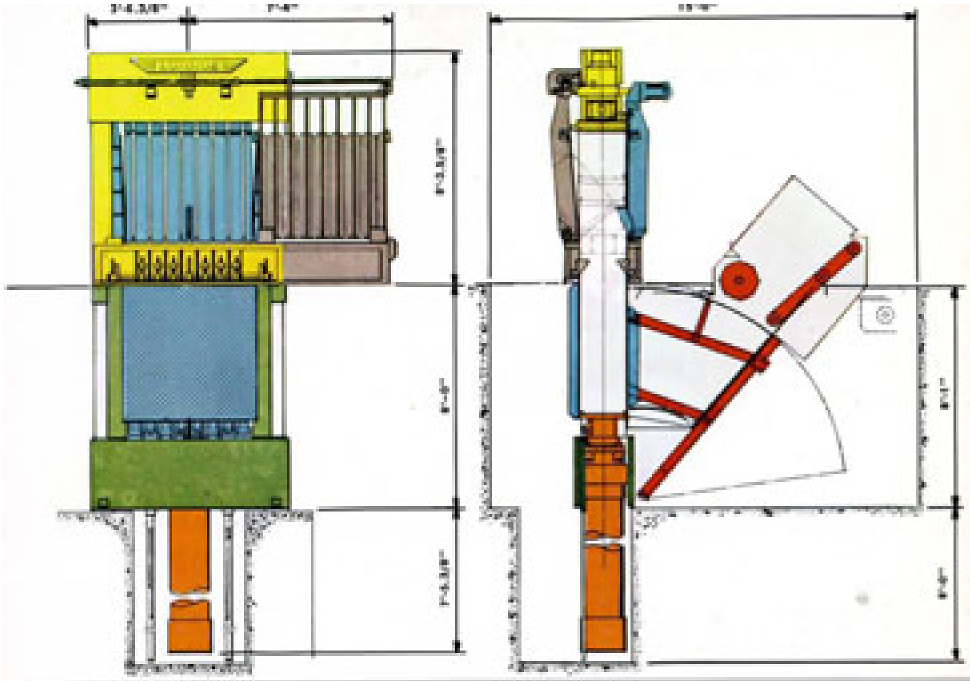

Figure 20. Lummus Swinging Single Universal Density Press.

Figure 21. Continental Double Box Down-Packing Press.

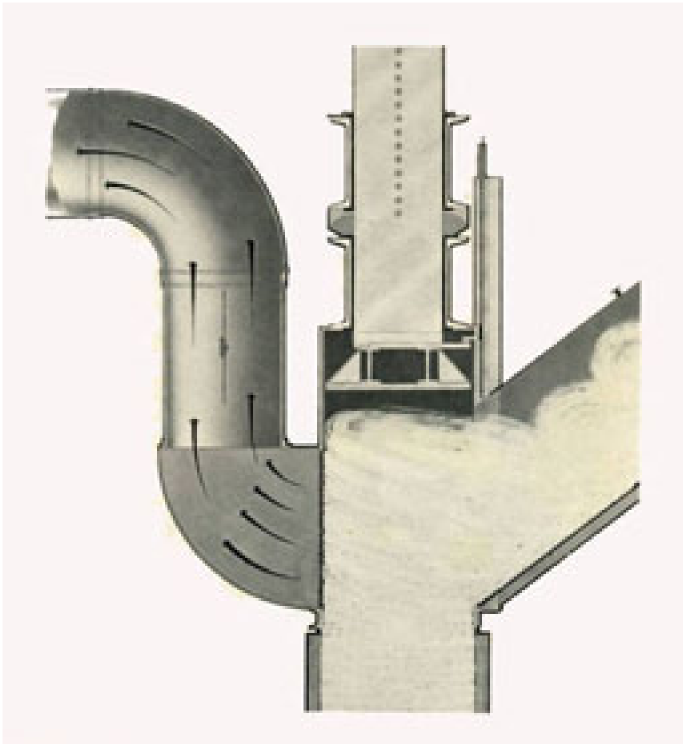

Figure 22. Continental Smooth-Flow Tramper Feed.

