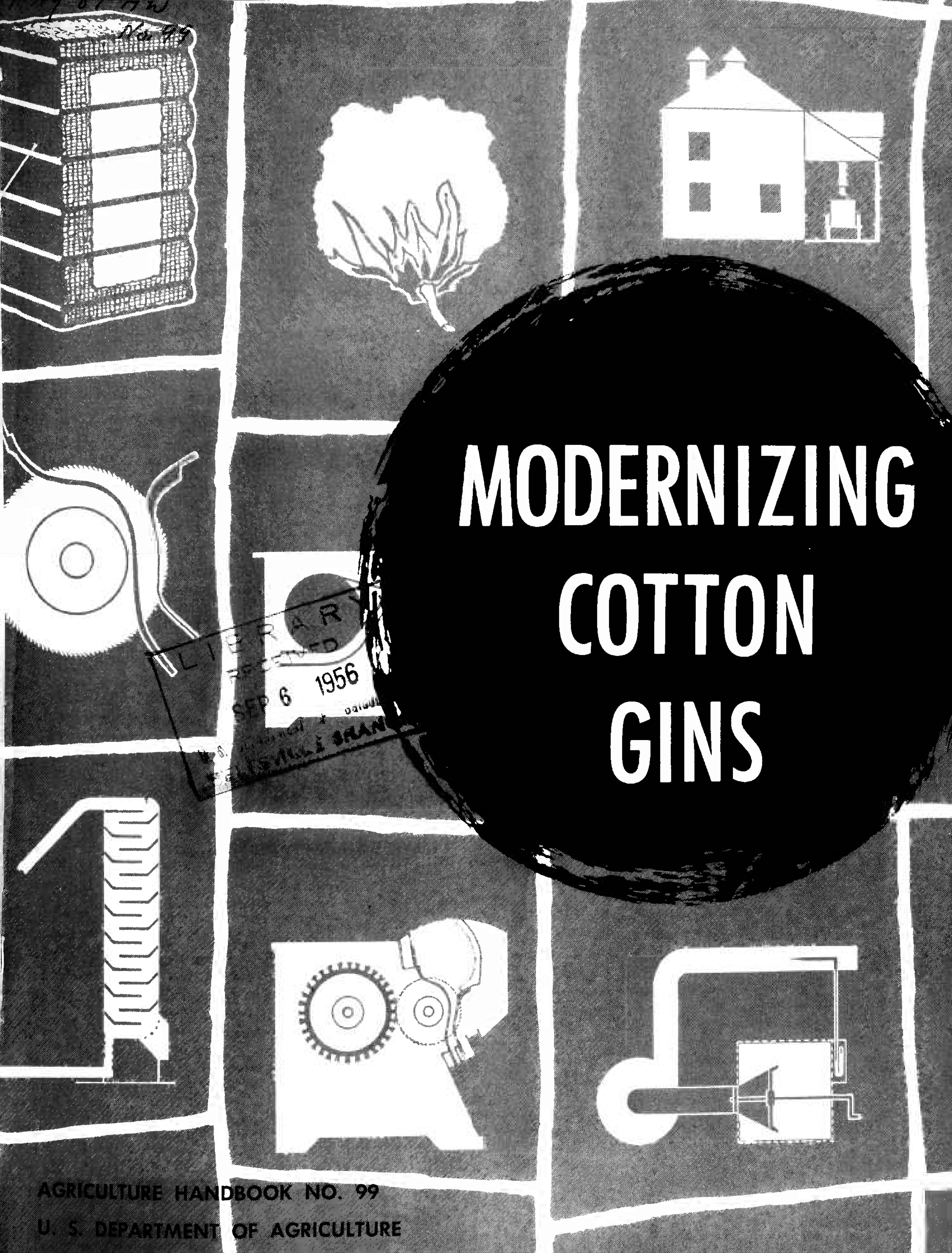

MODERNIZING COTTON GINS

AGRICULTURE HANDBOOK NO. 99

U. S. DEPARTMENT OF AGRICULTURE

Improved cotton ginning practices and better ginning establishments preserve the inherent qualities of the cotton fiber, aid in keeping planting seed pure, and tend to increase profit. Most ginners would modernize their establishments in whole or in part if they were assured that they were taking the right steps and that they were following the recommendations of State and Federal agencies working toward these improvements.

In the case of existing cotton ginning establishments it is frequently a question whether to remodel or to rebuild completely. This question can best be answered by asking other questions.

Is the present equipment still serviceable and in good condition? If so, is it adequate for the present requirements of conditioning, cleaning, and extracting both hand-picked and machine-harvested cottons?

Will the cost of modernization of either equipment or buildings be less by remodeling than by entire replacement? Which will attain the main objectives with regard to both public and private interest?

Is the present or proposed establishment economical in operating the equipment for cotton handling, ginning, and disposal of products?

Does the present or proposed establishment comply with latest safety practices and public codes on dust and smoke elimination, on insect quarantine requirements, fire insurance underwriters' limitations, and on preservation of purity of planting seed?

This Handbook is intended to help ginners and cotton producers to answer these questions and to plan according to the needs of their own individual circumstances and those of their communities.

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Washington, D. C. Issued August 1956

MODERNIZING COTTON GINS[1]

By *Agricultural Engineering Research Branch, Agricultural Research Service*

EVALUATION OF EXISTING GINS

Consideration should be given to the location of the gin, because conditions have so changed since 1940 that some gins are now in unsatisfactory locations. Accessibility to roads and transportation facilities and the proximity to competitors may have changed so much since the original establishment of the ginning plant as to affect materially the present value of the plant.

