Freeman

Ginning And Baling Cotton In The U.S.

GINNING AND BALING COTTON

IN THE

UNITED STATES

BY

PERRY JOHN FREEMAN

B. S., UNIVERSITY OF ILLINOIS, 1907

THESIS

SUBMITTED IN PARTIAL FULFILLMENT
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I HEREBY RECOMMEND THAT THE THESIS PREPARED BY

Perry John Freeman

ENTITLED Ginning and Baling Cotton in the United States.

BE ACCEPTED AS FULFILLING THIS PART ON THE REQUIREMENTS FOR THE

PROFESSIONAL DEGREE OF Mechanical Engineer

C. R. Richards

Head of Department of Mech. Engineering

Recommendation concurred in:

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Edward C. Schmidt
G. A. Goodenough

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Waiting Their Turn at The Gin.

It was the privilege of the writer some years ago to spend several weeks traveling through the South, in which he had, from boyhood, felt a strong interest fostered by songs and stories of life in "Dixie." So pleasant were the impressions of this trip that an opportunity for a longer stay in the "Land of Cotton" was desired. Therefore the offer of a position with the Gullett Cotton Gin Co., of Amite, La., was promptly accepted. While assisting in the manufacture of ginning machinery the writer realized, as never before, the magnitude of the Cotton industry and its far reaching importance to the world.

Though much has been written about the final processes of converting cotton into cloth, no detailed account of the preliminary stages of separating the staple from the seed and preparing it for shipment has as yet been given which would be intelligible to one who had never seen a ginning plant in actual operation.

Much of that which has been written on the subject has been for the purpose of promoting some special features for financial gain rather than to describe the general principles which are common to all well designed ginning plants. Therefore, while it has been necessary in many cases to use illustrations from manufacturer's catalogs, it has been the special aim of the writer to show fundamental parts and methods of operation common to all plants. Particular care has been taken also to describe the various combinations of machines from the small plantation outfit to the community ginning plant.

Special acknowledgment for catalogs and other information is due Mr. E. H. Bostick, Vice President, the Gullett Gin Co., Amite, La., also to the following: Mr. A. L. Smith of the Continental Gin Co., Birmingham, Ala., Mr. W. J. Rutledge of the Murray Co., Dallas, Tex., Mr. Thos. A. Ott of the Lummus Gin Co., Columbus, Ga., Mr. Edward Hobart of the Carver Cotton Gin Co., East Bridgewater, Mass., Mr. Clanton Davis of the Gullett Gin Co., Dallas, Tex., Messrs. Leigh and Butler, Boston, Mass., Messrs. Ford, Bacon and Davis, Engineers in charge of construction of cotton warehouses of the Port of New Orleans, Mr. Robert D. Webb, of the Webb Compress Co., Minden, La., Mr. S. K. Waymer of the Alsop Process Co., St. Louis, Mo., Mr. C. Folks, cotton planter, Star Hill, La.

The following references have been consulted: American Journal of Science for 1832; Hunt's Magazine, January 1847 and December 1849; the Story of Cotton, E. C. Brooks; Cotton, C. P. Brooks; Cotton, C. W. Burkett; King Cotton, J. L. Watkins; Industrial History, A. S. Bolles; Transactions, A. S. M. E. Vol. XIX and XXII; Inventors, P. G. Hubert; The Electrical Review; The American Machinist; Bulletins, U. S. Department of Agriculture; Bulletins, Department of Commerce, Bureau of the Census.

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I

EARLY HISTORY OF COTTON IN THIS COUNTRY.

Effect of Cotton on the History of the Country.- No other single factor has had a greater influence on the social and political development of our country than the cotton industry. It made New England a great manufacturing center and formed the basis for the semifeudal social system of the South, thus laying the foundation for the subsequent strife between the two sections.

Introduction of Cotton into the United States.- Numerous efforts dating from 1621 were made to cultivate cotton in Virginia and in adjacent colonies, but the climate was found to be unsuitable. After a lapse of more than a century it was introduced into South Carolina, Georgia, and Louisiana, but the industry made slow progress as is shown by the fact that in 1784 eight bags of cotton were seized in Liverpool on the grounds that "so large a quantity could not be produced in America."

The principal reasons for the slow growth of the cotton industry were the slight demand from the manufacturers, the large amount of labor required for picking the variety of cotton which was com only grown, and the great difficulty of separating the fiber from the seed.

Varieties of Cotton.- Several kinds of cotton have been grown in the United States, but all may be broadly classified into Sea Island and Upland cotton. The former has a small black seed and a fine silky fiber or staple which is more easily separated from the seed than that of the Upland variety. The staple varies in length from 1 5/8 to 2 1/4 inches, and is used for making fine fabrics and laces, but is of greatest importance in the thread industry.

The area of production of this variety of cotton is limited by climatic conditions, being confined to a part of Florida, the coast and adjacent islands of South Carolina and Georgia, and the crop has seldom exceeded 100,000 bales per annum. The bolls are small and partly closed, the lobes being so sharply pointed that they prick the fingers to the serious inconvenience of the pickers.

There are several varieties of Upland Cotton, the one most largely cultivated at the time of the invention of the cotton gin having a green seed and being very hard to pick from the bolls. This fact coupled with the extreme difficulty of separating the fiber from the seed greatly retarded the extension of the cultivation of cotton. So firmly did the lint adhere to the seed that a single laborer could remove only a pound in a day.

The Mexican variety of cotton, which has a brownish seed, was introduced into this country about 1806, and almost supplanted the other varieties as it had a larger

boll which opened easily, thus rendering it possible for a laborer to pick three times as much of this kind of cotton as of any other variety.

Figure I shows Upland cotton which has some bolls ready to be picked and also the seed as it appears after

Figure I - Upland Cotton and Seed.

the staple has been removed. The average length of the fiber is given as 1.10 inches, and cotton having a staple over 1 3/16 inches in length is termed long staple.

II

PRIMITIVE GINS

The Churka Gin.- Ever since cotton had been grown in any quantity in this country efforts had been made to devise machines to separate the fiber from the seed. Figure 2 shows a type of roller gin called a "Churka" which was of East Indian origin and was used to some extent, especially

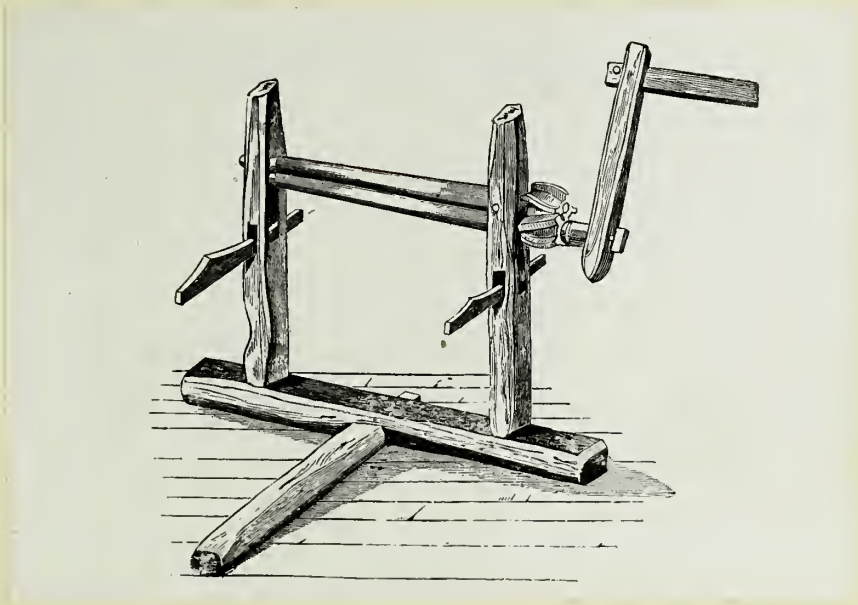


Figure 2 - The Churka Gin

for Sea Island Cotton. As it was usually made it resembled a modern clothes wringer, having two parallel rollers placed a small distance apart, which were turned in opposite directions by means of gears. Sometimes the rollers were of different diameters, the larger one being made of wood, the smaller of iron. The operator turned a crank with one hand and fed the seed cotton between the rollers with the other.

The seed could not pass between the rollers, but the cotton lint slipped through falling into a pile. This gin had an output of about three pounds in a day.

The Treadle Gin.- In 1772 a Mr. Krebs in Mississippi claimed to have invented a roller gin. This came into general use, and is described by the historian Roman as follows : "It is a strong frame of four studs, each about four feet high and joined above and below by strong transverse spindles, having a small groove through their whole length, and by means of treadles are put in opposite motions. The workman sits behind the frame with a thin board before him on which is placed the cotton thinly spread, which the rollers receive. The lint goes through the rollers, and the seed falls down in a separate pile. The French population have improved upon this plan by a large wheel which turns two of these mills with such velocity that seventy pounds of clean cotton can be made every day."

About the year 1790, this treadle gin was greatly improved by Dr. Joseph Eve of Augusta, Georgia, who adapted it for use by horse or water power. A Mr. Pottle of Georgia also, introduced an improved gin which became popular. The primitive gins were thus increased in capacity up to seventy or eighty pounds of clean cotton per day. These gins were not suitable for cleaning the Upland cotton, which was far more difficult to gin, and most planters preferred to pick the seed of that variety out by hand.

III

WHITNEY'S SAW GIN.

Whitney's Trip to Georgia. About this time Eli Whitney, a graduate of Yale, went to Georgia to teach in a private school. Through a misunderstanding the position was already filled when he arrived, and he was left without money.

The widow of General Nathanael Greene offered him a home on her plantation until he could secure a satisfactory position. While there he spent much of his time wandering about the plantation and doing repair jobs which came up. There is a story told that one day some carpenters were sawing through a partition which had seed cotton stored against it on the other side. The saw drew the lint through the kerf, but the seedcould not pass through and this incident supplied the inspiration for the invention of the gin. At any rate the story illustrates the actual working principle of a saw gin even as it is used today.

Description of the Gin.- On June 20, 1793, Whitney filed a petition for a patent on his saw gin which is illustrated in Figure 3. In a letter to Thomas Jefferson he stated that "the cylinder is 2 feet 2 inches long and six inches in diameter. It is turned by hand and requires the strength of a man to keep it in constant motion. One negro can clean fifty weight (I mean fifty pounds after it is separated from the seed) of green seed cotton per day."

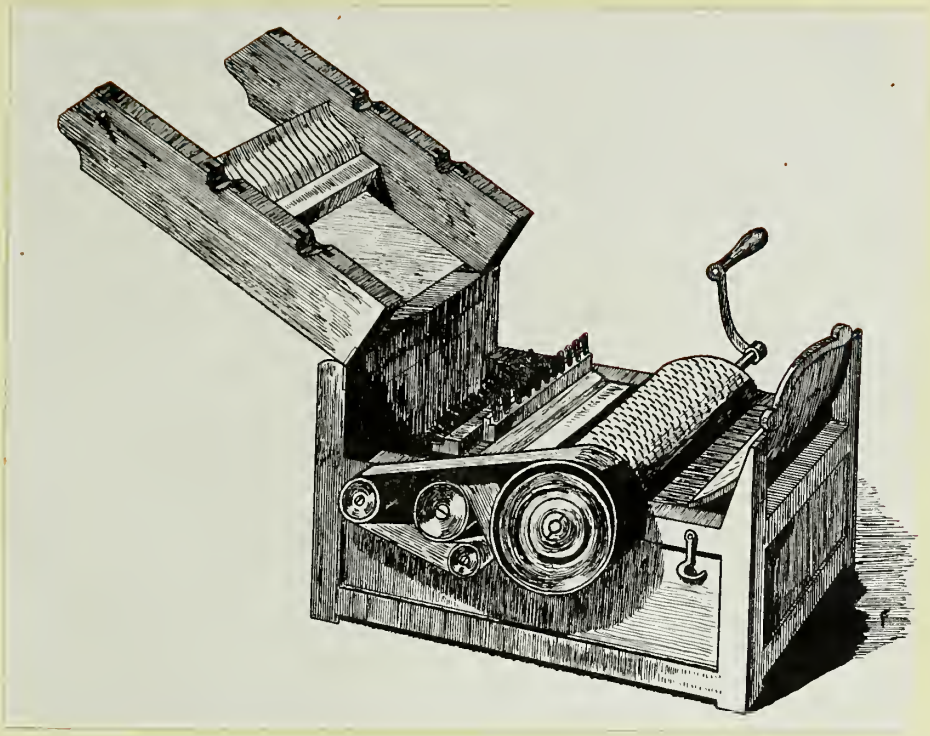


Figure 3 - Whitney's Original Gin

The cylinder had rows of wire teeth which were arranged to pass through narrow openings in a curved plate or grid. When the cylinder was turned the short teeth would drag the fiber through this grating, but the seed were too large to pass through the opening and would drop down below. A brush was placed just behind the toothed cylinder. This brush was made of two cross arms having stiff bristles at the ends which came in contact with the wire teeth when the machine was turned. The toothed cylinder and the brush revolved in opposite directions, and since the velocity of the bristles was greater than that of the teeth, the cotton was swept off and dropped into a pile separate from the seed.

Whitney Starts to Manufacture Gins.- Although a patent was not issued to Whitney until March 14, 1794,

he formed a partnership on May 27, 1793, with Phineas Miller, also a graduate of Yale. The latter financed the undertaking and Whitney went at once to Connecticut to manufacture as many machines as he thought would supply the demand.

This was one invention for which the inventor did not have to create a market by advertising, as can be seen by a letter which Miller wrote to Whitney then in New Haven, on October 26, 1794. "Do not let a deficiency of money, do not let anything hinder the speedy construction of the gins. The people of the country are almost running mad for them, and much can be said to justify their importunity. When the present crop is harvested there will be real property of at least fifty thousand, yes, of a hundred thousand dollars, lying useless unless we can enable the holders to bring it to market. Pray remember that we must have from fifty to one hundred gins between this and another fall if there are any workmen in New England or in the Middle States to make them."

Whitney's Difficulties.- So important an invention could not long be kept a secret, and before the patent was secured it is said that people broke into the building and carried off the original machine, the public in this manner coming into possession of the invention.

Miller and Whitney started out not only to manufacture, but to operate the gins. To this end they secured water rights in many places, and in 1796 they had thirty

gins operating in Georgia. Some were driven by horses or oxen, and some by water power.

Too late they realized that it would have been more profitable to have confined the business to manufacturing gins and selling patent rights. People began to plant large quantities of cotton trusting to get it ginned by the new process. They hired mechanics and constructed gins in such numbers that after four years the matter became so serious as to threaten to ruin Whitney's business. The inventor was unable to get a favorable decision in any court and by 1800 the infringements upon his patent were practically unrestricted. It was not even possible to sell patent rights, for the public refused to pay for the use of an invention which they could appropriate for nothing.

The firm of Miller & Whitney was hampered by lack of capital and sickness, and in March 1795, the factory, drawings, and all were burned. These troubles served to give an added excuse for people to violate his patent rights. A further difficulty arose in the claim made by England that the saw gin injured the staple, a story which has been persistently circulated ever since. Later on the reputable manufacturers required cotton to be cleaned on Whitney's gin, and thus a serious obstacle to the progress of the ginning industry was removed.

In the meantime several rival claimants for the credit of the invention appeared. Among these was Hodgin Holmes,

who had received a patent on a saw gin May 12, 1796. The chief difference between the two gins was that Holmes cut teeth around the circumference of metal plates having large holes through the center and passed them over a wooden cylinder while Whitney had used wire spikes, the essential feature of both being the same.

Judge Johnson's Decision.- In spite of all conflicting claims, the honor of the invention undoubtedly belongs to Whitney, and full recognition was accorded him after a review of the whole matter in a session of the United States Court held in Georgia during December 1807. The text of Judge Johnson's decision handed down on this occasion is worthy of notice, as it not only settled the controversy over the invention of the saw gin, but also gave a lucid insight into the economic effects which the introduction of the gin had produced on the country, even at that early date. It is in part as follows : "The whole interior of the Southern States was languishing and its inhabitants emigrating for want of some object to engage their attention and employ their industry, when the invention of this machine at once opened views to them which set the whole country in active motion. From childhood to age it has presented to us a lucrative employment. Our debts have been paid off, our capitals have increased, and our lands trebled themselves in value. We can not express the weight of the obligation which the country owes to this invention. The extent of it can not now be seen. Some faint presentiment

may be formed from the reflection that cotton is rapidly supplanting wool, flax, silk, and even furs in manufactures, and may one day profitably supply the use of specie in our East India trade. Our Sister States also participate in the benefits of this invention, for besides affording the raw material for their manufacturers, the bulkiness and quantity of the article affords a valuable employment for their shipping."

Whitney never realized any ultimate financial reward from his invention, and any remuneration which he did receive was dissipated in an endeavor to protect his rights. When he did finally receive a favorable decision from the court, his patent had nearly expired and he said in a plea for an extension of the patent, that estimating the value of labor of one man at twenty cents a day, the whole amount which had been received by him for his invention was not equal to the value of the labor saved in one hour by his machines then in use in the United States.

IV

GINNING AND BALING COTTON IN ANTEBELLUM DAYS

Ginning.- It was claimed by Whitney that the idea of using saws was original with him, accordingly he abandoned the use of wire spikes on his later machines. The number of saws used in each gin was soon increased and the daily output was proportionally raised. Animal and waterpower was adopted enabling the planter to operate gins of a capacity of 50 saws as early as 1825.

The invention of the mote board by Eleazer Carver in 1847, was very important as it made it possible to regulate the air current to carry off only the cleaned cotton and leave the motes, much as a threshing machine separates the chaff from the wheat. From this time on until some years after the Civil War there were but few changes made in the methods used in cleaning Cotton. Many of these old time ginning plants such as is shown in Figure 4, are still standing and a few are in operation.