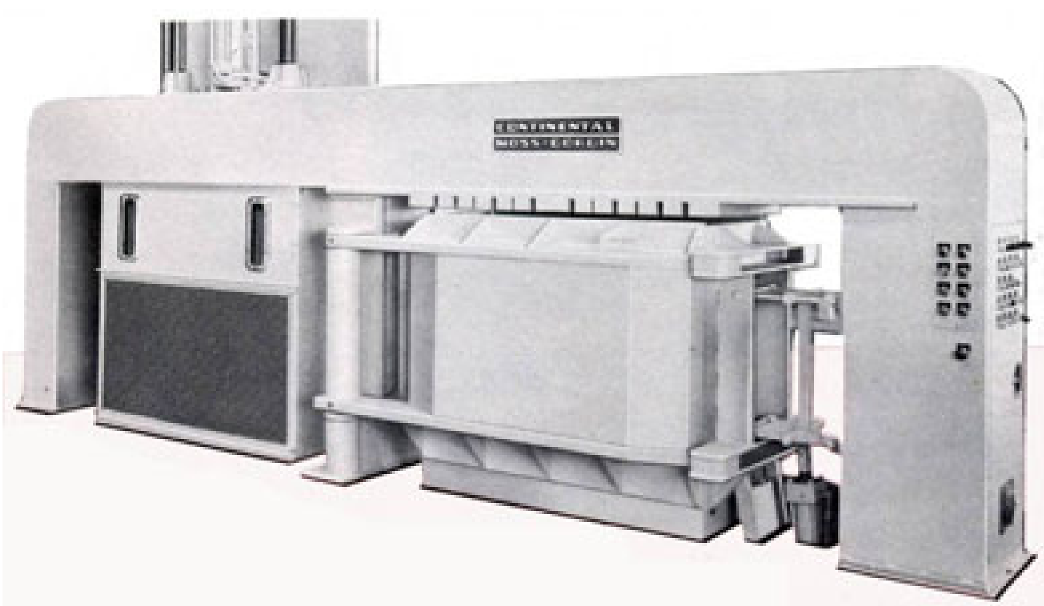

Figure 23. Continental/Moss-Gordin Fixed-Box Press.

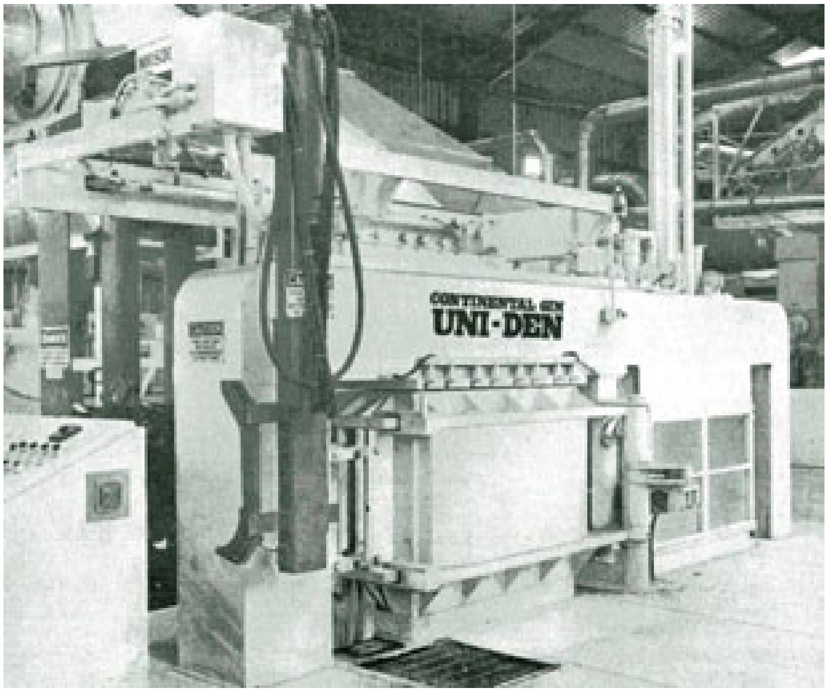

Figure 24. Continental Gin's Uni-Den Twin Ram Press.