A simple sketch of the property showing the relative positions of the several buildings and accompanied by marginal notes describing the territory served, the average number of bales of cotton ginned over a representative period, the increase or decrease in cotton acreage in the community, and other influencing factors will be of assistance in making a complete evaluation.

The inspection of the buildings on the property should be made only by a person experienced in building. Definite information should be obtained regarding the condition of each building, the feasibility of remodeling, and the adequacy of the plant for use under present conditions. From this information a builder can readily provide estimates covering the cost of additions, alterations, and repairs. If a new all-steel, 24-foot plate-height ginning building of ample width is to replace a wooden building, a preliminary estimate of $6.25 per square foot of floor area may be used. This estimate is based on 1954–55 materials and labor costs.

Cost of equipment and machinery may be most satisfactorily obtained directly from the manufacturers, because they can advise regarding items entering into the purchase, shipment, labor, and erection.

[1] Many of the improvements in ginning equipment reported in this Handbook were developed by staff members of the Cotton Ginning Research Laboratories, which are located at Stoneville, Miss.; Mesilla Park, N. Mex.; and Clemson, S. C. This Handbook is a revision of and supersedes Farmers' Bulletin 1802, "Modernizing Cotton Gins," by C. A. Bennett, T. L. Baggette, and F. L. Gerdes.

ELEMENTS OF MODERN GINS

A modern cotton gin plant is fire resistant, conveniently arranged inside and outside, and properly lighted and ventilated, either artificially or naturally. It has cleaning or extracting equipment suited to the production and harvesting practices of the community, and the gin stands are equipped with lint cleaners for further cleaning of the cotton. Provision is made for artificially drying green, damp, or wet cotton. The saw shafts of the gin stands are preferably directly connected for driving, and there is a minimum of shafting and belting. Bearings are of the antifriction type rather than of the babbitted design. Cotton piping and fans are of a size that contributes to economy in power consumption, and the rate of feeding the seed cotton to the ginning system is automatically controlled with selective regulation devices, for bulk suction as well as individual gin stands.

Seed is handled from the gin stands by pure-seed, self-cleaning belts and pneumatic systems. The belts may discharge to mechanical lifts or through sealed dropper wheels into small-pipe seed-blow lines, which in turn deliver the seed to scales or bins.[2]

Power-transmitting equipment for auxiliaries now consists of high-speed countershafts; antifriction bearings; high-speed silent V-belts, chains, and roller chains; and gear reducers. These devices have generally replaced the old-style line shafts with babbitted bearings, flat-belt or rope drives, gears, and countershafts. Seed scales are becoming standard equipment for accurately weighing seed purchased from the farmer. A modern gin also has a convenient weatherproof elevated hopper to hold the seed temporarily until it is delivered to trucks.

Means for disposing of foreign matter from the

[2] Bennett, C. A., and Franks, G. N. cottonseed handling with small air pipes. U. S. Dept. Agr. Cir. 768, 8 pp., illus. 1948.

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plant are desirable. Several forms are described in the section, Handling Seed and Trash, page 13.

Modern gins in certain regions also have adequate facilities for storage of bales where they will be protected against weather and fire. Shelter sheds protect incoming loads of cotton against rain. Seed-cotton storage houses or special large trailers are used in some areas to provide for holding seed cotton in storage for transferring it from storage to the gin.

Arrangement of Buildings and Grounds

Among the factors to consider in deciding on the best arrangement of the ginning buildings are the shape and size of the lot, the location of entrances and exits with respect to the public highways, the position of railroad tracks, and the method of handling wagon and truck traffic through the entrances and exits of the lot.

Figure 1 shows three good lot layouts for the arrangement of buildings. The shape and size of the lot and the location of the gin with reference to roads and railroads may prevent the adoption of ideal arrangements, so no hard and fast rule can be laid down.

No shelter sheds or other accessories have been indicated in the suggested layouts, because the number and location of such accessories are largely dependent on local conditions and practices. Gins in different regions handle cotton in different ways. Weighing procedures are not at all standardized, except that, in general, the truck scale is either in front of the office or beneath the suction pipe of the gin.

Building Construction for Gins

If gin buildings are not of masonry or all-metal construction, they should be of heavy, mill-type timber coated with fire-resistant materials. Good illumination and ample headroom are necessary. Figure 2 shows gin buildings with desirable dimensions. Single-battery buildings should be 30 or more feet in width, with added side extensions for special machinery at ground level; double-battery outfits require widths of 48 feet or more, and buildings should have at least 24 feet between the floor and roof plate. The length of the building should be proportionate to the number of gin stands and the space required for other machinery and service activities. Straight-line roofs are desirable, but offsets are frequently employed in 1½-story gins to obtain ample headroom over the press platform.

In new all-steel buildings, full-length overhung truck sheds and runways for approach and unloading are favored because there are no posts to be damaged by careless driving or accident. This necessitates strengthening certain parts of the building for ample support. Such construction is particularly desirable on city lots and other restricted spaces.