Every large plantation had its gin house which was about 50 ft. by 75 ft., built on posts ten or twelve feet high in order to make room underneath for the large wooden wheels, levers, and mules which furnished the power. Figure 5 shows the interior of a gin house with the lint room on the right. This was provided with ventilators to permit the air and dust from the cotton to escape. The gin would usually be placed with the outlet opening into

this lint room and the cotton would be blown into it by the blast from the revolving brush. A ginner was required to

Figure 4 - Plantation Gin and Press.

feed the seed cotton into the gin and a ginner's helper to supply him with cotton, which three or four "hands" carried upstairs in baskets. One man was needed to keep the seed

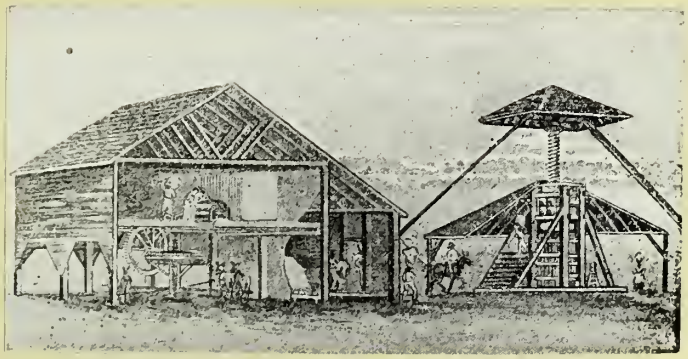


Figure 5 - Interior of an Old Gin House.

out of the way of the ginners feet, and in some cases another man was required to push the lint back into the lint room. When the gin was started the cotton entered the lint room like an imitation snow storm. The process was continued until sufficient cotton was obtained to start baling or until the lint room was filled.

Early Methods of Packing Cotton.- One of the earliest methods of packing Cotton for market was to hang a canvas bag between two trees, the cotton being tramped and pounded in with a pestle until the bag weighed about three hundred pounds. In the earliest gin houses a circular hole two or three feet in diameter was cut through the floor and a long bag was suspended through it. The cotton was then tramped and mauled into the bag until the density was about five pounds per cubic foot. The bag was then cut loose at the top and dropped to the floor below where the end was sewed up ready for shipment. One bag per day was the output of one man.

One of the first methods of using animal power was as follows : A strong wooden box about 4 feet long, 18 inches wide and 4 feet deep was placed horizontally. A heavy chain was fastened to one end of a timber about 14 inches square and 18 feet long which was on rollers. An upright windlass was located just back of the box. The bagging would be placed inside the box and the cotton packed in as firmly as possible by hand. Then a follower block which just fit into the box, would be placed against the

cotton and the heavy timber forced against it by means of the windlass. The sides of the box which were hinged and held by clamps, would then be removed and the bag sewed together. The bale would be about 3 feet by 4 feet by 18 inches. It is said that two men could pack six bags in a day.

The Screw Press.- The first screw press was introduced in 1801 by Sir William Dunbar, an extensive cotton planter in Mississippi. The press was made for him in Philadelphia at a cost of $1000.00. About 1846, metal screw presses were introduced, but the large wooden screw was almost in universal use until some years after the Civil War. The press or "Screw" as it was called, stood out of doors and was surmounted by a roof as shown in Figure 4. The bottom of the press consisted of a heavy box about five and a half feet long by thirty inches wide, and several feet deep. At the lower part of the box there were doors about three feet high hinged by extending the bottom batten into holes made in the main frame of the press. There were similar doors at the ends, but these were not hinged. The top part of the press was made strong enough to hold in an upright position the large wooden screw which carried two long sweeps. A heavy follower which just fit the press box was fastened to the lower end of the screw. The power to drive the press was furnished by mules hitched to the ends of the sweeps.

Preparatory to pressing a bale the doors at the bottom would be opened and a piece of bagging would be spread on

the floor of the box with ends and sides extending over. Then the doors would be closed and fastened by means of wooden bars and wedges. The screw would be turned to its highest position until the follower was above the box and could be turned at right angles, thus allowing room to drop cotton into the box from the top. Three or four laborers would then carry the lint in baskets and place it in the press box. After the box had been partly filled, two men would get into it and tramp the cotton down so that it would hold enough to make a full sized bale. When the box was level full another piece of bagging was placed on top and the follower turned around. The screw was allowed to run down by its own weight as far as possible. The mules were then hitched to the sweeps and the screw forced down until the bale was the desired size. The doors would then be removed while the screw was held fast and the bagging sewed at the ends and sides covering the cotton completely. Five or six strong hemp ropes would be tied around the bale in a special knot which permitted the operator to draw the rope tight by means of a lever before the knot was made fast. This process being completed, the screw pressure would be relieved and the bale rolled out, leaving the press ready for another. The bales thus produced were about five and one half feet long by thirty inches wide and twenty-four inches thick having a density of seven or eight pounds per cubic foot.

With this style of press, a half a dozen men could turn

out from five to eight bales in a day. At first hemp bagging was used, but later cotton bagging was adopted as it was cheaper. The use of iron hoops in place of rope was introduced about 1846, but met with determined opposition from the cotton merchants. Some of these hoops were made of round iron which cut into the cotton bales and proved very unsatisfactory, but finally flat iron hoops entirely superseded ropes as a means of holding the bales in shape.

V

MODERN METHODS OF HANDLING COTTON

Improvements Not Wanted.- From the invention of the gin until some time after the Civil War, there was no demand for methods other than those previously described. To be a "gentleman" it was necessary for a planter to own a certain number of slaves, and thus a peculiar industrial system was established, the planter in accordance with this standard acquiring large areas of land. He had no desire to see any methods introduced which would enable the small farmer to compete with him so long as he had the slaves to do the work. Steam power would have brought an added responsibility with no advantages commensurate with the risk. Under the care of his "hands" the boiler would be quite liable to explode and twenty-five thousand dollars worth of human property destroyed. The mules and negroes were needed to raise the cotton and it was more satisfactory to let the same labor prepare it for market.

Portable Ginneries.- Before the war every large plantation had its gin house, but with the downfall of slavery the large plantations were broken up and some method of handling cotton from the small farms was needed. At first it was thought that portable ginneries would serve the purpose, but it was soon found that the small farmers lacked facilities for storing the cotton until the whole crop was gathered. Also finaqcial conditions made it imperative that the crop be taken to market without delay after it was

picked. For these reasons the portable gin and baling plant had to move for nearly every bale, an expense which consumed the profits of the business, and after a thorough trial this method was abandoned.

The Growth of the Toll Ginnery.- In addition to the gin houses already established on the plantations, country merchants erected new ones and began to gin for toll. This was the beginning of the large modern ginning plants which are capable of cleaning the cotton for a whole community. It was now desirable to use as few men as possible to operate the plant and gradually labor saving devices have been added and improvements made which enable one man to do more work than could be done by a dozen men with the old style outfit. The size of the plant, of course, depends upon the quantity of cotton raised in any community, and thus it is necessary for manufacturers of ginning machinery to arrange many different combinations to suit the needs of the various cotton growing centers. The growth of the methods of handling the seed cotton before ginning and the seed after it has been separated has reached such proportions as to almost overshadow the ginning operation itself.

Essential Features of a Modern Gin.- The principles which were employed by Whitney in his first gin are still used by most of the manufacturers today. A revolving saw cylinder passing between bars of iron spaced closely together separates the lint from the seed and a rapidly revolving brush removes the fiber from the saws. Some manufacturers have adopted the use of an air blast in place of a brush

as a means of removing the lint from the saws.

The Saw Cylinder.- A modern saw cylinder which is partly assembled is shown in Figure 6. The saws are usually made from a special grade of English steel 0.037 inches thick which is blanked out into discs ten or twelve inches in diameter. These discs after being centered and punched are placed

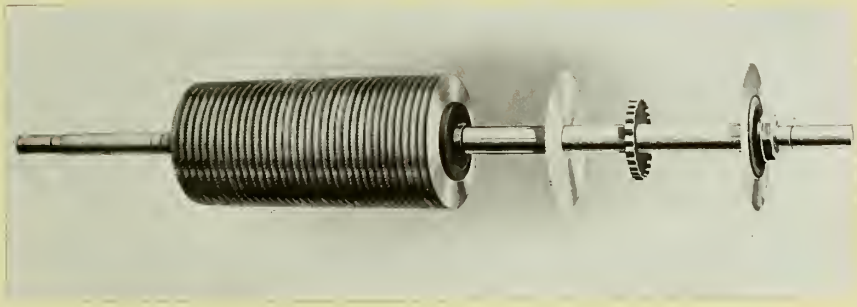


Figure 6 - Saw Cylinder With Metal Space Blocks.

on a tooth cutting machine which is provided with an indexing head that determines the number of teeth cut in each saw. As the discs are rotated the teeth are cut out around the circumference, there being 235 teeth in a ten inch and 265 in a twelve inch saw. The saws are straightened in the usual manner by hammering on a large anvil. The teeth are cut with a "roach back" which adds to their strength. The throat is well rounded to prevent cutting the fiber of the cotton and the teeth are filed to a needle point by means of two different automatic filing machines. After the saws have been filed they are placed on a mandrel and polished by running them in sand. They are run backward and then forward

until they are perfectly smooth to prevent the cotton from clinging to them.

The saws are then assembled on a shaft in groups of 60, 70, or 80. Space blocks either of wood or metal are placed between the saws and the whole securely clamped by means of nuts and washers. The space blocks are made by special machinery to insure uniformity, thus enabling the ginner to secure interchangeable saw cylinders. This makes it possible for him to send the extra cylinder to the factory for sharpening or other repairs.

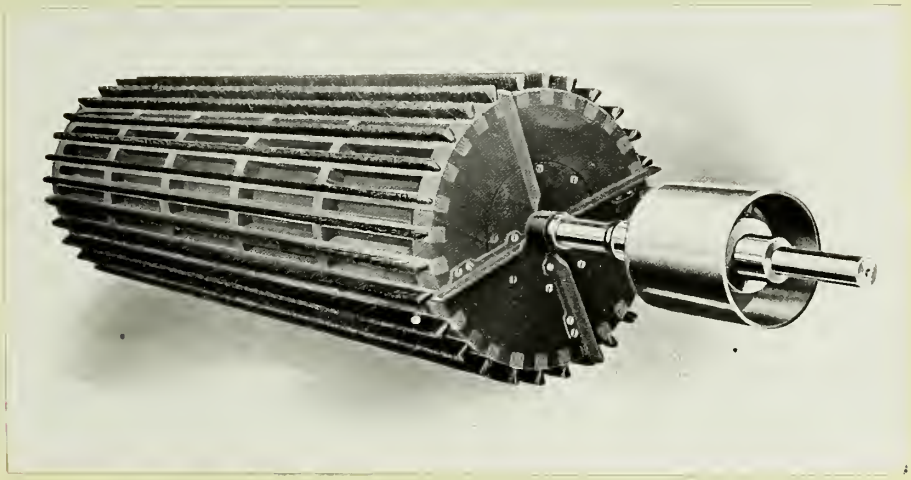


Figure 7 - Cotton Gin Brush

The Brush Cylinder.- The brush cylinder must be very substantial and, as shown in Figure 7, is made up of selected gum sticks of uniform weight into which high grade bristles are set by means of a special tufting machine which doubles a bunch of bristles at the middle, passes a steel wire

staple around them, and forces all into a drilled hole fastening them firmly in place. These sticks are placed in a metal lined built-up cylinder and firmly fastened. The bristles are then accurately trimmed and the brush placed in a running balance at about 2500 revolutions per minute.

The Ribs and Breast.- The gin ribs are made of charcoal iron chilled at the point of wear, ground, and polished. Figure 8 shows the breast of a plain gin, the curved bars

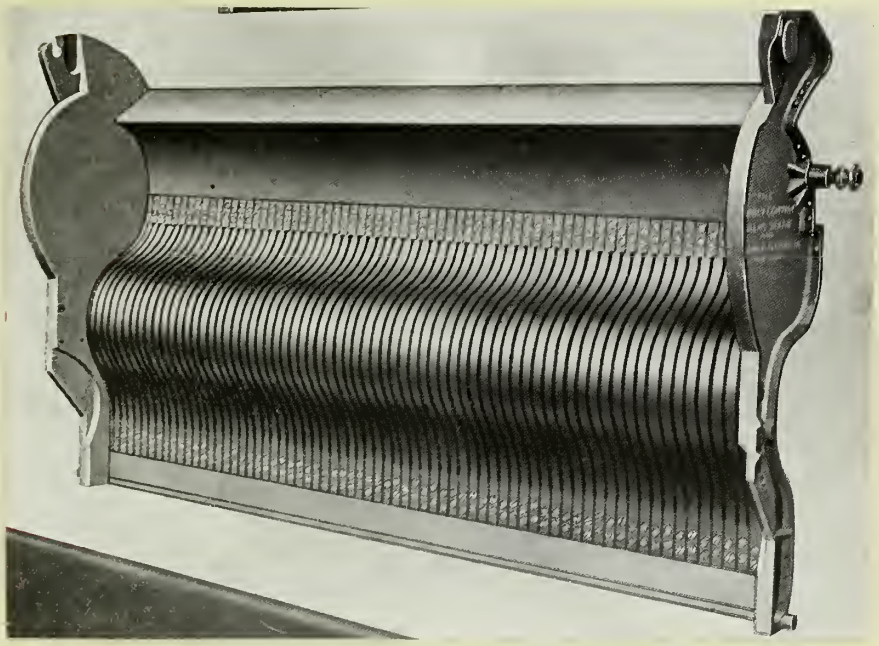


Figure 8 - Breast of a Plain Gin

being the ribs. The saw cylinder is adjusted at the ends to insure free running of the saws between the ribs. Some method is also provided to regulate the distance which the saws project beyond the ribs in order to enable the ginner to handle different grades of cotton. There are two general classes of gins depending upon the shape and arrangement of the ribs.

The Plain Gin.- Figure 9 shows a plain gin which is used for ordinary clean cotton. The seed cotton is fed into the roll box A where it is quickly formed into a revolving roll by the drawing action of the teeth against the cotton with the result that new material is continually presented to the saws and the seed permitted to drop down after it has been separated from the fiber. The saws rotating as shown by the arrow carry the lint between the ribs B, and the seed,being too large,drop down at D.

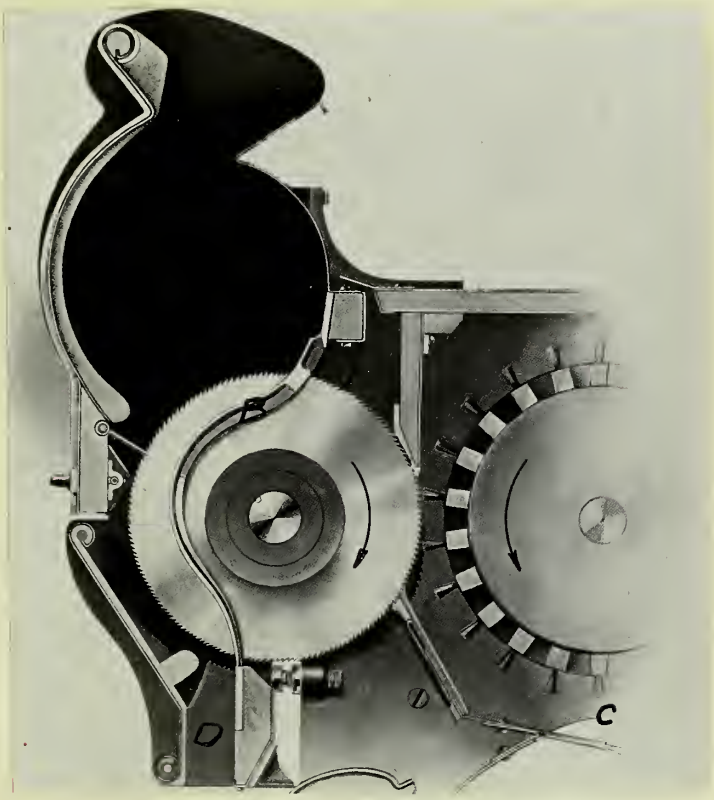


Figure 9 - Plain Gin

The brush rotating in the direction indicated at about four times the R.P.M. of the saws sweeps the lint from the teeth, and the blast from the brush forces the cotton out at C. The quality of thestaple will depend somewhat upon the speed

at which the saws are run. The customary speed for a gin of this type is 400 revolutions per minute. If the velocity is too great, the lint will be jerked from the seed with such force as to break the fiber, but with proper care in ginning there need be very little damage to the staple.

Single Rib Huller Gin.- A single rib huller gin which is a type adapted for cotton containing some partly opened bolls, is shown in Figure 10. The seed cotton is fed into the outer compartment A and falls upon the rapidly revolving roller B which loosens up the cotton and throws it toward the saws. It is then carried upward against the projecting "knees"

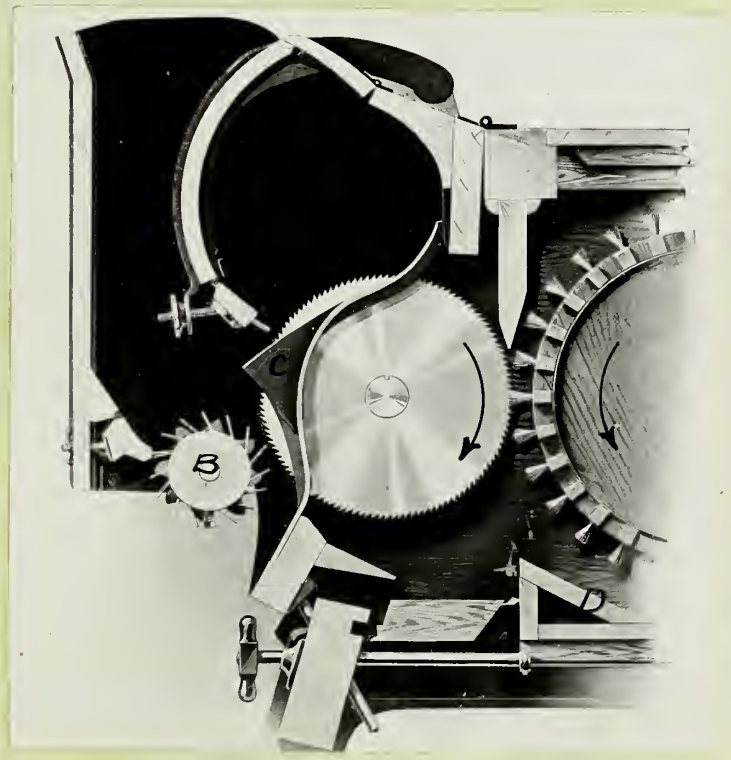


Figure 10- Single Rib Huller Gin.