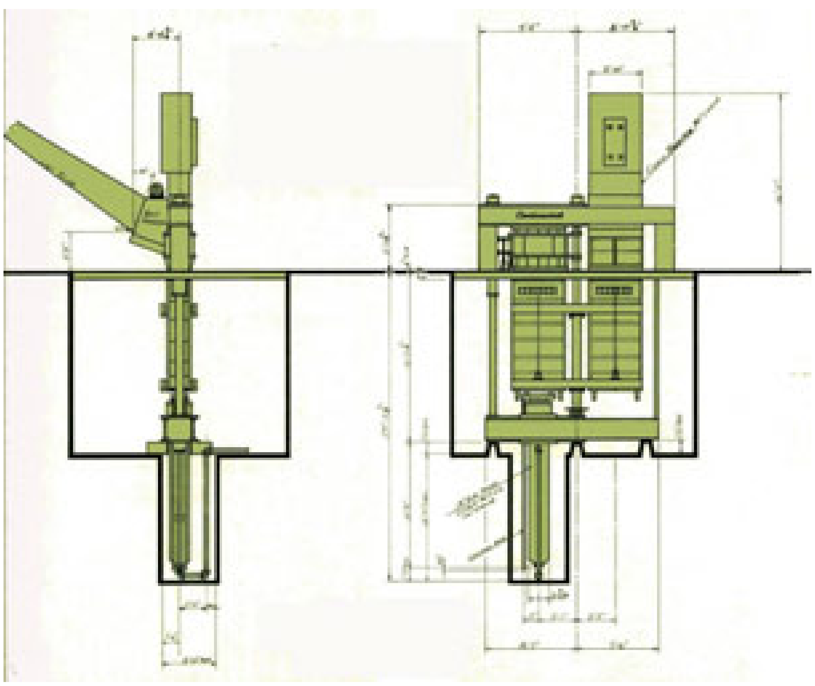
Figure 25. Continental Model 800/Uni-Den Universal Density Press.

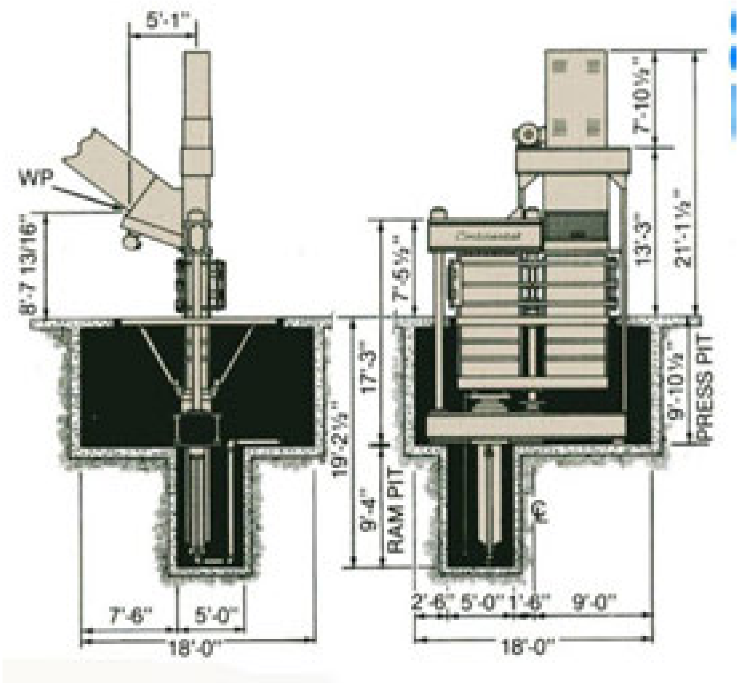

Figure 26. Continental 8400 Uni-Den Baling Press.