The roofs of modern gin buildings may be flat, pitched, or curved, but, above all, they should be fireproof and readily accessible for cleaning and repair. Many types of trusses are in use, the best forms being of structural steel or heavy timber framed so that block-and-tackle loads may be supported from the lower chords. By selecting the roof trusses with this in mind, the

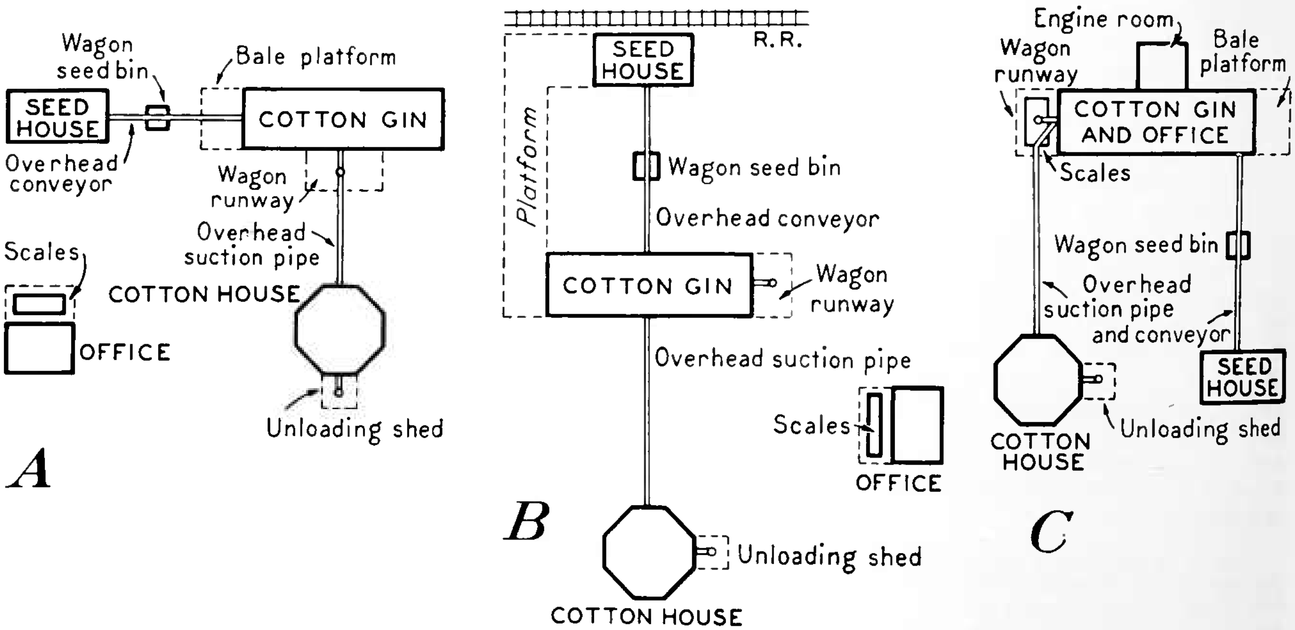


FIGURE 1.—Lot layouts for cotton-gin buildings: *A*, Plan with operations controlled from a special office on the grounds; *B*, plan in which the office may be either separate or within the ginning buildings; and *C*, plan offering efficient supervision of operations.

installation, removal, and rearrangement of ginning machinery are made safer and simpler.

If a gin building has more than one story or platform in connection with a ground-level floor, inclines or ramps are better than steps for moving bales and heavy machinery.

Buildings should be made ratproof wherever possible. Concrete floors, parapets, and guards make this a relatively simple matter in modern construction, if properly designed and reinforced.

Single-story gin buildings with concrete floors have been gaining in favor because they are durable and permit more rigid installation of equipment. For such buildings, the bale presses may be either of the type for up-packing from a pit, or the single-story down-packing type. If a submerged lint flue is to be used with the machinery, its trench may drain to the press pit where a small automatic-float pump maintains dryness in both trench and pit.

Some form of crane, incline, or lift may be needed to raise the bales from the ground level to a platform or truck bed, unless the floor level is unusually high or the bale scale is on a trolley hoist that permits loading after weighing.

In some cases a 1½-story gin building is preferred to a single-story building. In it machinery may be kept on the ground level and yet permit the use of a 2-story press in conjunction with an elevated platform of structural steel or reinforced concrete having a half cellar beneath, with full headroom for pump, workbench, storage spaces, and miscellaneous machinery.

Few 2-story gin buildings are now being built. These buildings are usually framed with wood and sheathed with galvanized iron. The principal advantages of a 2-story gin building are that the ground floor may be used for seed sacking directly beneath the gin stands and that the main line shaft may be placed on concrete pedestals so that