C which are far enough apart to allow the seed to pass between them but close enough together so that the hulls and similar substances are separated from the cotton and thrown

back upon the roller whence they are dropped between the spikes and fall down with the seed. After passing into the roll box E the ginning operation is the same as that in the plain gin.

The Mote Board.- The mote board shown at D is used in some form in all types of gins. This device makes it possible for the ginner to so regulate the air supply that the lint is separated from the motes which fall below.

Double Rib Huller Gin.- Figure 11 shows a double rib huller gin which not only separates the hulls from the cotton, but keeps them out of the seed. The seed cotton is fed into

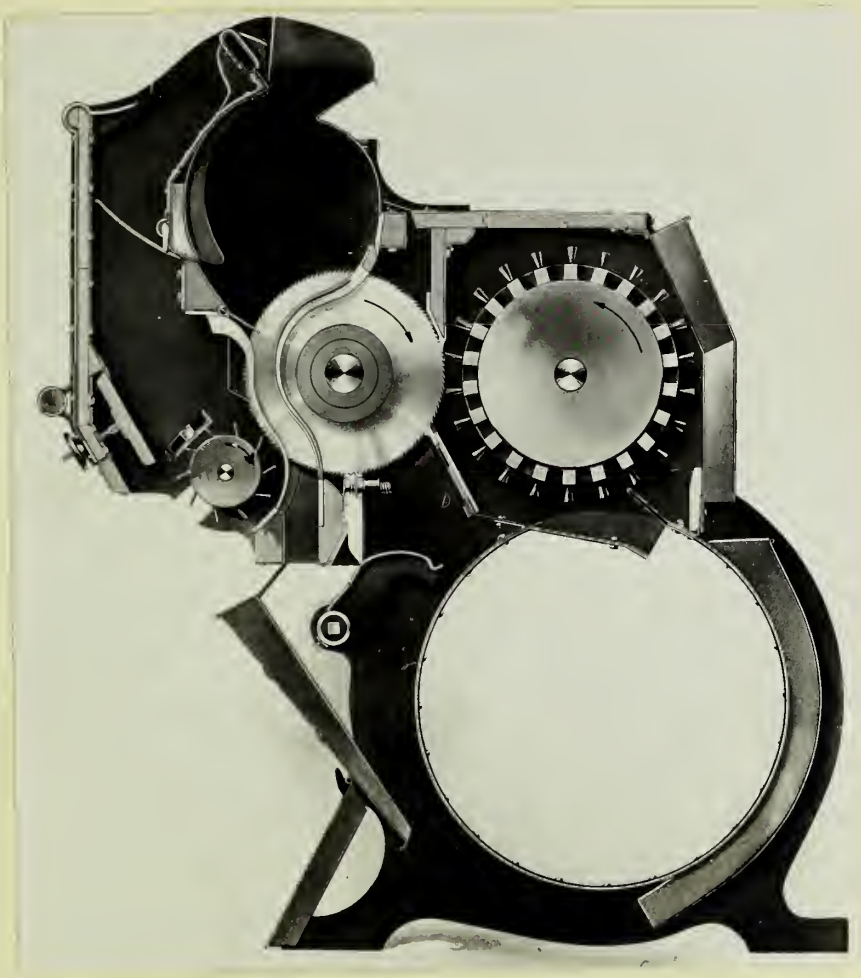


Figure 11 - Double Rib Steel Huller Gin.

the outer compartment and falls upon the spiked roller which throws it against the outer or huller ribs through which the saws project a short distance. The hulls and trash are separated and drop out past the spiked roller. The seed cotton on being carried into the roll box is acted upon by the inside ginning ribs and the seed falls down between the two sets of ribs into a conveyor. This type of gin is becoming very popular as it makes it possible to gin a better sample from bolly cotton than is possible with a plain gin. Some gins have two spiked rollers or other devices to agitate the bolls and open up the cotton. Huller gins are usually run at a slower speed than plain gins, averaging about 375 revolutions per minute. The gin shown in the illustration is made of steel, the large opening being the lint flue which carries the lint away from the gin.

The Air Blast Gin.- The gins which have been described are all of the brush type very similar to the original Whitney gin. Figure 12 shows an air blast plain gin, which operates entirely without brushes. The cotton is fed into the roll box and the lint separated from the seed in the same manner as in the gins previously described. A galvanized steel pipe with a thin projecting lip which extends the full length of the saw cylinder is connected with a blast fan, and a thin strong stream of air is directed against the backs of the saw teeth in such a manner as to remove the lint. The air carries the cotton on into the lint flue connection, which is shown just beneath the air pipe, and from there on the process is

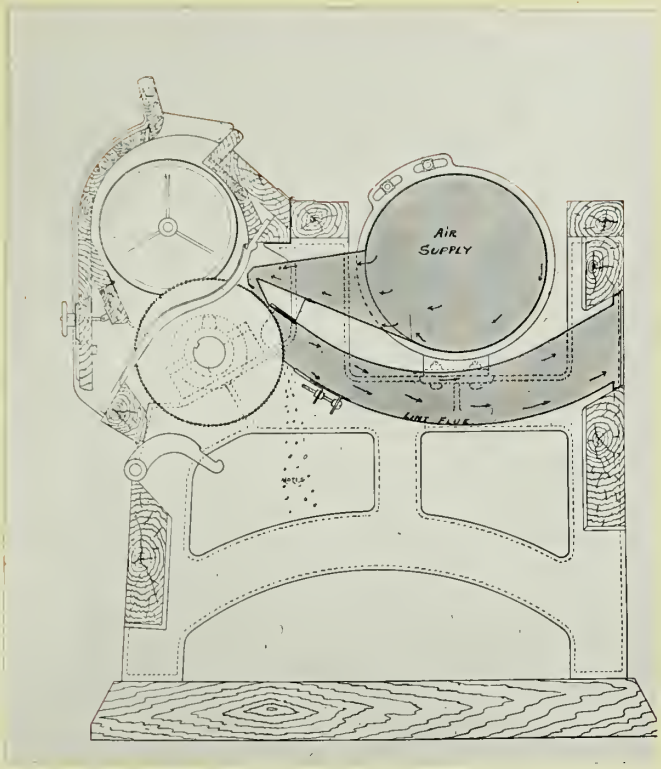


Figure 12 - Sectional View of an Air Blast Gin.

the same as will be described for other gins.

It is claimed by the manufactures that the air blast gin reduces the fire risk since there is no rapidly revolving brush to ignite the cotton by friction in the bearings. On the other hand the manufacturers of the brush types of gins assert that the air blast does not operate so well with damp cotton, and does not mote the lint cotton effectively.

Gins, Feeders, and Condensers.- Until about 1875 it was customary to feed the gins by hand. At that time a feeding attachment was added and a few years later a condenser as shown in Figure 13 was brought into use. This condenser delivered the cotton in the form of a bat and did away with the use of a lint

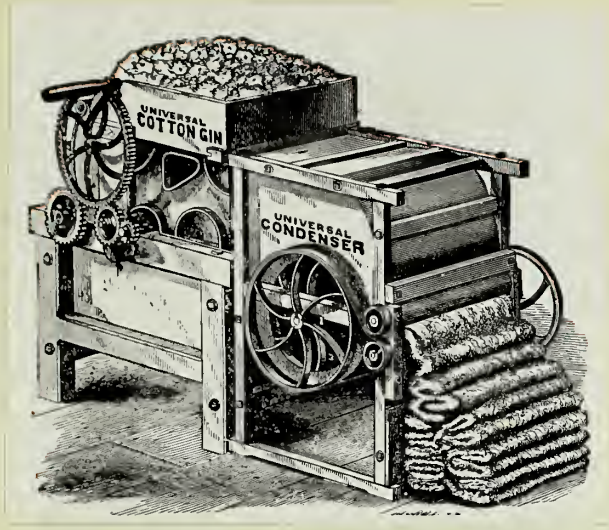


Figure 13 - Cotton Gin with Condenser.

room to receive the cotton from the gin. A modern 70 saw huller gin is shown in Figure 14. The general appearance is the same for all types of gins. They are made with either wood or iron frames and are driven by various different systems of belting. The one in the illustration is driven by

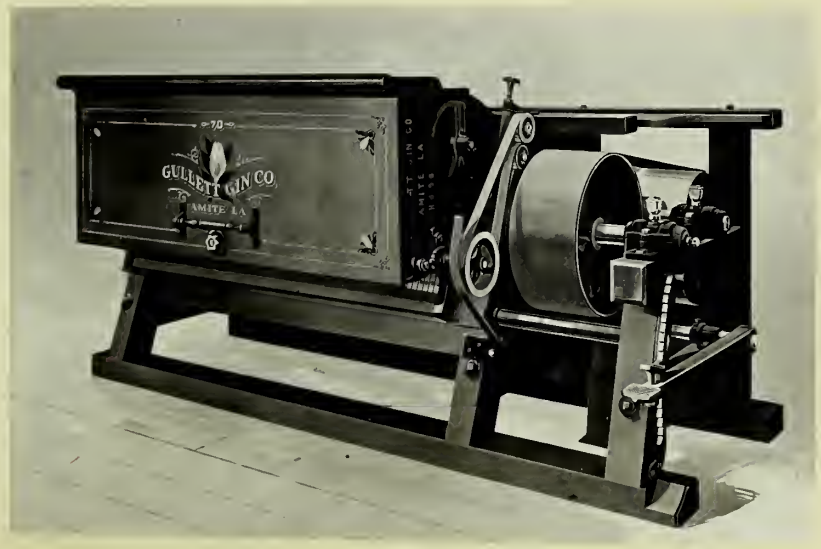


Figure 14 - Single Rib Huller Gin.

a main belt, and is started and stopped by adjusting the foot lever which operates a tightener pulley.

Figure 15 shows a plain gin equipped with a horizontal basket feeder and a horizontal condenser. This arrangement of machinery was adopted about thirty years ago and is still used

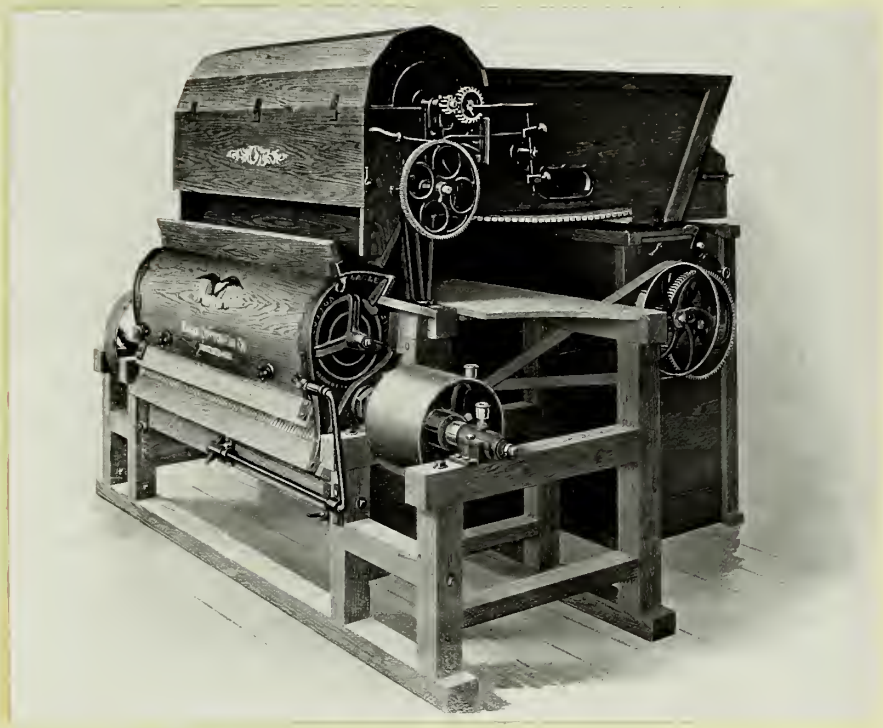


Figure 15 - Plain Gin with Horizontal Feeder and Condenser.

in small plantation outfits. The cotton is carried from the wagon in baskets and emptied into the hopper or upper part of the feeder, the interior of which is similar to Figure 16. The conveyor B carries the cotton towards the spiked roller A which feeds the cotton into the top of the gin in a steady stream. A leveling board is arranged to insure uniform delivery and the speed of the apron can be adjusted to suit the

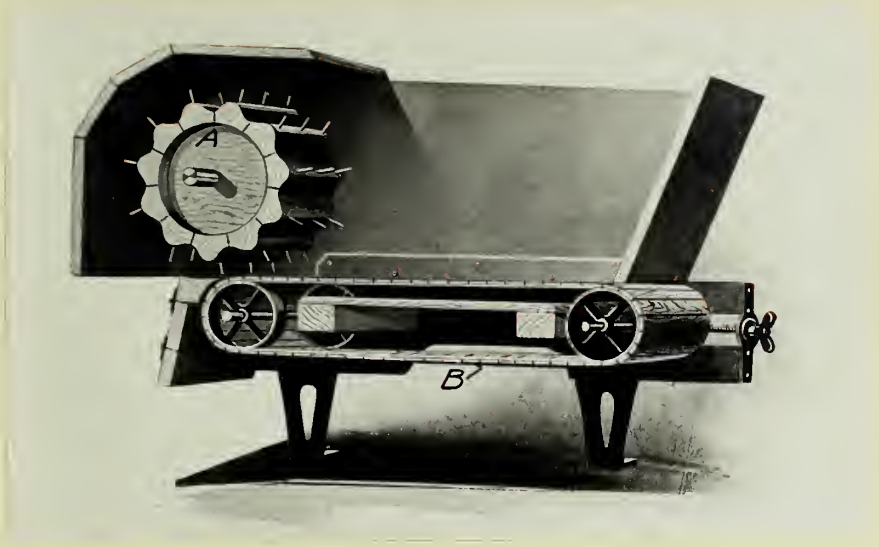


Figure 16 - Sectional View of Horizontal Feeder.

condition of the cotton being ginned.

The horizontal condenser is illustrated in Figure 17. The cotton is blown by the brush through a short flue against a large revolving wire drum inside the condenser, where with the aid of a hinged roller, it is formed into a bat and passes

Figure 17 - Horizontal Condenser.

out on the floor ready for baling. The dust and air pass through the wire screen and down through an opening in the floor which is cut the full length of the condenser.

Plantation Outfit with a Pneumatic Elevator.- For use on plantations and in small cotton growing communities, an outfit similar to Figure 18 is used, the seed cotton being taken directly from the wagon or store house.

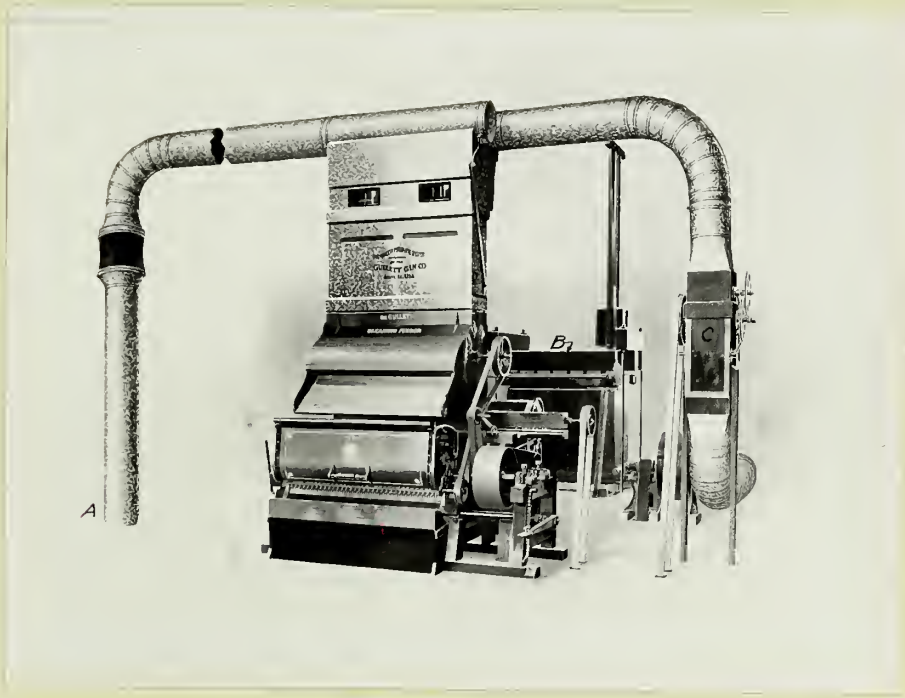


Figure 18 - One Gin Plantation Outfit.

The pneumatic elevator was first put out in a crude form by a Mr. Sailor of Little Rock, Arkansas, about 1885. It acts partly as a cleaner and serves to remove the dust from the seed cotton.

The cotton chute or receiver is shown in Figure 19.