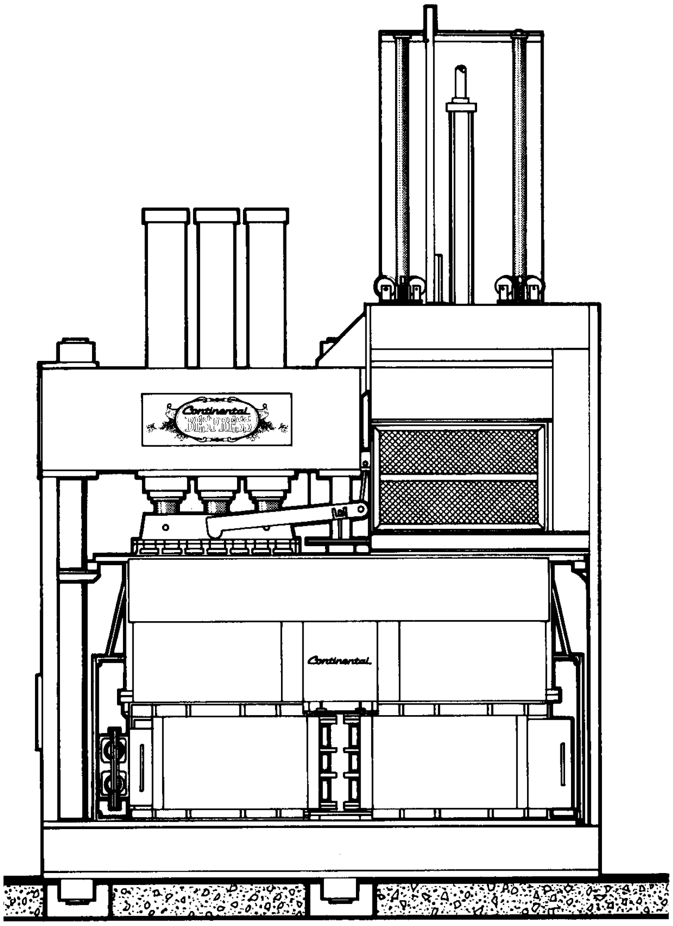

Figure 27. Continental Eagle Bespress Universal Density Press.

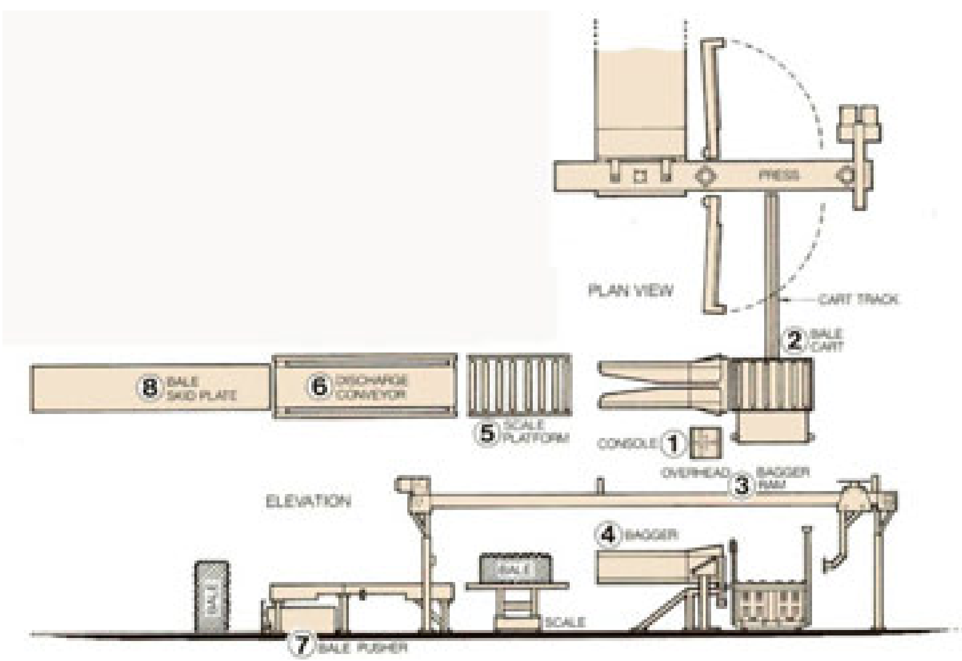

Figure 28. Continental/Murray Bale Bagging and Conveying System.