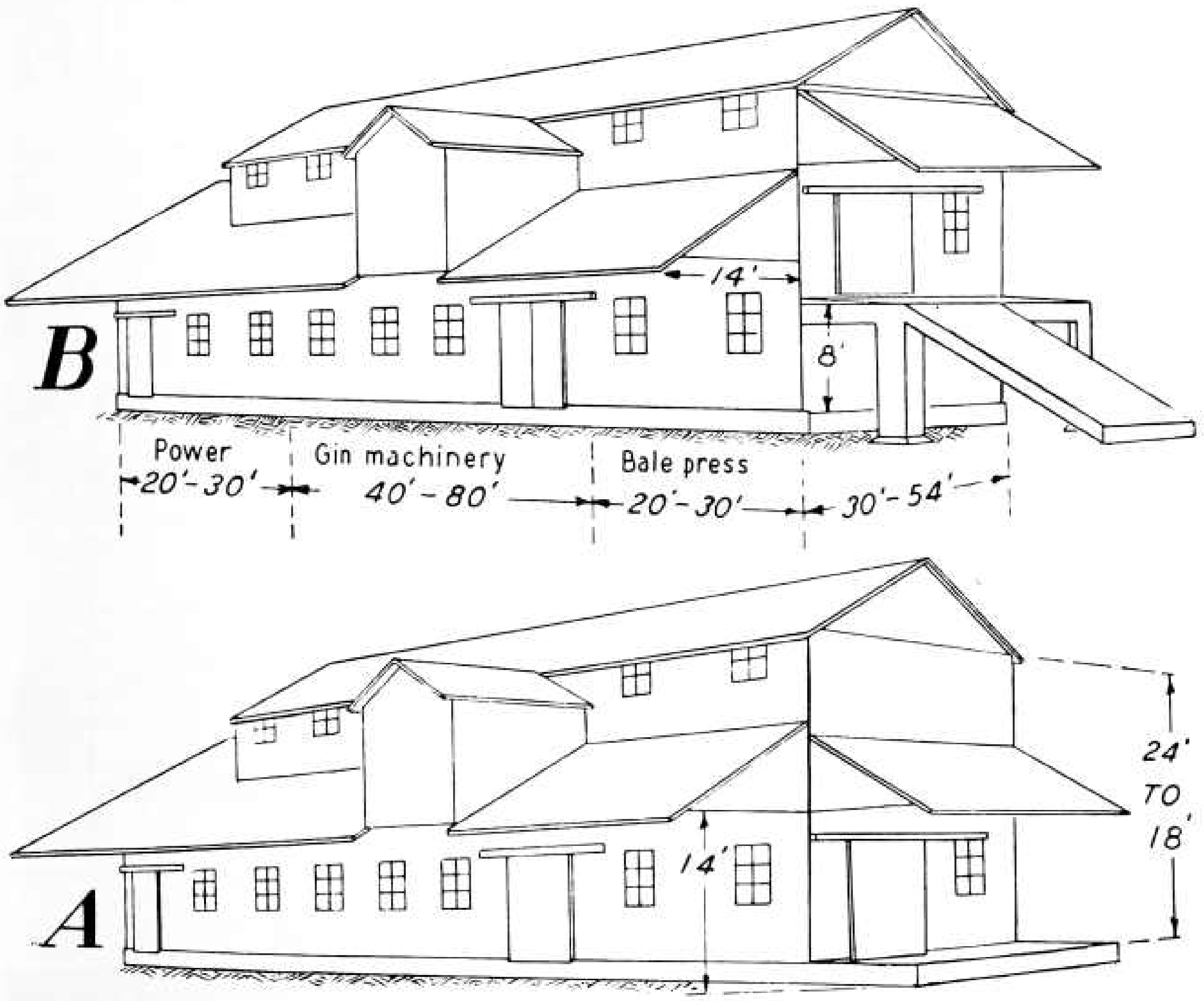


FIGURE 2.—Dimensions of modern gin buildings: *A*, One-story gin; *B*, 1½-story gin.

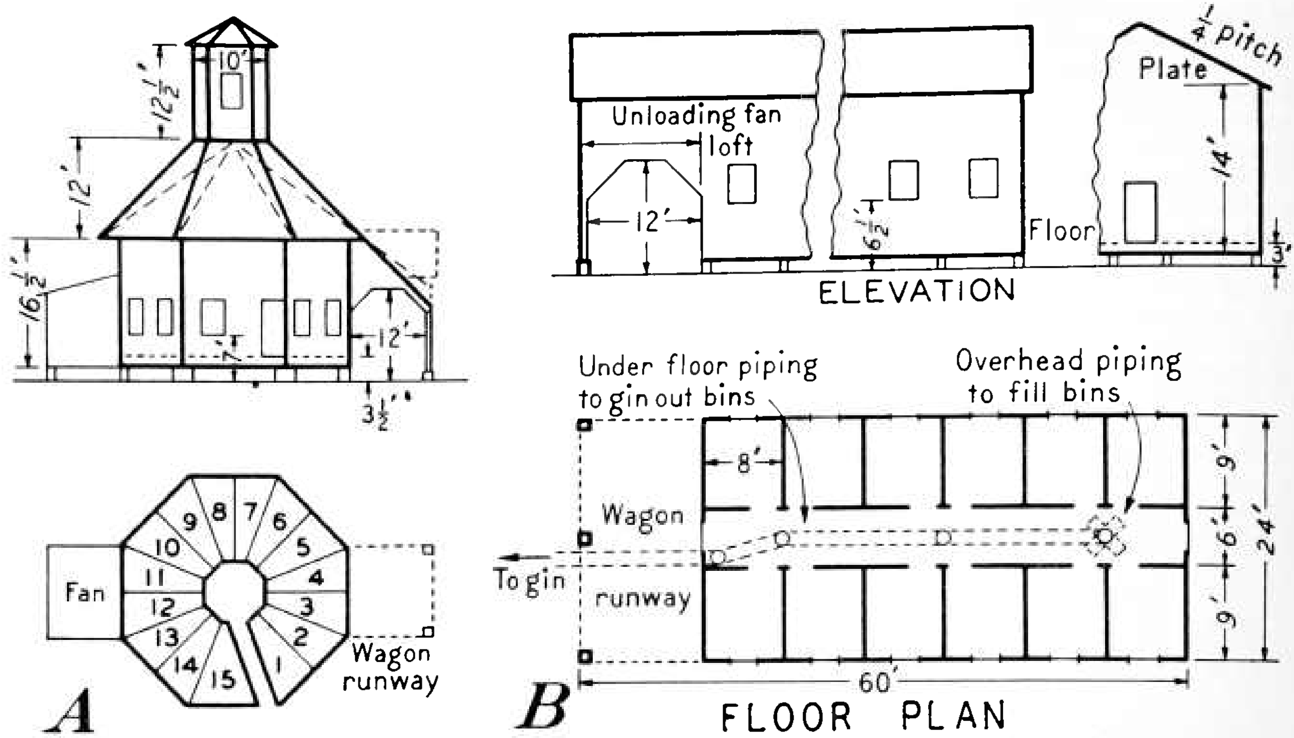


FIGURE 3.—Principal dimensions of typical houses for the storage of seed cotton: *A*, Octagonal storage house; *B*, rectangular storage house. Some of these houses are now built with 24-foot plate height.