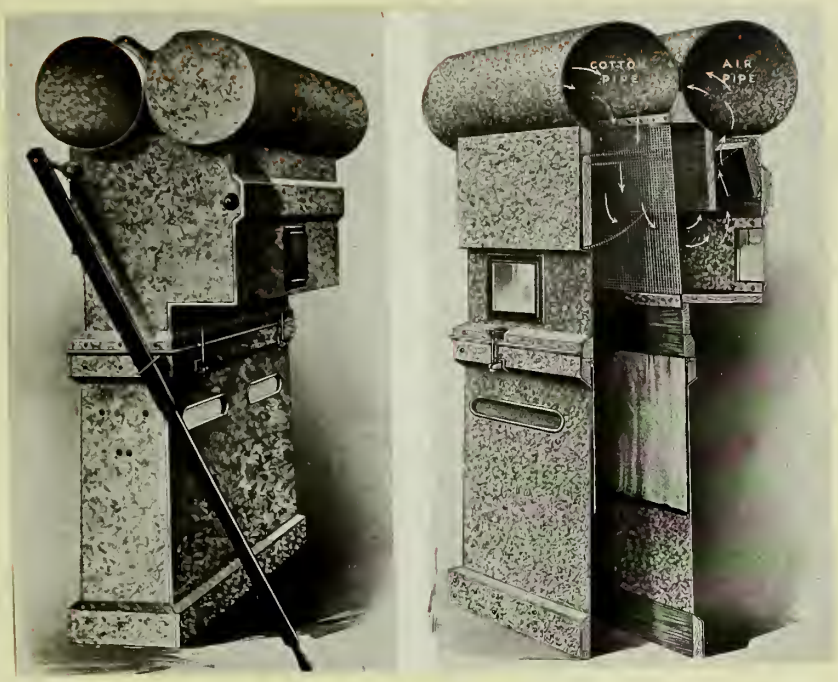


Figure 19 - Cotton Receiver.

The upper part of the receiver consists of a double pipe; the front one opening down into the feeder is termed the cotton pipe and the rear one opening into a compartment behind the chute is called the air pipe. The chute is separated from the compartment by a heavy wire screen. Inside of each chute near the middle a canvas valve is attached, the flaps of which hang down when not in use. To operate the elevator the suction fan is started and the pipe A (Figure 18) placed down on the seed cotton. The suction through the top of the gin causes the canvas valves to close, a vacuum is created and the cotton is raised and forced against the wire screen where it would remain if some means were not provided to break the suction. Between

the receiver and the fan there is located an automatic cut off valve C (Figure 18) which is driven by a belt from the line shaft. This valve is simply a box in which one side is opened and closed at regular intervals admitting air, and thereby cutting off the suction. The cotton is dislodged and drops down into the feeder and the reversal of pressure at the screen keeps it clear of lint. The dust in the cotton passes through the screen and out through the fan, this process partially cleaning the cotton. As soon as the chute is full of cotton, the canvas valve does not operate as the cotton itself takes its place. The chute is provided with a valve operated by a lever which enables the ginner to cut out any gin when it is so desired.

Cleaning Feeder.- In order to better prepare poorly picked cotton for ginning and to supply it evenly to the gin, a cleaning feeder is used which is similar to Figure 20. As

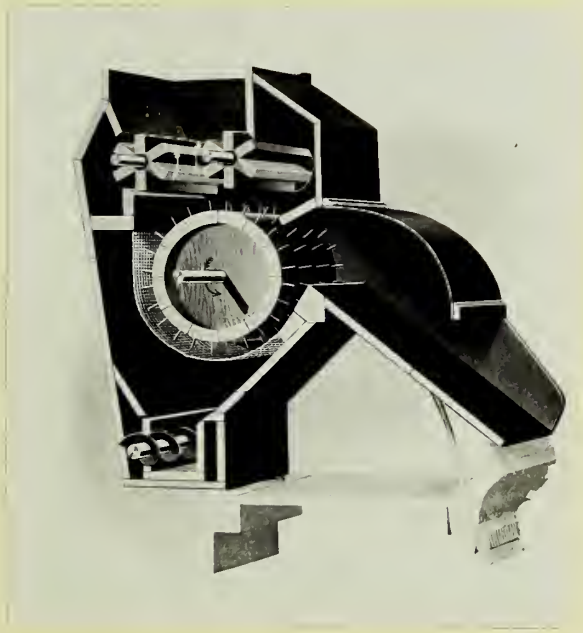


Figure 20- Section of a Cleaning Feeder.

the seed cotton drops from the pneumatic cotton chute it falls directly upon two rollers which are either fluted or spiked and revolve very slowly in opposite directions. These rollers hold the cotton and break up the wads; the rapidly revolving picker just below the rollers beats the cotton many times before removing it and finally whips it against a screen which allows the dirt and sand to pass through into the small conveyor below, while the cotton is deposited in the front of the gin in the same manner as with the apron feeder. This type of feeder must be used with a pneumatic elevator system such as shown in Figures 18 and 22, but is also suitable for any other type of elevator which may be used. The driving mechanism can be adjusted to the speed required for any cotton and the feeder can be stopped instantly if necessary.

The Single Box Press.- After the cotton has passed through the horizontal condenser and fallen to the floor, the bat is carried by hand to a single box press B (Figure 18). It will be noted that the location of the press has been changed from out of doors to a position near the other machinery. When the condenser was adopted the lint room was no longer needed and at first the press was moved into it and all machinery driven by the same power.

About 1870, steam presses were introduced which increased the density from about six or seven pounds as obtained with the old press to twelve pounds per cubic foot. The modern press is usually hydraulic or of a screw type and very substantially constructed. Figure 21 shows an up-packing single

box press. The horizontal dimensions of the box are 27 inches wide by 54 inches long, which are the nominal dimensions of a standard cotton bale. The box is filled with cotton through the open hopper door which is hinged at the lower end to the sides of the Press. The door is closed as soon as the hopper

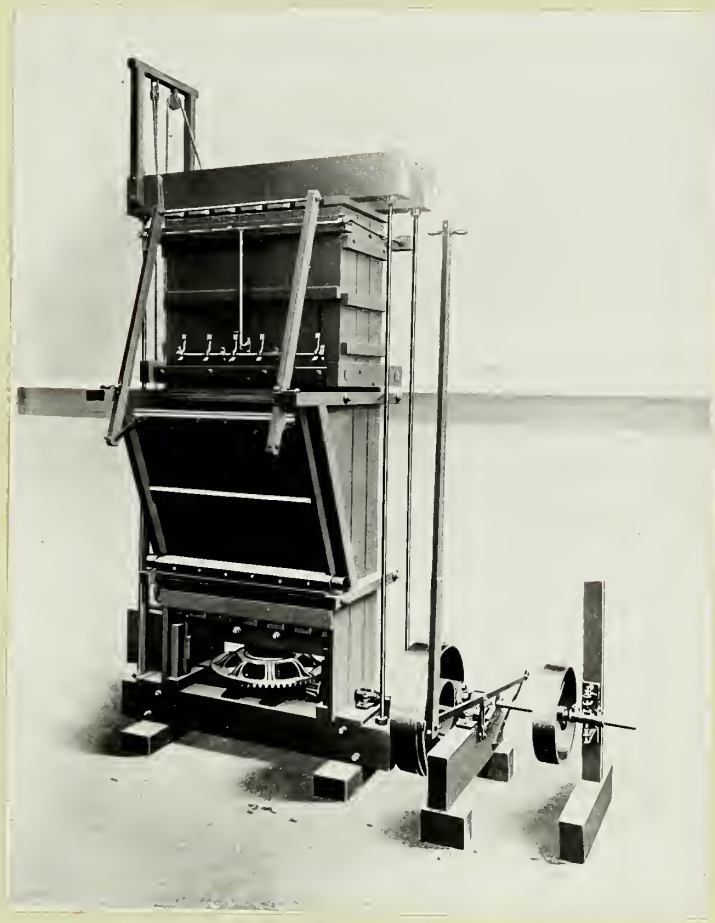


Figure 21 - Single Box Self-Packing Press.

is filled and the follower inside run up by means of the screw until the retainer dogs at the lower end of the box take hold of the cotton, thus keeping it up in the box while the follower is run down for another charge. The operation is repeated until the proper sized bale is secured. The operation of re-

moving the bale will be discussed more fully in connection with the double box press.

The Pneumatic System Outfit.- Mr. R. S. Munger developed the pneumatic elevator and was the first to adopt the plan of having one condenser for a battery of two or more gins to which the cotton was blown through a system lint flue. From the condenser the cotton was fed directly into the press, and thus a method was established which not only saved labor, but increased the capacity of the machinery.

Figure 22 shows a two-story system ginnery complete. The whole plant is driven from the line shaft below and in this way all machines are kept at the same relative speed. The pneumatic elevator is similar to that used in the plantation outfit and the cotton is ginned in the same manner. The battery condenser B receives the cotton from all of the gins and delivers it to the double box press which is just to the left of the condenser. A closer view of a similar plant is shown in Figure 23. The cotton leaves the gins through short flues A shown in Figure 24 and is blown by the blast from the brush directly to the condenser, the air and dust passing out through the ventilators. At B there is a connection for a steam pipe controlled by a quick opening valve. In case the cotton becomes clogged in the saws and takes fire, the ginner can readily extinguish it by flooding the system with steam, an arrangement which affords great protection from that kind of accident.

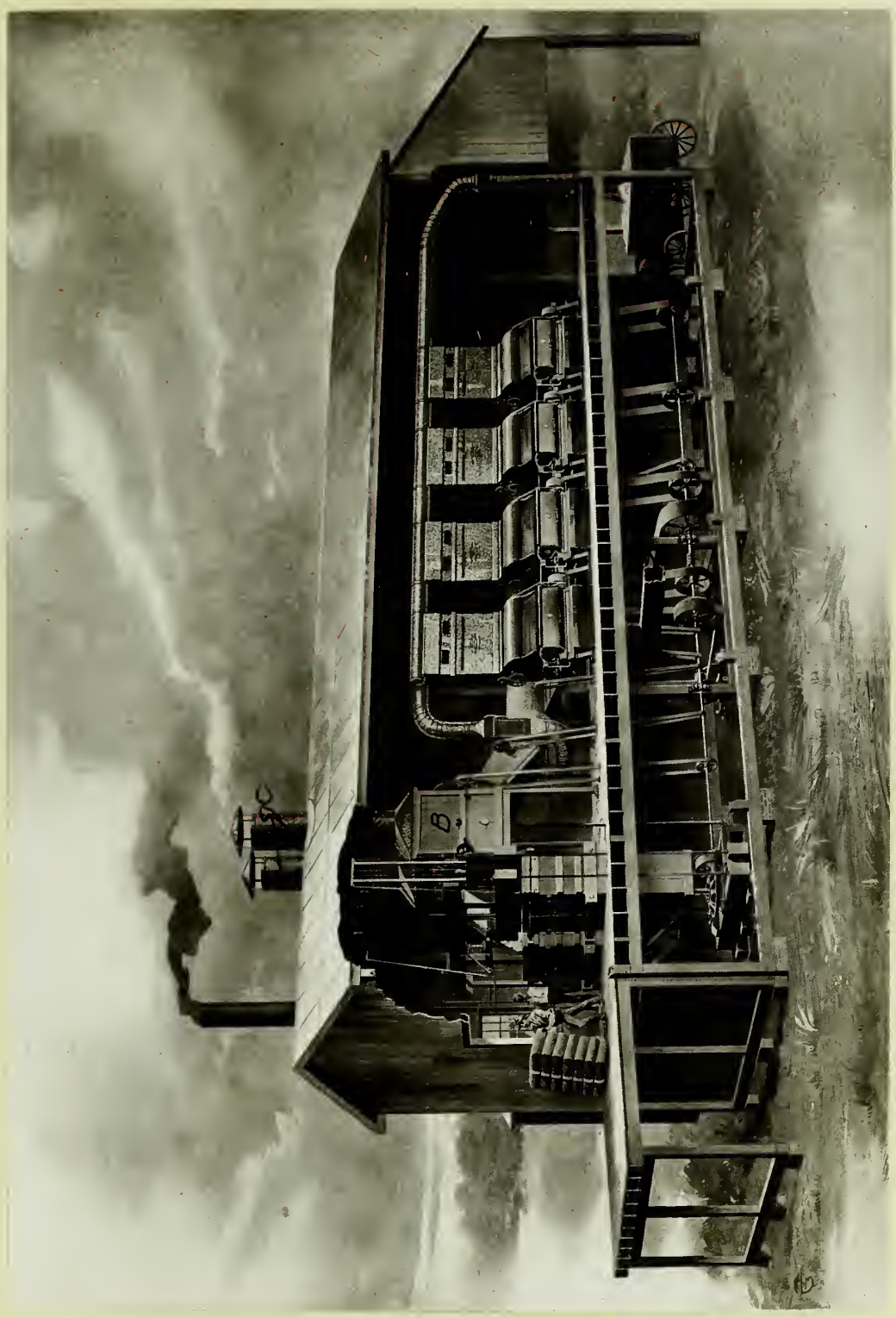


Figure 22 - Two-Story Pneumatic System Ginnery.

Figure 23 - Pneumatic Elevator over Battery of Four Gins.

Figure 24 - Lint Flue for Four Gins.

The Battery Condenser and Lint Slide.- The essential features of a battery condenser are shown in Figure 25. The

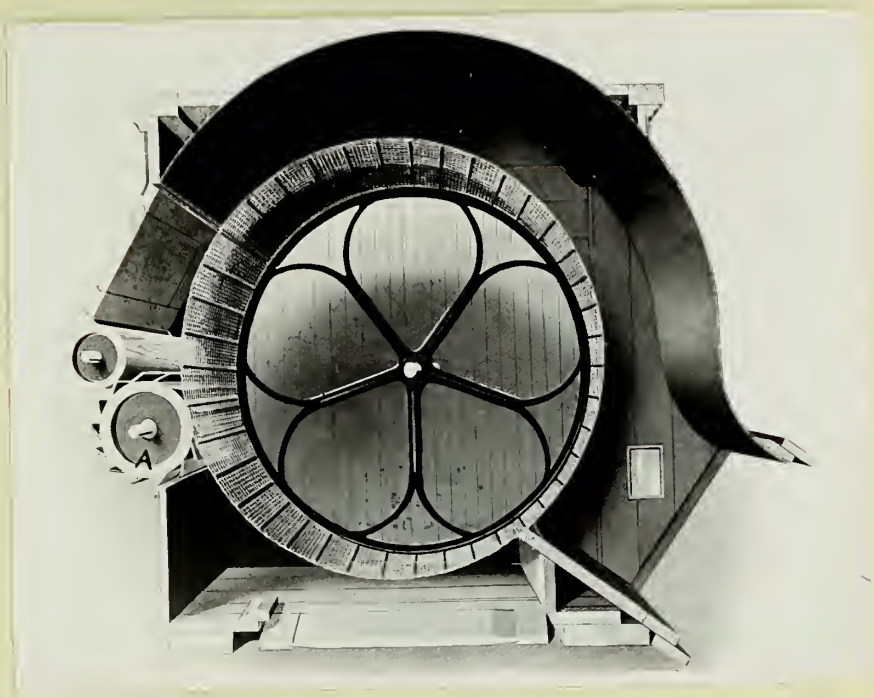


Figure 25 - Sectional View of a Battery Condenser

cotton is blown against the large revolving screen, the dust and air escaping at the ends and passing upward through ventilators; the lint collects on the drum in the form of a bat and is removed by two doffer rollers. One of these A has rubber flaps which wipe the lint clean from the drum.

A lint slide shown in Figure 26 conducts the cotton to the press; the small roller A prevents the cotton from being carried back by the doffing roller when allowed to accumulate while changing the bale.

Figure 26 - Lint Slide.

The Double Box Press.- From the lint slide the cotton passes to the left side of the double box press shown in Figure 27. The first double box press was introduced before the days of system ginneries by the Gullett Gin Company. Later Mr. R.S. Munger adapted it for use with his system outfits. It had been customary for two men to tramp the cotton into the box while it was filling, hence the device which Munger designed to replace the men is called a "tramper." The simplest tramper to install is one operated by steam as shown at A. The cylinder is usually 10 or 12 inches in diameter and the piston may be either driven up and down by steam, or, as shown in the figure, the down stroke only uses steam and the return is made by means of a counterweight. The steam piping is not shown, but is a simple installation using a quick opening three-way valve.