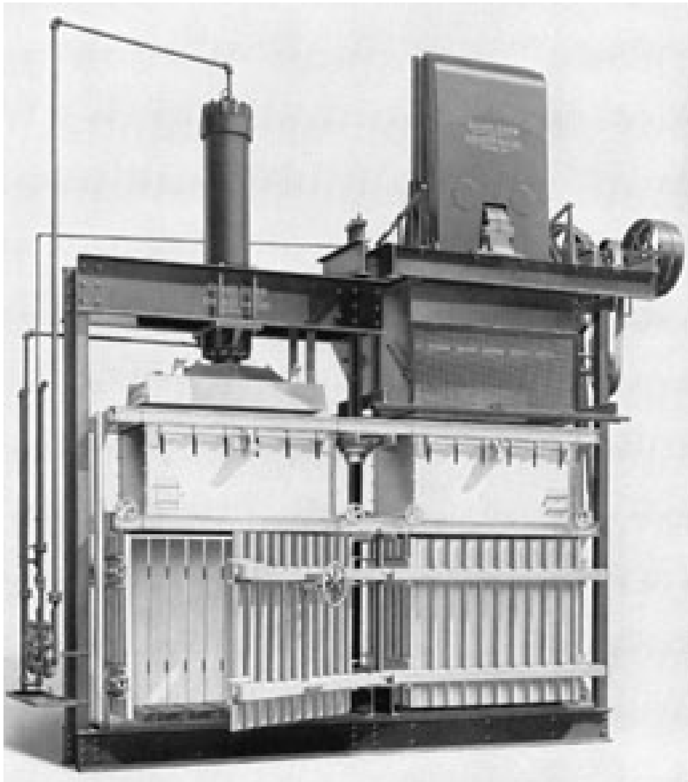

Figure 29. Gullett "Trusteel" Up-Packing Press.

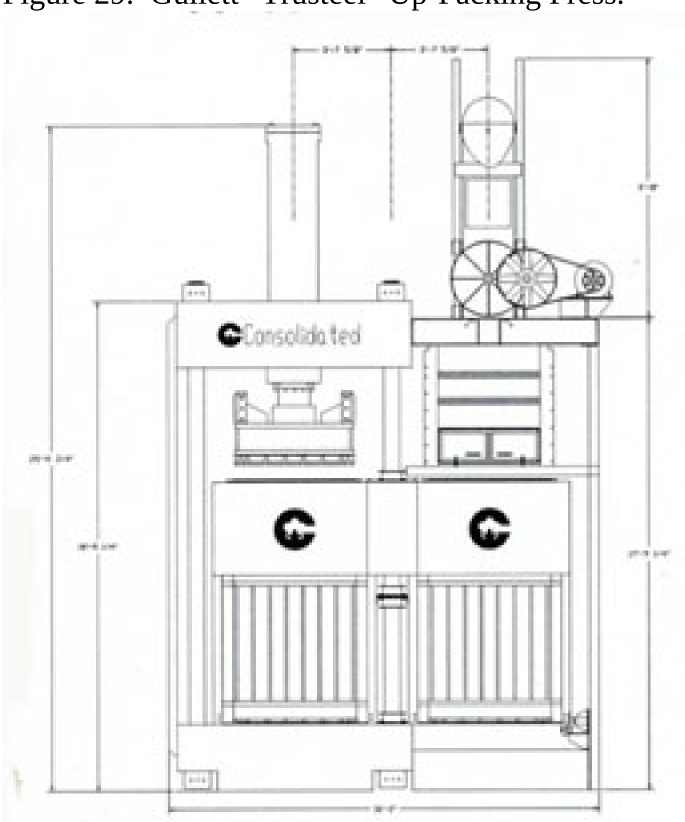

Figure 30. Consolidated Down-Packing Press.

Figure 31. Lummus 20 in. x 41 in. Automatic Gin Press.