belt drives may be carried upward through the ginning floor without occupying too much space or being hazardous to workers. However, ginning machinery usually operates with less vibration in a 1- or 1½-story building where it can be solidly mounted.

Gin buildings are seldom constructed to contain the seed cotton and seed storage. From the viewpoint of fire underwriters, there are good reasons for the gin building to be separated from other buildings on the premises. For many States—since 1954 instructions were promulgated by underwriters—minimum distances of 40 feet between buildings, 40 feet from buildings to overnight bale storage, and 100 feet to incinerators are required by insurance authorities if lowest rates are to be obtained. For open cotton-storage yards, the 1954 rules are that no gin building may be closer than 200 feet and no incinerator closer than 500 feet.

Figure 3 gives diagrams and dimensions for seed-cotton storage houses that are used throughout the Cotton Belt. The bin dimensions frequently vary from those shown. The octagonal cotton house is compact and may be filled either by the suction-dropper or rembert-type cotton fan. In a few instances the suction fan is within the gin building proper, and the pipe to the cotton house is used to fill the cotton house, to cool and dry stored seed cotton when damp, and to transfer seed cotton to the gin stands when the house is being emptied. Rectangular cotton houses are preferred in some sections; and both belt and pneumatic systems are used for filling the bins. These houses are usually single-story, framed with wood, and sheathed with galvanized iron. The floors are preferably of wood because concrete floors often collect moisture, which is detrimental to the cotton.

Modern gins, however, are now making significant savings in labor and building costs by resorting for temporary storage to demountable trailers with screen sides. These trailers serve

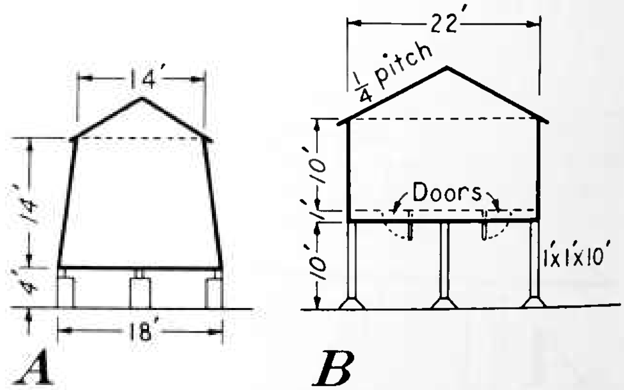


FIGURE 4.—Principal dimensions of typical houses for the storage of cottonseed: *A*, Truck-bed height seed-storage house; *B*, elevated seed-storage house with driveway underneath.

dual purposes of hauling seed cotton from the fields and providing storage at the gin yard until they are unloaded at the gin suction telescope. Tarpaulins or open shelter sheds afford protection against inclement weather between time of harvesting and ginning of these trailer loads. Air-cooling systems are applicable.

Storage houses for cottonseed may be of the types shown in figure 4.

Cotton Docks and Bale Storage

The form and extent of cotton docks in a large measure depend on the building and grounds. It is customary to have a sheltered dock at the end of the gin house with bale runway and bale platforms, either unsheltered or sheltered, as shown in figure 5, *A* and *C*. The elevated skeleton platform (fig. 5, *B*) is a unique means of handling cotton bales where shelter is not provided. The bale house shown in part *D* affords complete protection in rainy weather.

Fire hazards to buildings and bales warrant fireproof construction and the adoption of fire-preventing measures. It is good practice to have bale-storage facilities 200 feet or more from the gin house to prevent spreading of fire from bales to the gin proper.

Seed-Cotton Bulk-Flow Control

An outstanding recent development enables all ginning systems to do their best work by providing controlled flow rates of bulk raw seed cotton from trucks or bins at the gin suction pipe. Several types of this control mechanism are on the market. The United States Department of Agriculture design of this apparatus is illustrated in figure 6, *A*, as an optional improvement to preliminary drying and cleaning at cotton gins. A more detailed sketch will be found in figure 37 in the Appendix.

Conditioners

In most sections of the Cotton Belt modernization of the ginning outfit calls for the installation of conditioning or drying apparatus. Seed cotton that is too high in moisture content will not clean or gin properly. The production of smoothly ginned, high-quality samples requires precise control of air temperatures and volumes as well as time of exposure, together with selective automatic feed control of seed-cotton flow through the system.

Many types of conditioners employing the drying process developed by the Department Cotton Ginning Laboratories are now on the market. (This process is covered by public patents Nos. 1,707,929, 1,871,773, and 2,078,309, which are dedicated to the free use of the people.)

Driers may be located either on the ground level or over the distributor or overhead cleaner. Two methods of tower-drier installation are shown in figure 6, which also depicts the bulk-flow control.