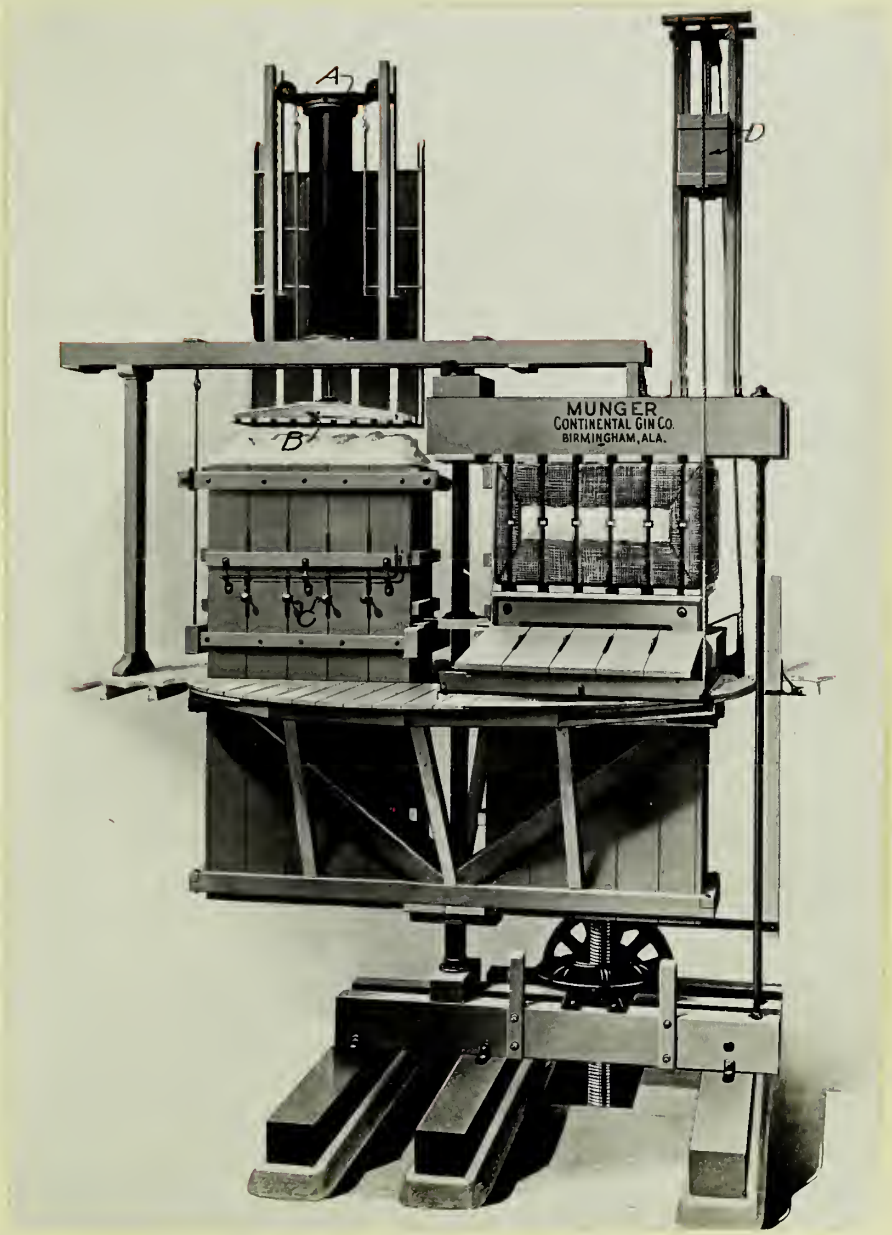


Figure 27 - Revolving Double Box Press

In operation a strip of heavy gunny bag is placed in the bottom, and when the box is filled the loose cotton is pressed down by the tramper. The platten B pushes the cotton down past the swinging retaining dogs C which are so spaced as to readily pass through openings in the platten. The cotton is retained in the bottom of the box and the process is repeated until a sufficient quantity has been tramped in to make a bale. A small gate is then lowered at the mouth of the lint slide and the press quickly turned through 180 degrees without stopping the machinery, and the filling of the empty box begun.

The press illustrated has a 5 inch double threaded steel screw driven from the line shaft by means of a friction pulley. A strip of bagging is placed on top of the cotton underneath the upper platten, and the follower run up against the bale until it is the required size. The press is then stopped and the upper doors released. To keep the doors from flying out with too dangerous a velocity from the pressure of the cotton, they are retarded by a heavy counterweight D. The bagging is then fitted around the bale and six flat iron ties are put on, being slipped between the timbers of the plattens. Some form of anchor is used to quickly fasten the ends of ties and to hold them securely when the cotton expands. The screw is then lowered and the bale is rolled out on the platform where it is weighed.

There are many hydraulic presses in use which operate in the same manner. The tramper is frequently driven by compressed air where steam is not available. Figure 28 shows a

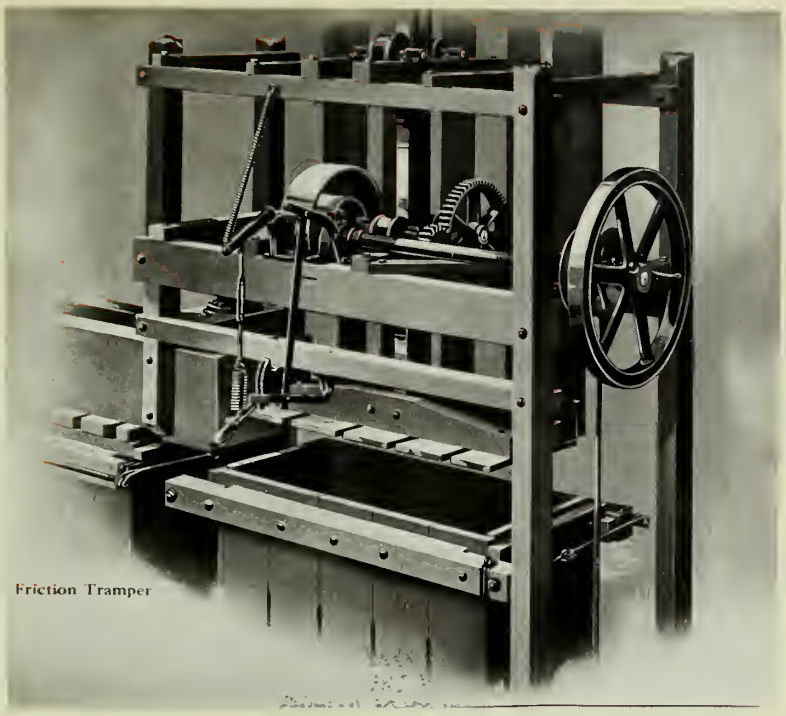


Figure 28 - Friction Tramper

friction tramper which is used where neither steam nor compressed air can be had in the plant.

The Belt Distributor System Ginnery.- Another type of installation which distributes the cotton to the feeders by means of a belt conveyor is shown in Figure 29. This outfit requires a smaller fan and somewhat less power to drive it than the all pneumatic system and also has the facilities for cleaning and drying the cotton before ginning. A suction fan is connected to the rear of the cotton cleaner C. When the pipe D is closed by means of the valve and cords the cotton will be drawn in through A from the wagon or cotton house into the upper part of the cleaner which is shown in Figure 30. The

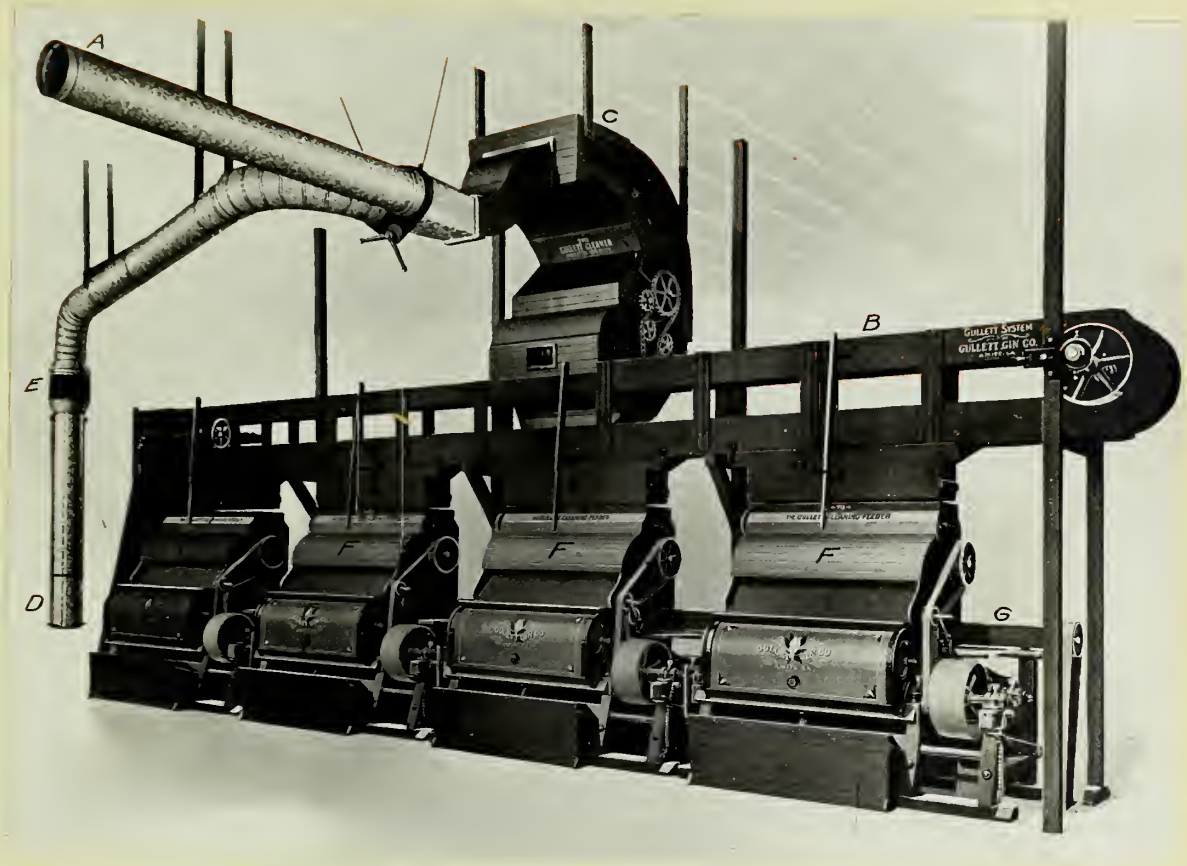


Figure 29 - Belt Distributor with Cleaning Separator

separator part is located in the top and consists of a perforated sheet steel screen curved as shown. The air space behind is connected to the suction fan by means of an opening at the back through which the dust is drawn. The cotton falls down between the wings of the revolving vacuum feeder A, which delivers it to the spiked breaker rollers B without disturbing the suction of the fan. These rollers revolve toward each other and in turn feed the cotton down to a large cylinder C, which has spikes mounted in staggered formation to catch the cotton and whip it against a screen of large mesh, cleaning it

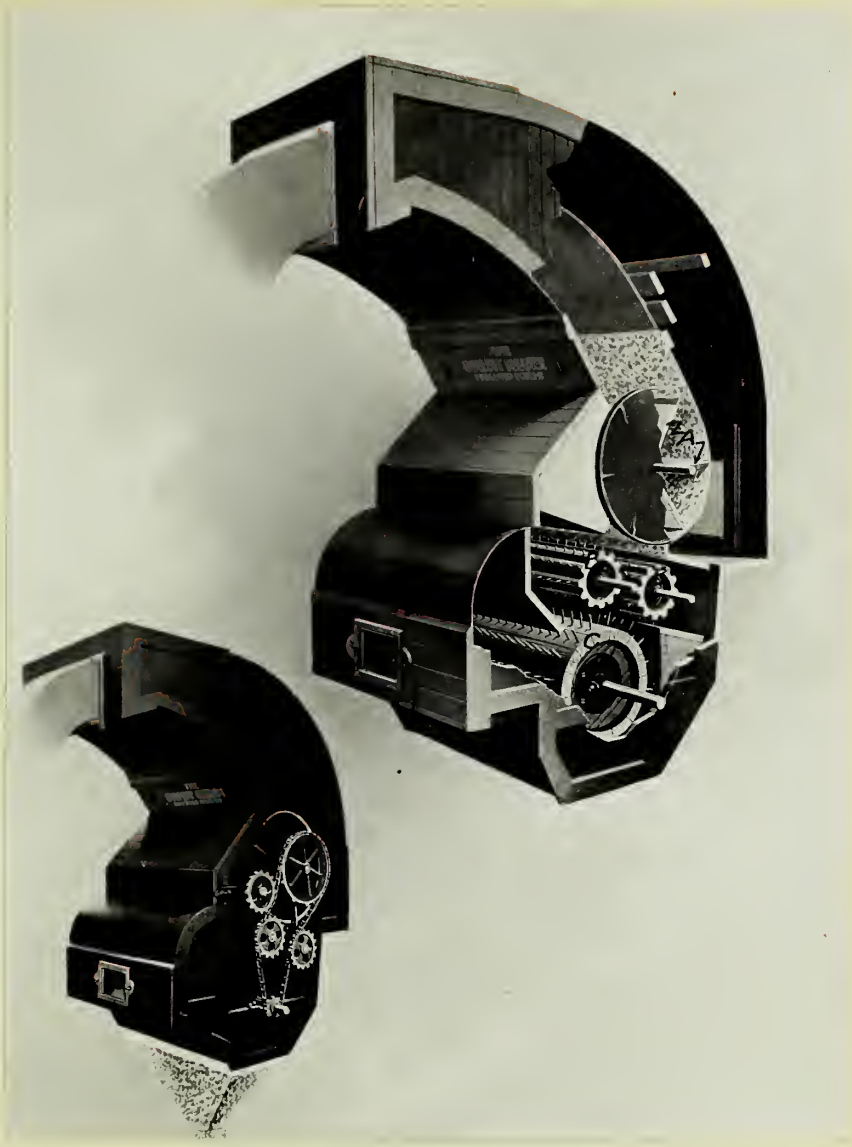


Figure 30 - Separator and Cleaner

of sand, which drops into the iron hopper below. As the cotton leaves the cleaner it is deposited in the belt distributor B (Figure 29), which has a wide canvas belt carrying long spikes. The cotton is conveyed towards the right from the cleaner and around to the bottom, and drops into the first feeder F; then later into the next and so on until the last gin is in operation.

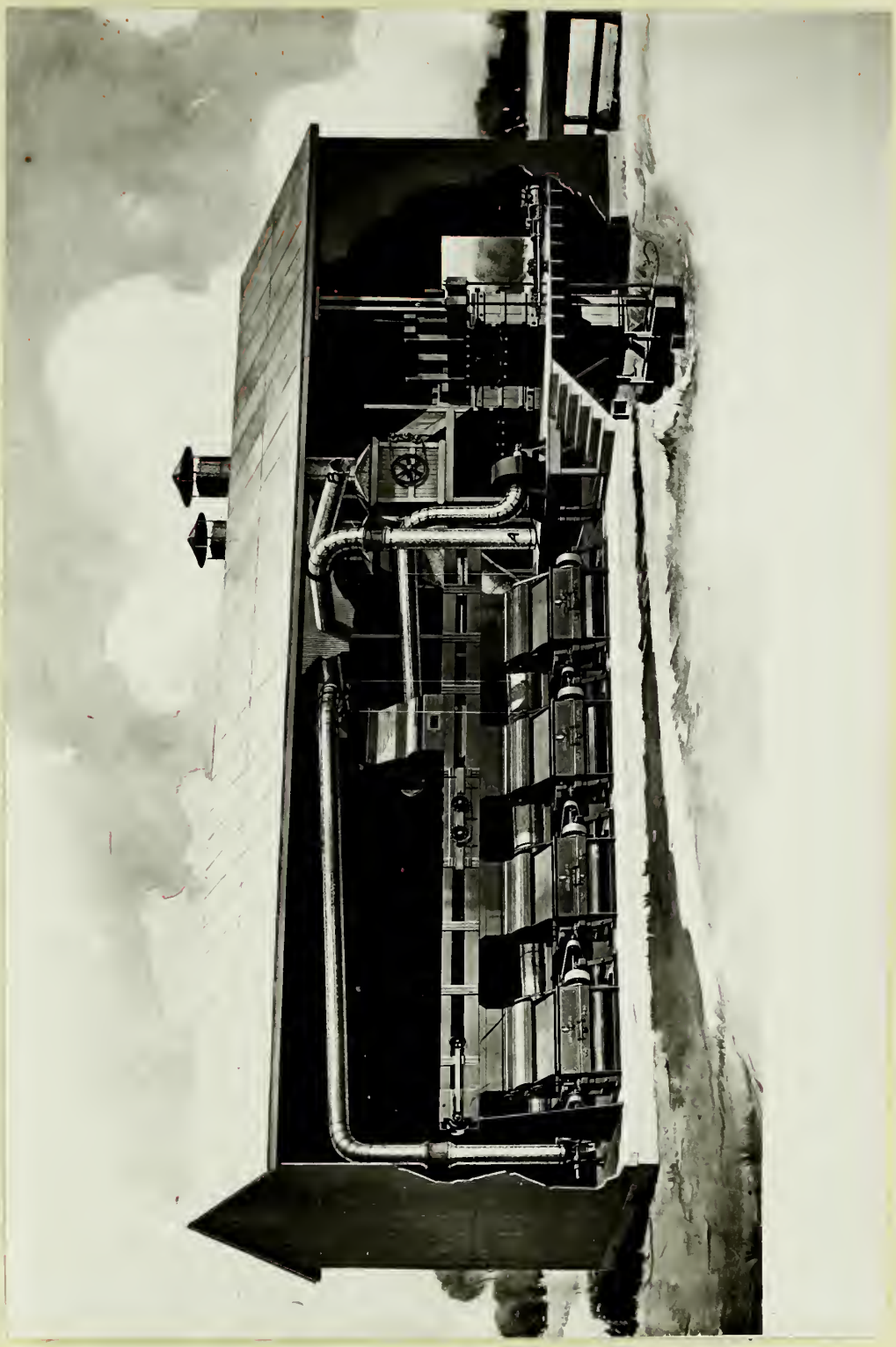


Figure 31 - One Story System Ginnery.