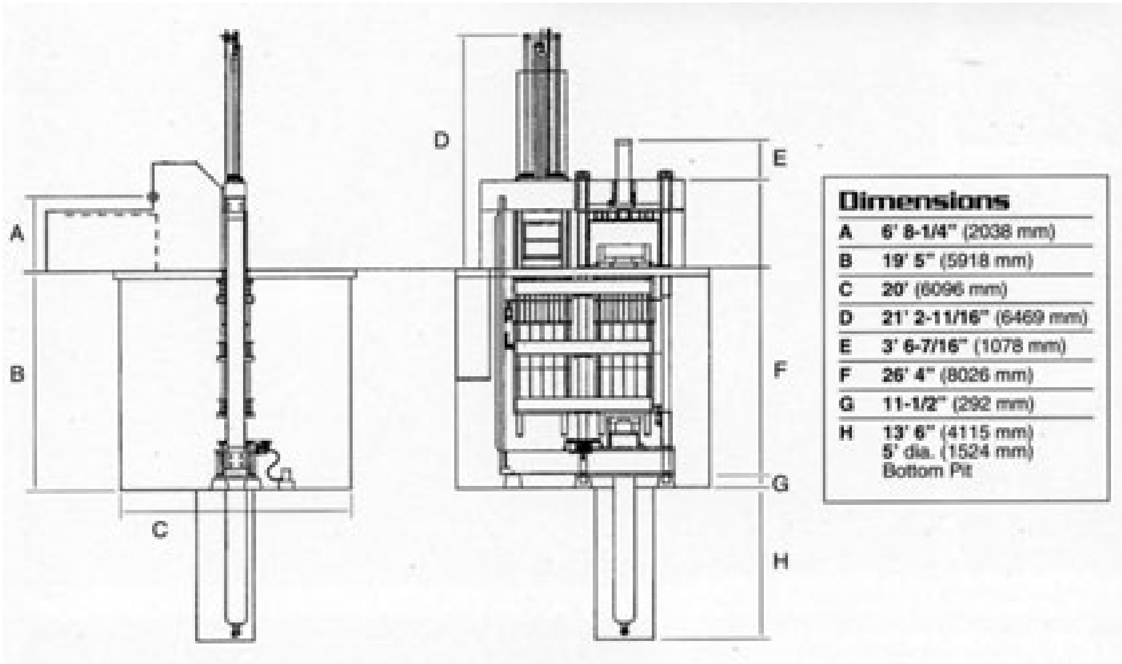

Figure 32. Continental Eagle Model 930 Magnum Universal Density Press.

Figure 33. Continental Eagle Model 950 Magnum Universal Density Down Packing Press.

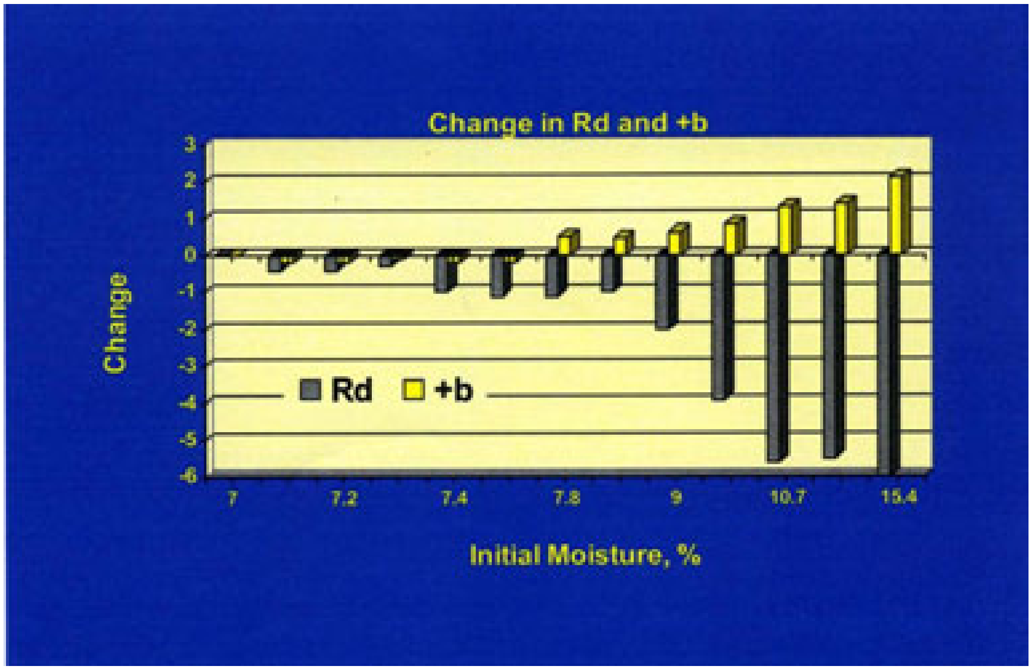

Figure 34. Reflectance and yellowness are adversely impacted by moisture sprayed directly on cotton fibers.