Among the other forms of driers on the market using the hot-air drying process are the big-reel drier, the multiple-trough drier, the unit extractor-feeder drier, and the overhead cleaner-drier. These driers are shown in figure 7.

Another drying system not shown utilizes a rembert-type fan with a "split suction," drawing hot air from a heater and the cotton from the trucks, after which the fan discharges to the tower. A fan having a capacity of 5,400 or more cubic feet of air per minute is necessary for such dual-purpose systems. Installations of this type are especially applicable to small gins having small volumes and limited power.

The sources of heat for driers may be direct or indirect furnaces using natural gas, butane, or fuel oil; boilers; or arrangements for utilizing waste heat from a diesel- or gas-engine exhaust and radiator. It is generally desirable to install the form of drier that will not interfere with the ginning service and will require a minimum of additional power. Either installation shown in figure 6 permits the vertical drier to be used very effectively with or without heat. Some of the other forms of driers shown in figure 2 are, by various methods of installation, able to achieve the same effect.

For compactness and greater flexibility in installing and operating, the tower driers have floor spacings that range from 8 to 12 inches. Connections between the first drier discharge and the delivery to ginning units frequently include a boll and rock trap developed at one of the Cotton Ginning Research Laboratories (fig. 8). The trap may include a permanent magnet for tramp iron. Four tentative positions of strip magnets have been approved by an interstate engineers-underwriters committee; namely, positions 1 and 2 in tower driers or discharge transition as shown in figure 8; position 3, in discharge connection from airline cleaner; and position 4, in discharge piping from big-reel and conveyor driers.

From the viewpoint of cotton mill experiences, a minimum fiber moisture content of 5 percent is desirable during the ginning treatments (table 1).

Cleaners and Extractors

Several factors determine the extent to which cleaners and extractors should be employed in cotton ginning establishments. These include the methods of harvesting used in the locality of the gin, the kinds of cotton, and regional weather conditions as they affect fiber moisture and leaf.

Cleaners may be obtained in a variety of forms, such as the axial-flow, cross-drum, or serpentine

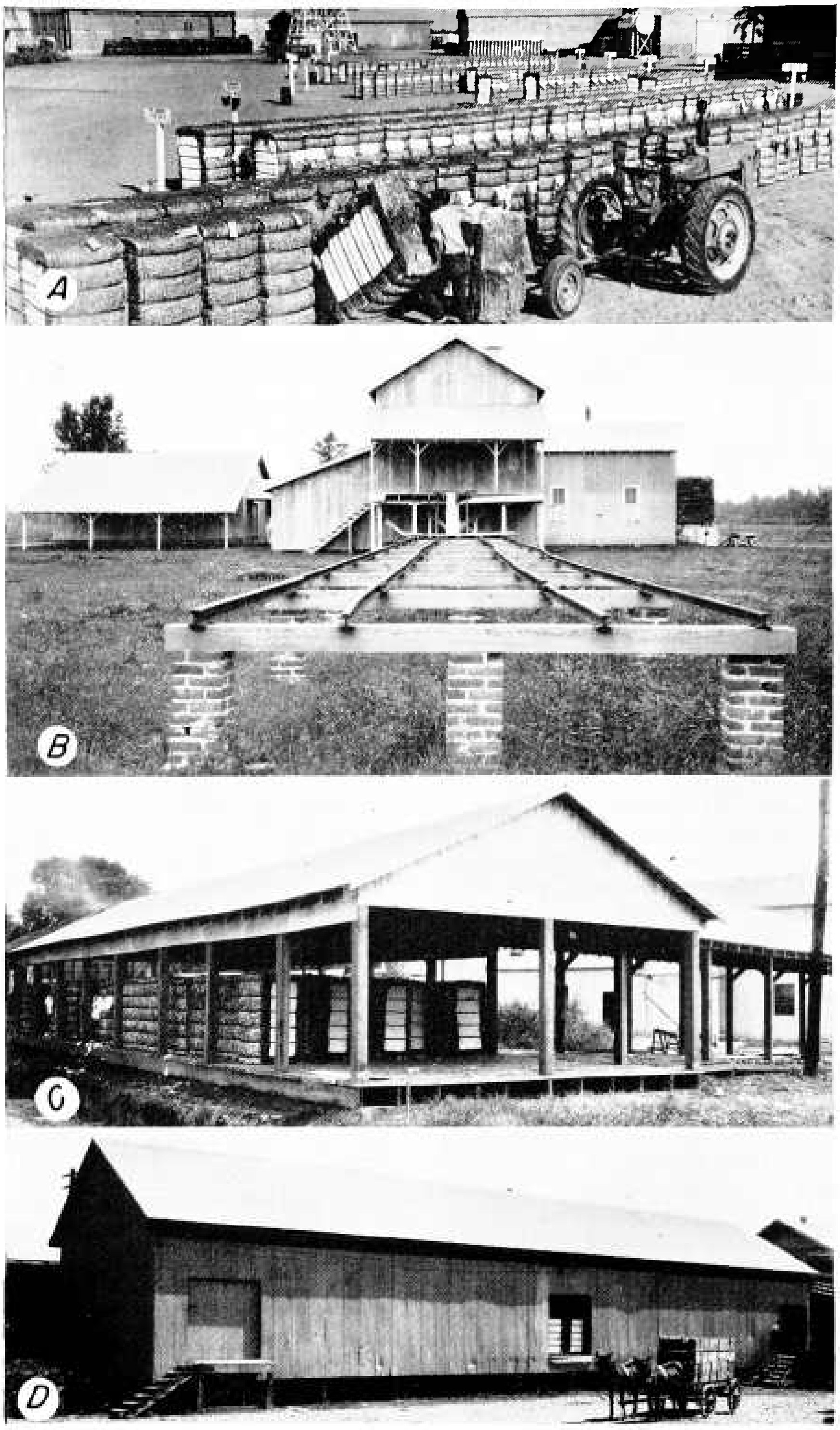


FIGURE 5.—Cotton-gin bale storage: *A*, Unsheltered storage on ground level; *B*, unsheltered, elevated; *C*, sheltered, open sides; *D*, sheltered, enclosed.