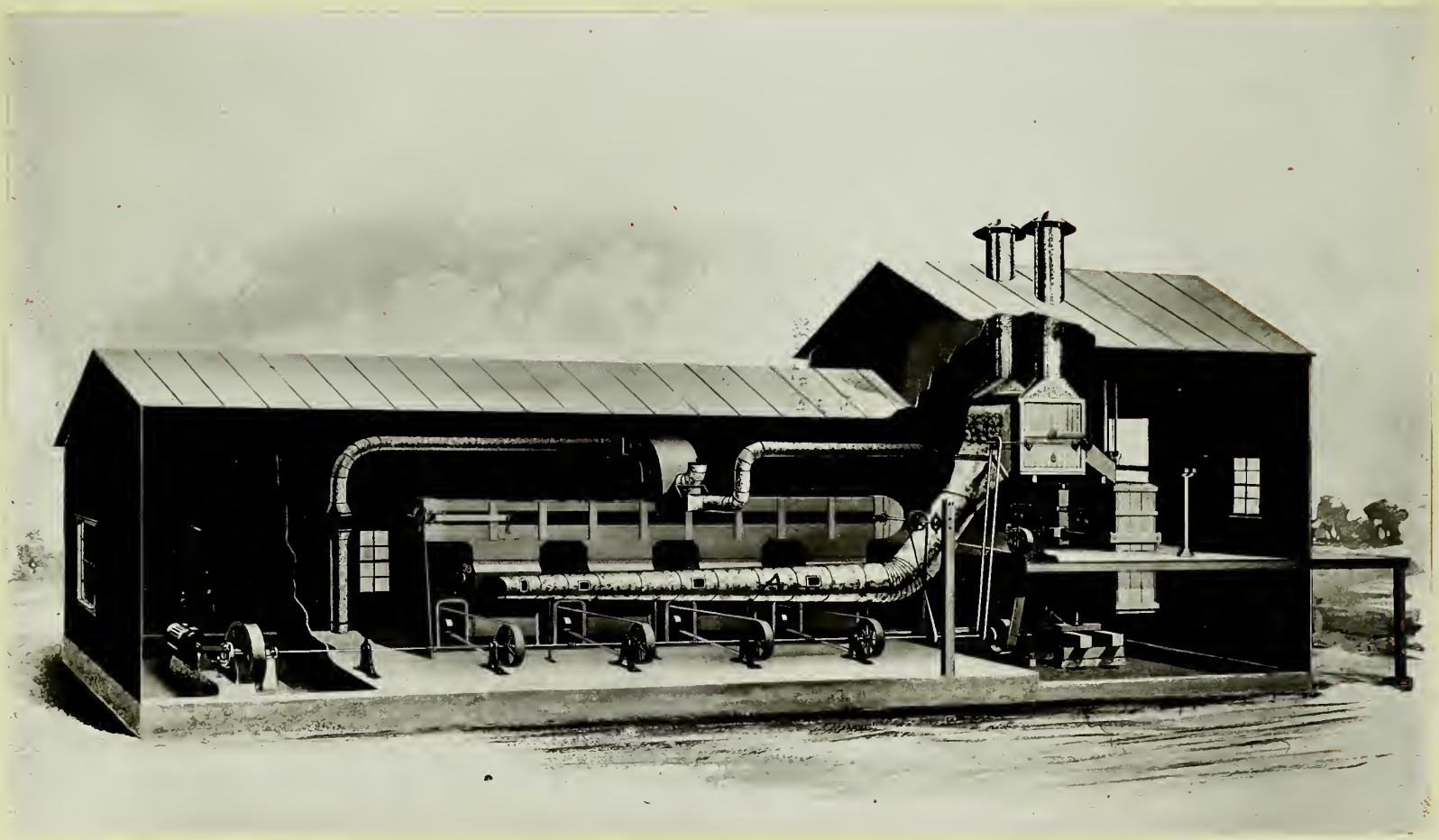


Figure 32 - Rear View of One Story System Ginnery

The distributor is open at the left end so that in case the feeders are all full any surplus cotton may be deposited on the floor. This is later picked up through D by properly adjusting the valve in the pipe and is passed again through the cleaner. The pipe is telescopic and the leather connection E permits the operator to move the pipe over the floor and draw cotton from a considerable area. By closing the valves to the gins cotton may be circulated through the cleaner as many times as desired and thoroughly dried and cleaned before ginning.

One Story System Ginneries.- When animal power was first used the gin was placed upstairs and there it remained for many decades. Figure 31 shows a one-story outfit which occupies a lower building than the two-story type. A concrete floor can be used and the ginner has the advantage of having most of his machinery on the first floor. Any type of elevator and distributor may be used, the one shown in the illustration being a belt distributor system with a hydraulic press. Figure 32 gives a rear view of a one-story installation showing the lint flue A and the observation glasses which are located at intervals along its length.

Air Blast System Ginneries.- Since there are no brushes to be driven in the air blast gin, there need be no separate belts to the gins if they are not desired. All of the gins in a battery are connected by universal couplings and driven by one belt or direct from a motor. An extra fan is necessary to furnish the blast for removing the lint from the saws in

addition to the regular elevator fan.

Arrangement of Large Ginneries. - Ginning plants as a rule do not have a very pretentious appearance from the outside. The fire risk is classed by the insurance companies as "Extra Hazardous" and very few business men have to pay as much as ginners for fire insurance. The roof and sides of the buildings are frequently made of sheet metal, and since there is no necessity for protecting the ginner against the cold, the buildings are constructed as cheaply as possible.

Figure 33 shows a typical modern ginnery which is located in Texas. The wagons are driven under the shed where the elevator telescope is located and from then on the ginning plant

Figure 33 - Ginning Plant in Texas.

does the rest. It is possible to build system ginning plants of almost any size. Some ginneries are in operation containing four batteries of four 70-saw gins each, and plants having ten 80-saw gins are to be found in many large cotton growing centers. Such plants are arranged in parallel batteries similar to those previously described, and gain economy in the first cost and in operation by reason of requiring fewer auxiliaries than would be necessary for separate plants.

Cotton Storage and Elevators.- Store houses are necessary for damp cotton if it is to be handled in large quantities, and they also enable the ginner to sort the cotton and thereby secure a more uniform grade in each bale. The octagon cotton house illustrated in Figure 34 is a type which is very largely

Continental Class "C" Storage Elevator

Figure 34 - Octagon Cotton House with Storage Elevator

used. The interior is divided into eight compartments or stalls. The unloader is located in the top of the house and attached to a fan, which is usually in the gin house. The cotton is taken from the wagon by the elevator and deposited in the proper stall by means of the chute. The cotton may be transferred from one stall to another or circulated to dry it by connecting the telescopic pipe B to the wagon suction pipe and also by connecting the telescopic pipe C to one of the cotton stalls. The cotton is conveyed to the gin house by placing C on the suction pipe from the gin house whence it will be drawn by the same fan which is used to elevate the cotton from the wagons at the gin house, and will be fed to the gins in the same manner.

Another type of unloader is shown in Figure 35 which takes

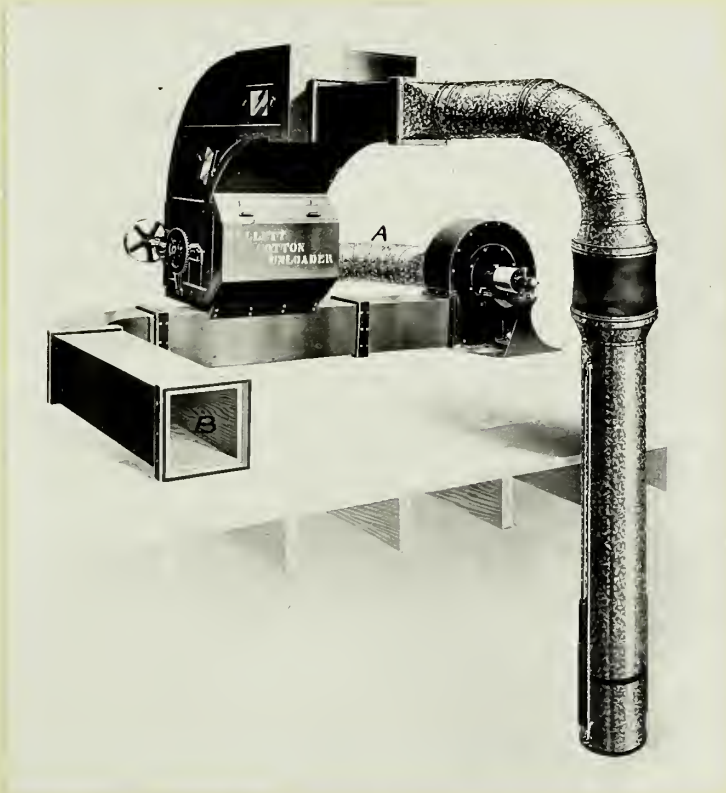


Figure 35 - Cotton Unloader.

the cotton from the wagon at the gin house and delivers it into the cotton house. This unloader is located in the gin house and is operated by a suction fan, which is connected at the back through the pipe A. The operation is similar to that of the upper part of the cleaner and separator shown in Figure 30. The cotton on being drawn up into the separator is fed into the pipe by a vacuum feeder whence it is blown to the store house by the blast from the fan.

Handling and Storing Cotton Seed.- Ordinary seed cotton when ginned will "third itself", that is one-third of the weight will be in the bale and two-thirds will be left as seed. Thus for every 100 bales of cotton ginned 50 tons of seed must be disposed of. At one time this was a very difficult problem, the seed being either burned or buried as it was too rich for stock feed and killed the animals which ate it. With the growth of the cotton seed oil industries it has become an important item and is taken care of very carefully. The ginning plant is equipped with devices to deliver the seed into a freight car, store house, or into seed bins whence it is dropped back into the farmer's wagon.

Both pneumatic and screw conveyors are used for these purposes. In the pneumatic system the exhaust pipe from the same fan which elevates the cotton to the gins passes beneath a screw conveyor which collects the seed from beneath the gins. This conveyor discharges into a vacuum seed feeder which operates in a manner similar to the vacuum cotton feeder, (Figure 30),

and delivers the seed into the blast pipe without loss of air, whence it is conveyed wherever desired. Frequently bucket elevators and screw conveyors are employed to distribute the seed as this method usually consumes less power than the pneumatic systems.

The Linter.- When the seed leaves the gin it is covered with short lint which must be removed before the seed is used in the oil making process. This is done at the oil mills and a product which is called "linters" is obtained. This is not considered part of the annual cotton crop although the output is over eight hundred thousand bales annually.

A modern linter is shown in Figure 36 which is similar

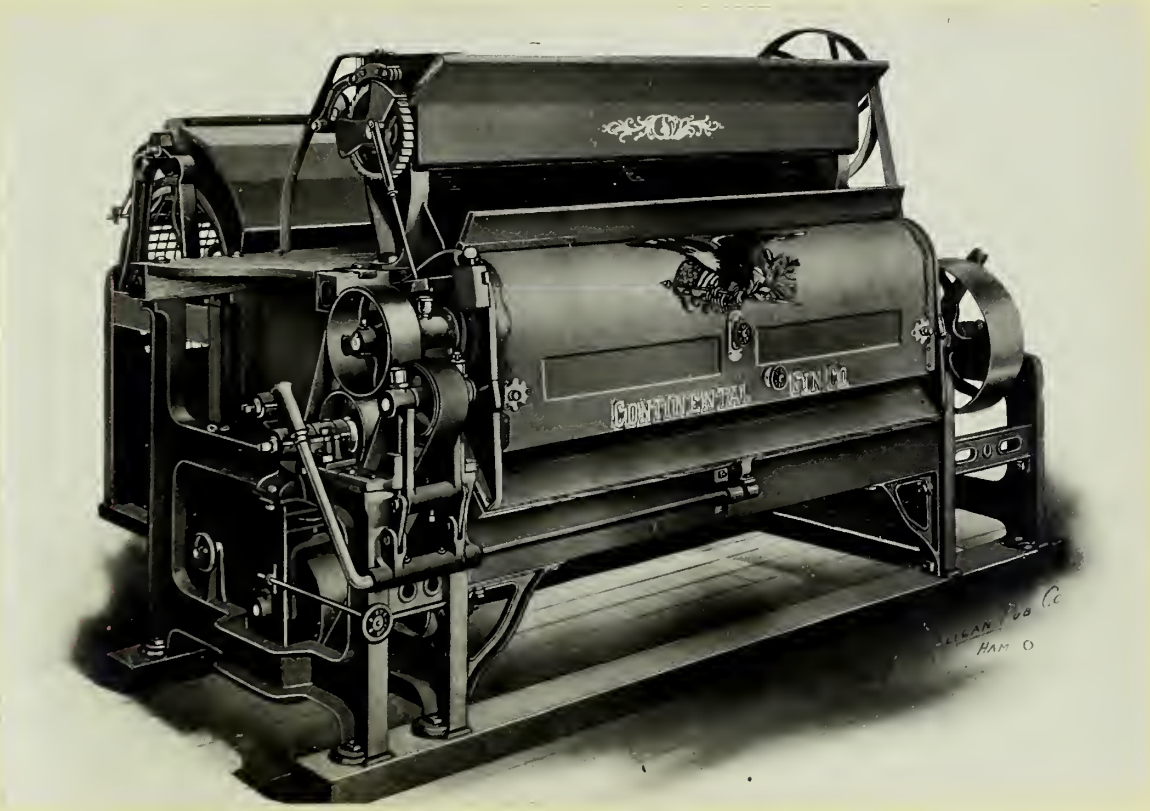


Figure 36 - Cotton Seed Linter

to a common gin with the exception that the saws are much closer together, there being 106 in this machine. The seed is fed into the roll box in the same manner that seed cotton is handled and the fine lint passes through a short flue to a condenser as in a small plantation outfit.

Picking Cotton.- A typical cotton field is shown in Figure 37, the cotton hanging out of the bolls ready to be picked. At the close of each season there is more or less cotton damaged by frosts, especially in the more northern cotton states. This cotton was formerly considered worthless and no attempt made to utilize it, but the modern cleaners and huller gins have enabled the farmers to save much of this part of their crop, especially in Oklahoma and Texas. There is a growing tendency among the

Figure 37 - Picking Cotton in Georgia

farmers to "gather" cotton rather than "pick" it and to expect the ginner to have machinery which will produce a clean sample. Because of the difficulty of getting cotton picked late in the season many growers "snap" the opened and partially opened bolls with the unopened bolls and send all through the same machinery. Several devices are on the market for preparing the seed cotton for the gins, one type of which shown in Figure 38 is used in place of a cleaning feeder. The staple which is obtained by these methods is inferior to clean picked cotton and is usually classed as "bollies." The saving in labor, and in cotton which would be lost more than overbalances the loss due to the lower price obtained for the mixed grade.

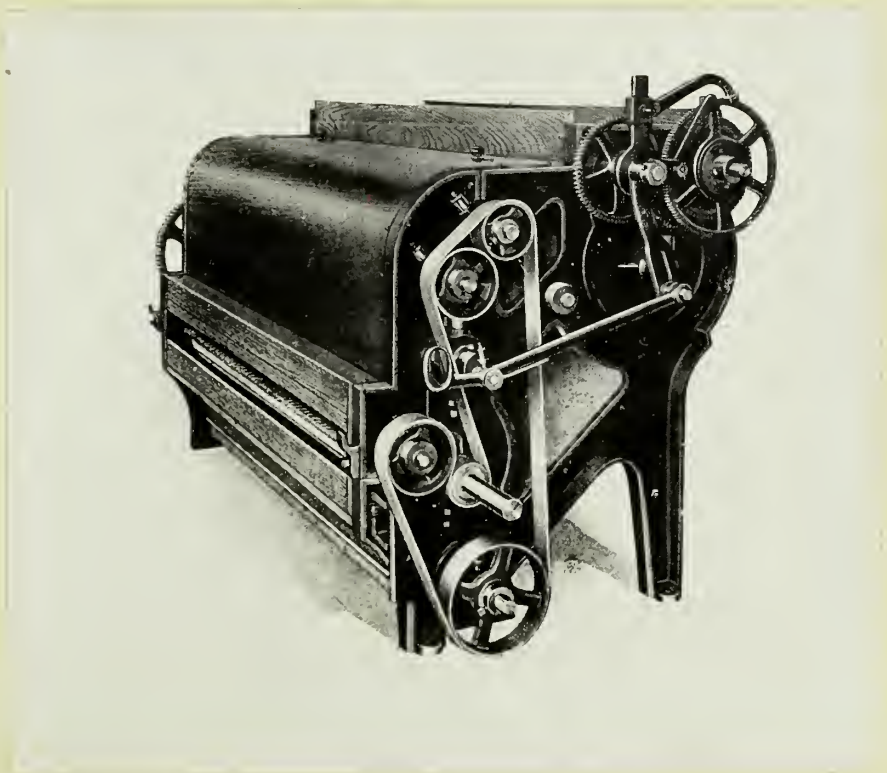


Figure 38 - Boll Extractor.

Compressing.- The density or weight of cotton per cubic foot depends upon the weight put into the press box, the care used in tramping, and the height to which the screw or hydraulic ram is run in pressing. The standard bale is nominally 27 inches by 54 inches, that is the inside dimensions of the press box are 27 inches wide and 54 inches long. The thickness of the bale will depend upon the weight and the method of pressing, but in most cases the bales weigh approximately 500 pounds and are about square at the ends. The greater the density the less shipping and storage room will be required. The density asked by the Maritime Associations and Cotton Exchanges is 22½ pounds per cubic foot, and to obtain this it is necessary to give the bale a second pressing or what is termed "compressing". The bales are placed in a huge press similar to Figure 39 which has a capacity of 2000 tons. These presses are usually operated by steam or hydraulic power and are located at the important shipping centers. A compress must handle at least 40,000 bales per annum to pay expenses, and the operators acquire considerable dexterity in handling the cotton. There is a record that a compress at Charlotte, N. C., handled 936 bales in five hours, each bale being tied with seven bands and the heads well sewed. Table I gives the results of a test made on a bale which was somewhat above the standard weight. It was first pressed in a standard 5 inch screw press. With a hydraulic press the bale would probably have been somewhat thinner before compressing.