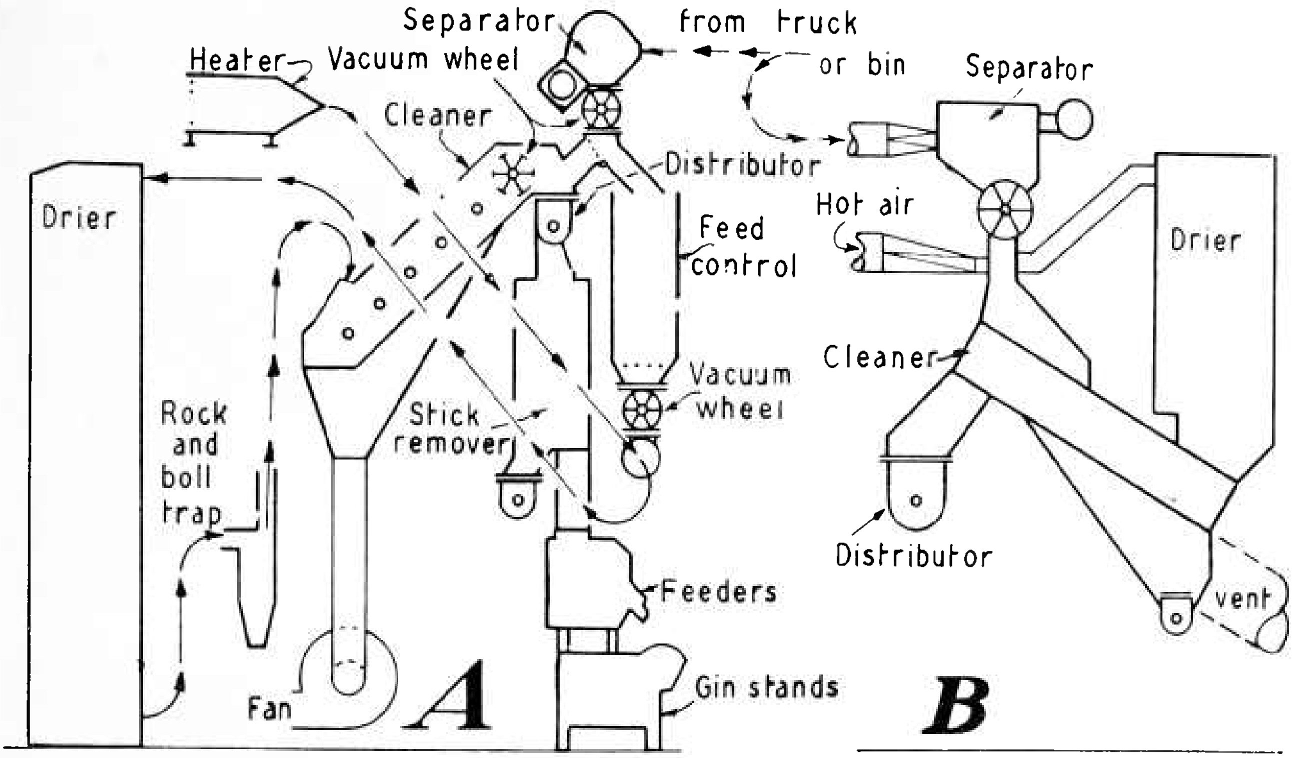


FIGURE 6.—Schematic diagrams of tower or vertical drier installations: *A*, Draw-through or suction type, which may have a full-length or stub tower; *B*, blow-through type with stub tower. The towers may be connected to the cleaners by piping instead of directly, as shown in *B*.