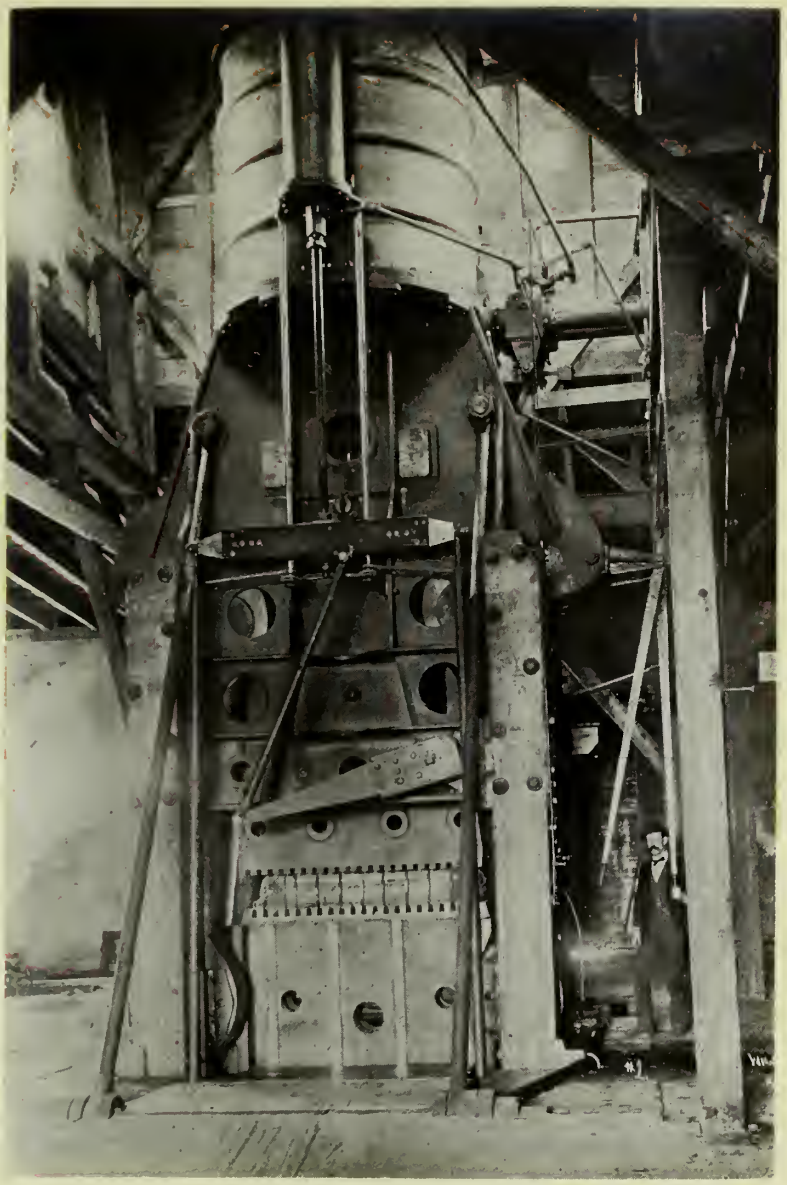


Figure 39 - High Density Compress

Table I - Comparison of Gin Pressed and Compressed Bales

	Before Compressing	After Compressing
Weight Lbs.	612	612
Length Inches	55	57
Width Inches	28	30
Thickness Inches	38	22
Cubic Feet	33.1	18.1
Density Lbs. Per Cubic Ft.	21.9	28.2

In compressing it is necessary to first press the bale considerably thinner than it will ultimately be in order to allow for the sinking of the ties into the bale when the pressure is released. It will be noted that the length and width of the bale increased about two inches and the thickness was reduced from 38 to 22 inches. The density was raised from 21.9 to 28.2 pounds per cubic foot, which is somewhat above the requirements for ocean shipping.

Storing and Handling Cotton at the Compresses.- It requires an enormous amount of storage and warehouse space to accommodate the cotton at the compresses. Figure 40 shows a compress plant and yard which illustrates the method of storing the bales in the open. If every bale of cotton which is produced in the United States during one year were placed side by side in a single line it would require a shipping platform

Figure 40 - Cotton Compress at Alexandria, La.

7120 miles long to hold the crop.

The State of Louisiana through the Board of Commissioners of the Port of New Orleans has erected a system of warehouses and terminals which have a capacity of two million bales with an ultimate capacity of twice that amount when the plans are completed. The terminal buildings cover approximately 50 acres and including the trackage adjacent to the plant the total area covered is about 100 acres. All buildings are of reinforced concrete and are divided into compartments for storing cotton. So perfect is the method of fire prevention that

insurance companies have agreed to a rate on cotton stored in these warehouses of 20 cents per $100.00, while a large portion of the cotton produced in the South now has to pay as high as $2.50 to $3.00 for each $100.00 of value.

There are several miles of overhead and ground level runways for use of motor cars and trailers for conveying the cotton from one compartment to another. There are specially designed bridge cranes which support automatic grapplers by which bales can be picked up and carried to the compress or piled. The cotton is stored in tiers ten or fifteen bales high and by means of an ingenious design of puller any particular bale may be removed without moving any others in the pile. It is thus possible to pass cotton through these warehouses and compress and place it on shipboard entirely by mechanical means.

The Ginner's Compress.- A type of press which is designed to produce a high density bale at the ginning plant is shown in Figure 41. It is known as the Ginner's Compress and is very similar to the standard double box revolving press with the exception that all parts are made very much heavier. It is operated by a hydraulic pump and a density of 28 to 35 pounds per cubic foot is secured which is greater than that obtained with the large compresses such as shown in Figure 39. The compress is operated in the same manner as a standard double box revolving press. The bales are bound with 8 or 10 ties and they look much neater than the ordinary bale.

Although this method of compressing at the ginning plant is very desirable in some ways, there are many conditions re-

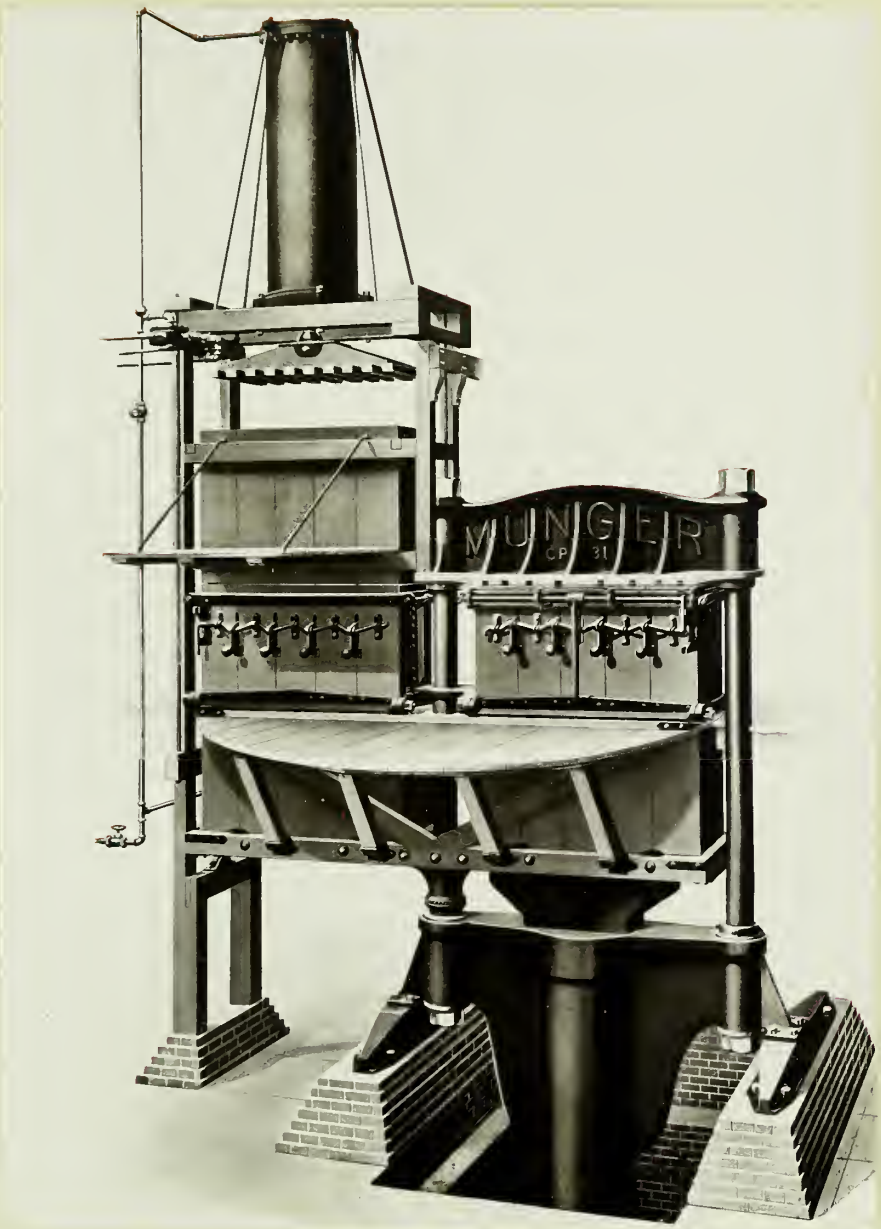


Figure 41 - Ginner's Compress

garding the purchase and shipment of cotton which render this operation impracticable at present, and few ginners have as yet cared to make the large additional investment necessary to secure a compress.

The Round Bale Press.- About twenty years ago Mr. John R. Fordyce brought out a machine for pressing round bales. This was improved and at that time and for several years afterwards it was predicted that this type of press would be the one ultimately used. Figure 42 shows the press as made in 1901. A

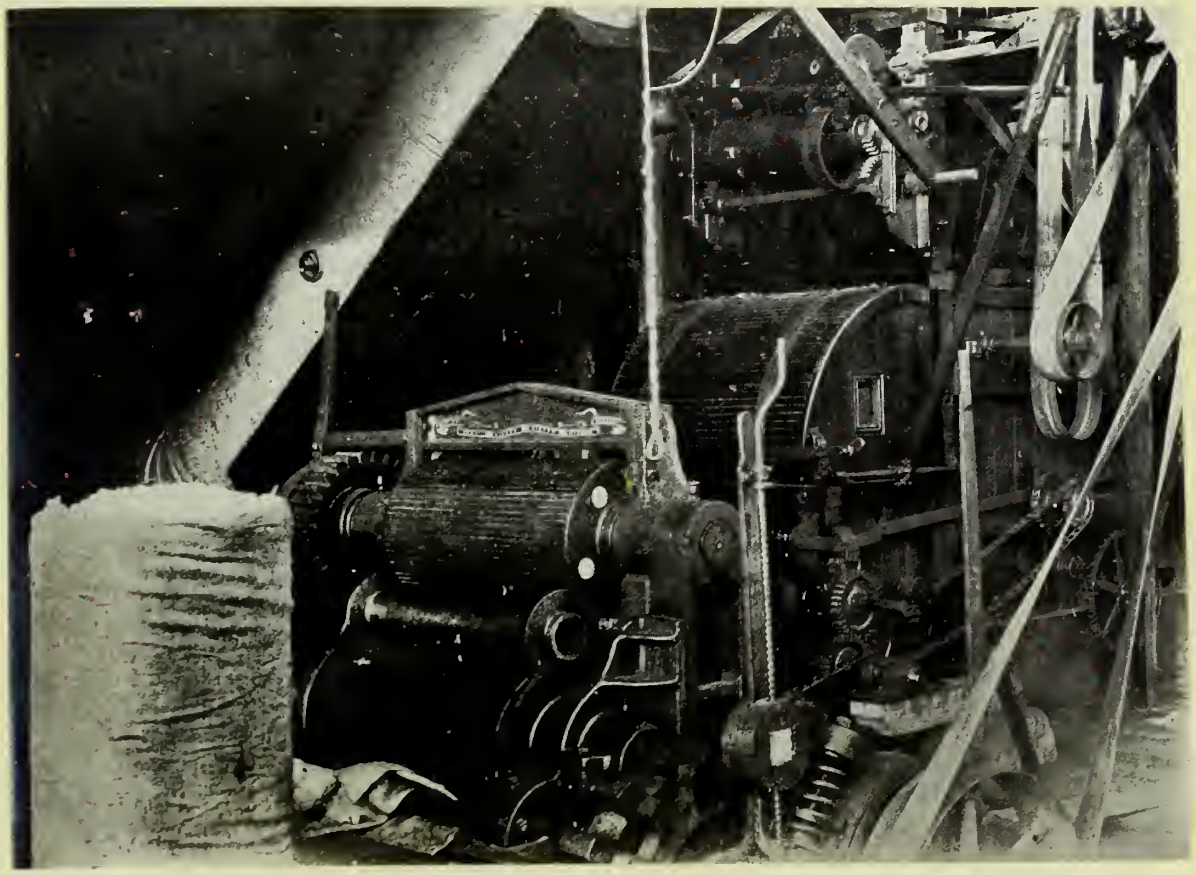


Figure 42 - Press for Round Bale

detailed description by the inventor will be found in Volume XXII of the Transactions of the American Society of Mechanical Engineers. The cotton is passed between three fluted rollers the single roller being at the top. The bat is fed from the condenser and winds around a core which consists of two cone shaped pieces with flanges at the large ends by which the core is removed when the bale is finished. There is no tendency for the bale to expand and no bands are needed. The bale is covered with a light burlap or cotton duck and sewed at the ends. The density of round bales is higher than any other, being from 35 to 40 pounds per cubic foot. The system from a mechanical standpoint is a success, but there are many other drawbacks and, although in 1902 the output was nearly a million bales, it has steadily decreased to 57,618 in 1914, and no doubt the round bale will soon be a thing of the past. The round bales did not pack together well on shipboard, also special machinery was required at the mills to open the bale. Buyers of cotton do not accept samples taken out by the ginner and as yet there are no reliable automatic sampling devices which would secure samples of all grades of cotton going into a bale. Hence the buyer cuts the bagging of the square bale and takes samples by means of a special tool from both sides, ends, and as nearly from the middle as possible. The round bale being made up of layers rolled very tight the methods of sampling which are used at present are impossible.

Kinds of Power Used to Drive Ginning Machinery.- Bulletin 131, Bureau of the Census gives the data shown in

Table II relative to the kind of power which is used to drive ginning plants. There are six different sources of power in use at present and these will be discussed in the order of their earlier importance.

Steam.- It will be observed that there has been a considerable falling off in the number of establishments using steam, but as yet there is no serious rival to this kind of power. The steam engine has proved very reliable and 86.2 per cent of all the plants are driven by it. The ginner hesitates to adopt any new kind of power plant in a business which is operated only a few months during the year especially if the new plant might refuse to run just when his busy season is on. Steam trampers are the cheapest type to install, and this fact together with the value of steam as a means of fire protection, since it can be turned into the lint flue, are items which the ginner must consider when selecting his power plant.

Water and Animal Power.- The use of water power has fallen off about 41.4 per cent during the period covered by the table and the number of plants using animal power dropped from 481 to 40.

Gasoline and Electric Power.- The number of ginneries using gasoline power has more than quadrupled, but considering the rapidity with which the gasoline engine has invaded other fields the progress here shown is slow. The number of plants using electric power has increased from 50 to 342 and is very widely distributed. Most of these installations average from three to four gins per establishment, some of them being large

Table II - Ginneries Classified According to Kind of Power Used.

Ginneries				Gins			Saws		
Power	1906	1909	1914	1906	1909	1914	1906	1909	1914
Steam	25,692	23,766	21,045	51,173	53,653	55,309	3,403,845	3,484,701	3,807,334
Water	1825	1544	1069	2194	1954	1455	126,040	115,704	88,433
Animal	481	199	40	482	199	41	22,810	9505	1970
Gasoline	438	806	1922	552	1113	2978	34,005	70,805	194,404
Electric	50	116	342	152	420	1398	10,700	29,120	101,415

outfits, of 8 gins having 80 saws each and requiring 200 H.P. to operate. The motor driven gin is satisfactory from an operation stand point as it can be started and stopped in custom ginning without great loss. There is an electric tramper now on the market, but as yet it can not compete with other types. Wherever electric power can be obtained at a reasonable cost it is destined to be largely used, but as yet the average cost is considerably above that for steam.

The Tendency Toward Larger Plants.- It will also be seen from Table II that although the number of active ginneries has decreased 4,068 or 14.3 per cent., the number of gins has increased 6,628 or 12 per cent. and the number of saws by 596,156 or 16.6 per cent. During this period the number of saws per ginnery has increased from 126 to 172 or 36.5 per cent. It will be observed also that animal power can not compete with mechanical, and the one gin plants which formerly were operated by animals are rapidly disappearing. This shows the tendency to eliminate the small and poorly equipped plants and to consolidate the business into larger centralized ginneries.

Amount of Power Required to Drive a Ginnery.- It is difficult to give any exact figures for the amount of power required to drive a ginning plant as there are so many different auxiliaries in use. A plant using a pneumatic elevator system requires more power than one using a belt distributor; and one using a cotton unloader must have in addition about 25 H.P. if the whole plant is to be operated at the same time. A study of the data secured by the Texas Power and Light Co.

for thirty-two modern ginning plants which are driven by electric motors shows that an installed horse-power of 3558 is required for ginning plants aggregating 11,650 saws or approximately .315 H.P. for each saw. This includes the power for driving all auxiliaries such as tramper, press, and unloader. The plants are operated about 4 months with an average consumption of 19 kilowatt-hours for each 525 pound bale at a net cost of 65 cents per bale.

Capacity of the Saw Gin.- The amount of cotton which can be ginned per hour under perfect ginning operation is given by the United States Census Bureau as 6 pounds of lint per saw. This is often increased to 8 pounds by speeding up the saws, but the high speed is usually detrimental to the staple.

VI

THE ROLLER GIN.

Early Use of the Roller Gin.- As has been previously stated, the gins in use before Whitney's invention were of the roller type and not suitable for cleaning Upland cotton. As the saw gin came into general use and the cultivation of Upland cotton increased, the use of the roller gin became confined to the Sea Island cotton.

In 1840 a patent was secured by a man named Macarthy on an improved roller gin which contains the basic principles of the modern roller gins. The roller was 4 inches in diameter and 3 feet long, dressed with leather arranged around it in spirals. The roller revolved in loose contact with a plate of sheet iron. The seeds were drawn up against this plate by the tendency of the cotton to adhere to the rough leather, while a rapidly reciprocating blade would strike them in such a manner as to detach them from the fiber.

The Modern Single Roller Macarthy Gin.- A modern single roller gin which is imported from England is shown in Figure 43. This type of gin is not made in the United States as the field seems to be too limited to interest American manufacturers. This gin operates in a manner similar to the one previously described. The roller is covered with leather, usually walrus hide, arranged in spiral grooves. This gin is intended for long staple cotton such as Sea Island. After the cotton has been thoroughly dried in the sun it is then passed

thrcugh a "whipper" which cleans it of dust and sand. It is then examined by two men who remove stained cotton and leaves as they place it in the hopper. The machine runs at 800 R.P.M. and requires about 2½ horse-power to operate it. As the lint leaves the gin it is again examined by two men who pick out cracked seeds and motes.

The cotton is then packed in Dundee bagging, making round bales or bags. No press is used as it is feared that it would injure the fiber. The cotton is usually pounded in with a pestle as in the old days. At one large gin house the bag is suspended from an iron hoop and a disc of two-inch plank which fits into the bag is moved up and down in a manner similar to a steam tramper.

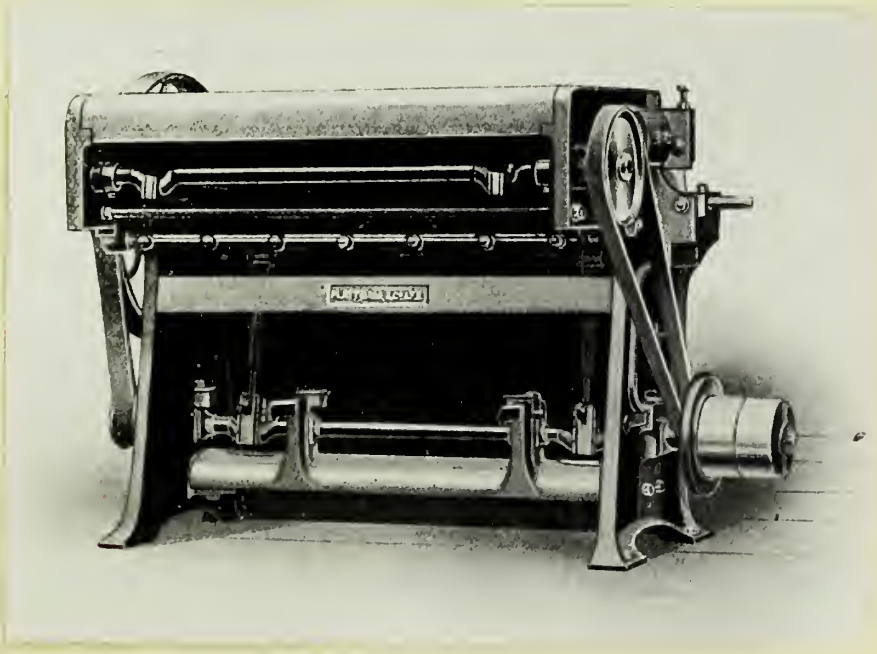


Figure 43 - Single Roller Macarthy Gin

The Double Roller Macarthy Gin.- An improved type of gin is shown in Figure 44 which has two rollers and is known

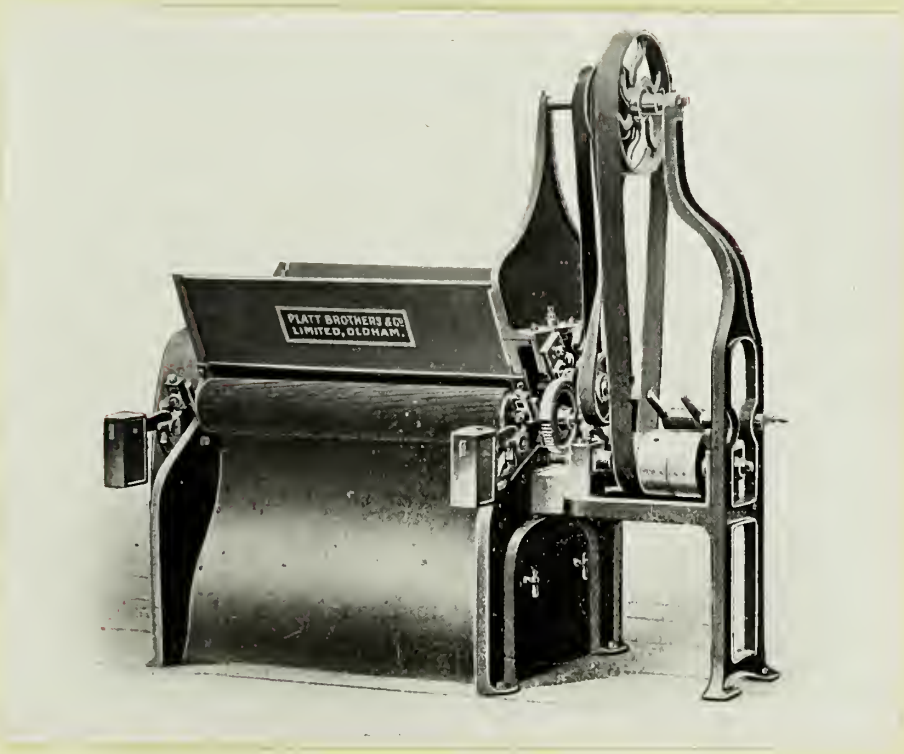


Figure 44 - Double Roller Macarthy Gin.

on the Sea Islands as the "double Macarthy." It may be used to gin Upland cotton and has a capacity of about 40 pounds of lint per hour. It is used in the United States, however, almost exclusively for ginning the fine long stapled Sea Island cotton. This gin required 3 horse-power and has a capacity of 60 to 80 pounds of cleaned Sea Island lint per hour when operated at 600 revolutions per minute.

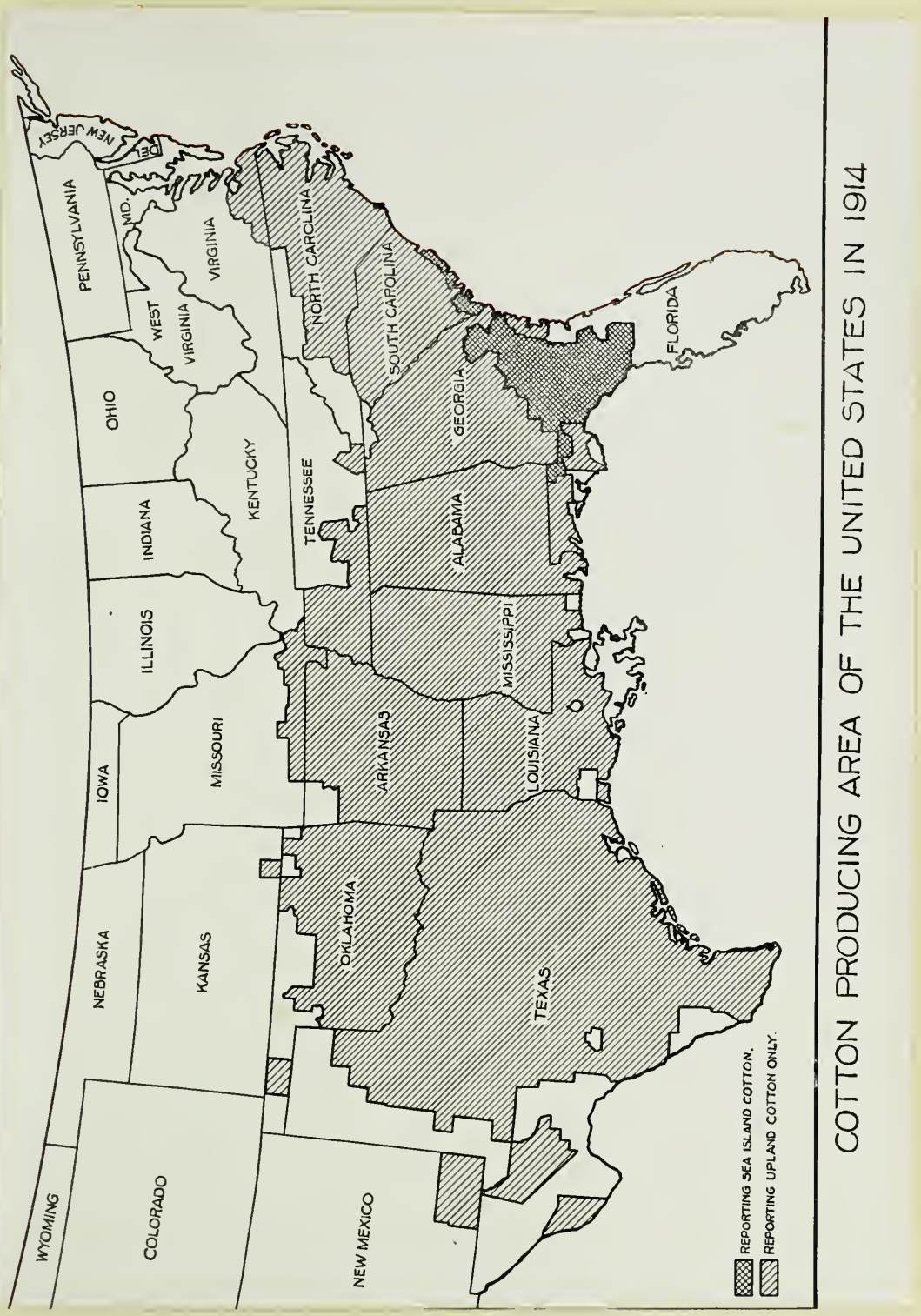
Comparative Importance of the Roller Gin.- Although the quantity of cotton which is ginned by this process is only

one-half of one per cent of the total crop produced in this country, the roller gin is of great importance in the industry because the Sea Island cotton for which this type of gin is employed is used for thread making and other purposes to which the Upland cotton is unsuited.

VII

THE ECONOMIC EFFECTS OF THE DEVELOPMENT OF THE COTTON GIN.

The Nation's Debt to Whitney.- A comprehensive picture of the beneficent effects of the introduction of Whitney's gin upon the industrial condition of the people of the United States was given in the decision of Judge Johnson of the Federal Court which was quoted in a preceding chapter, on the occasion of his settling further controversy between Eli Whitney and the rival claimants of his invention. The words of the judge are substantially true today: The development of a speedy method of separating the Upland cotton from the seed has indeed "presented a lucrative employment" to thousands from "childhood to age", from the humble negro who "scrapes" the cotton free from grass to the millionaire mill owner; it made possible the rapid development of Alabama, Mississippi, Louisiana, Florida, and Texas whose "inhabitants were emigrating for want of some object to engage their attention and employ their industries"; it has given to the world an abundant source of inexpensive clothing which has brought comfort and cleanliness within the reach of all; great manufacturing cities have sprung up; fleets of merchant ships and miles of railroads are needed to convey our cotton to distant parts of the earth; and as a crowning gift the saw gin has opened to the world a wonderful storehouse of Nature, the long despised cotton seed, from which are extracted such widely varied products as salad and cooking oil, oleomargarine, dye stuffs, fertilizer, stock feed, paper stock, varnishes,

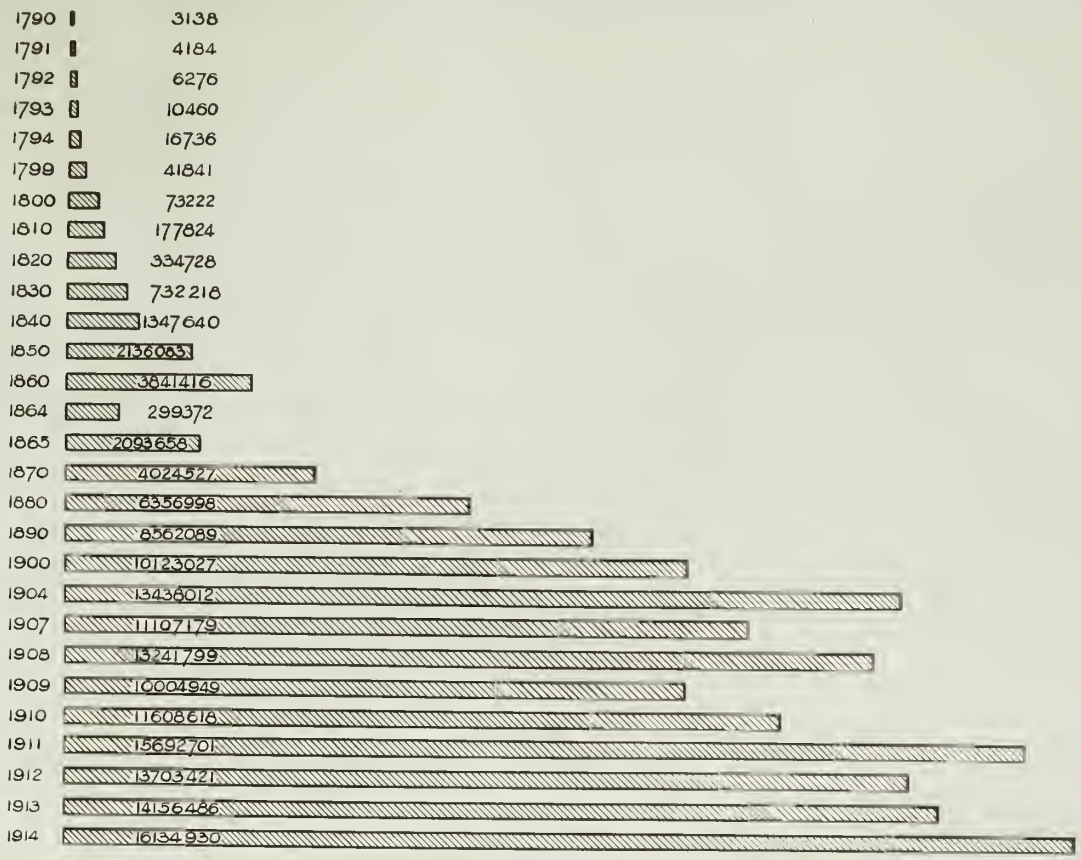


COTTON PRODUCING AREA OF THE UNITED STATES IN 1914

artificial silk, photographic films.

A by-product of the cotton seed industry is the "linters" which is used in the manufacture of batting, felt, mattresses, twine, lamp wicks, gun cotton and similar explosives.

The Cotton States.- The cotton producing area of the United States is shown on page 73. It will be observed that the area where Sea Island cotton is grown lies along the eastern coast and is confined to parts of three states. This area is considerably larger than that which was cultivated at the time of the invention of the saw gin but the production is less than one-half of one per cent of the total Upland cotton, averaging below 100,000 bales annually. Without some more rapid means of separating the seed from the lint than the roller gin the amount of cotton produced in this country would have been limited almost to that amount. A modern saw gin will do the work of ten roller gins on Upland cotton and thus the cultivation of Upland cotton was made a profitable industry and has spread over vast areas of the South. The production of cotton from 1790 to 1914 is shown on page 75. From 1799 to 1800 during which time large numbers of saw gins were made in open disregard of Whitney's patent rights, there was a large increase in the quantity of cotton produced. The effect of the introduction of labor saving machinery after the close of the Civil War can be observed in the increase in production from 1870 to the present day culminating in the record breaking crop of 16,134,930 bales in 1914.



PRODUCTION OF COTTON IN THE UNITED STATES 1790~1914
(IN 500 POUND BALES)

The relative importance of the cotton crop of the United States is shown graphically in Figure 45. Of the total production of commercial cotton grown in 1914, the United States contributed 62.3 per cent, her nearest competitor being India with 15.4 per cent.

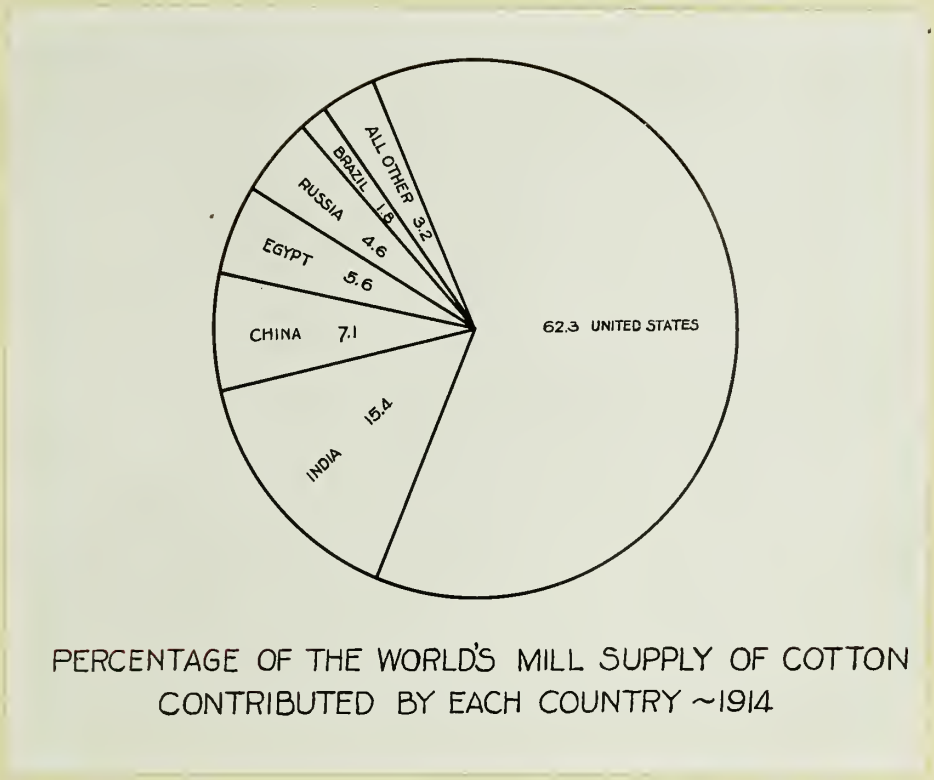


Figure 45

Value of Cotton in the United States.- Some idea of the number of dollars represented by a year's yield of cotton may be gained from the following figures taken from the Year Book of the United States Department of Agriculture for the year ending June 30, 1914 :

Total Value of Cotton Exported - - -	$610,475,301
All other Agricultural Products - -	609,476,889

This means that the value of baled cotton exported exceeded by about a million dollars the value of all other agricultural products, both animal and vegetable, including forest exports. In addition there were 5,884,733 bales consumed in domestic manufacture, of which over 51 per cent was used in the mills of the cotton growing states. For the same year the total value of the crude cotton seed products was $156,036,437, including the value of the linters which amounted to $7,711,752. Under normal conditions the total value of raw cotton products amounts to about a billion dollars, being $1,043,760,000 for the year ending June 30, 1914.