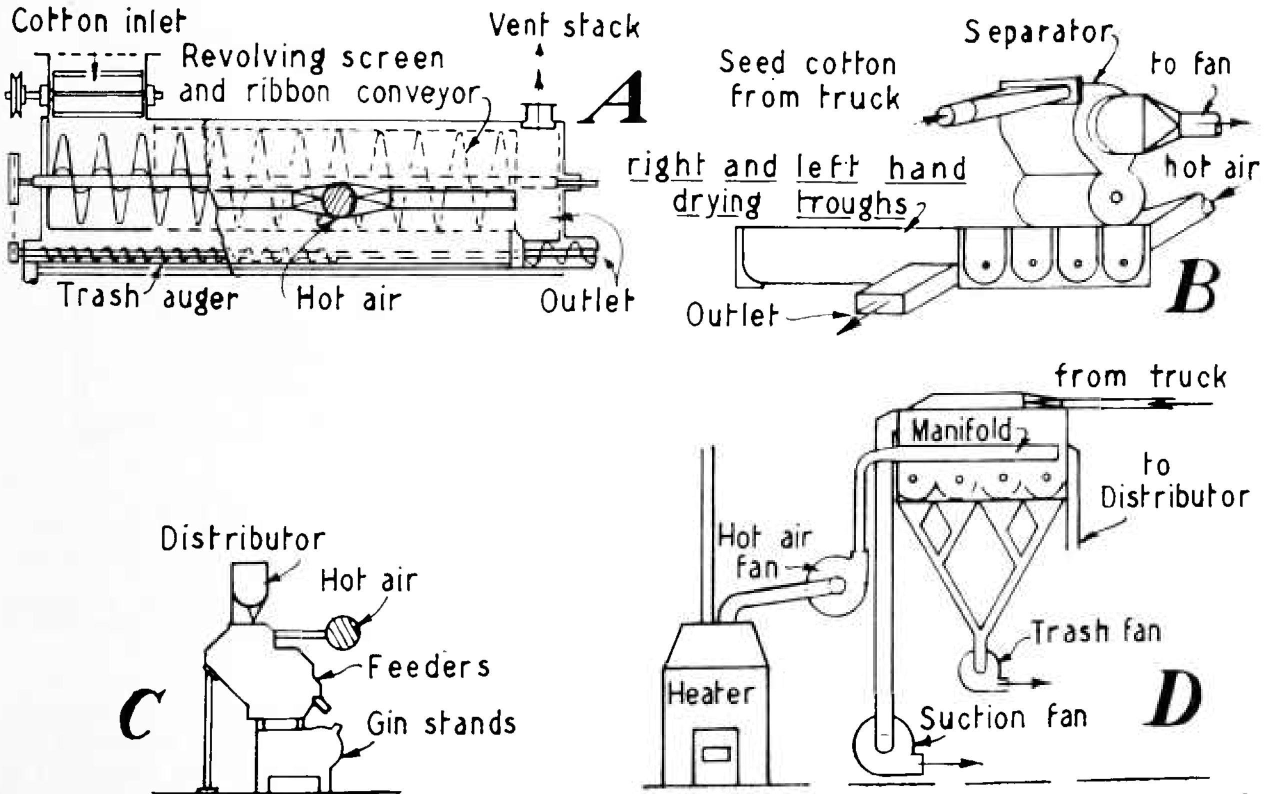


FIGURE 7.—Various forms of commercial driers: *A*, Big-reel drier; *B*, multiple-trough drier; *C*, unit extractor-feeder drier; and *D*, overhead cleaner-drier.

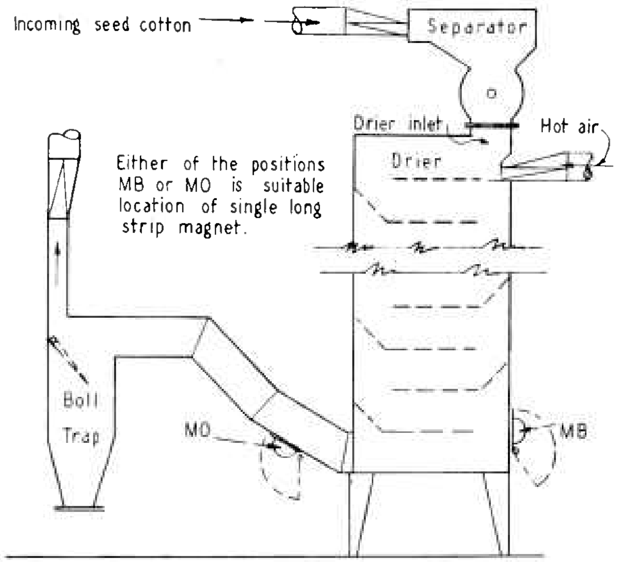


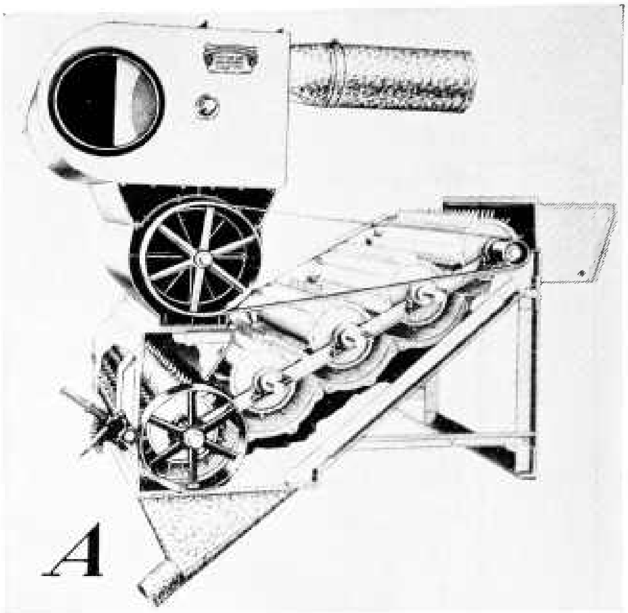
FIGURE 8.—Schematic diagram, showing location of boll and rock trap with suitable location of single long-strip permanent magnet for tramp iron.

types.[3] Cylinders for cross-drum types of cleaners may be equipped with spikes, spider arms, or paddles. In general, airline cleaners permit only a horizontal flow of the seed cotton from inlet to the outlet of the machine. Gravity-type cleaners permit a vertical flow of the cotton. Inclined gravity cleaners are common where there is little headroom. Modern forms of inclined gravity-type cleaner-separator installations are shown in figure 9. The separator is mounted at the lower end of the cleaner (fig. 9, *A*) in gins where headroom is limited. Frequently the separator is placed at the upper end with a bypass so that the cotton may be discharged either to the cleaner or directly into the distributor (fig. 9, *B*.)

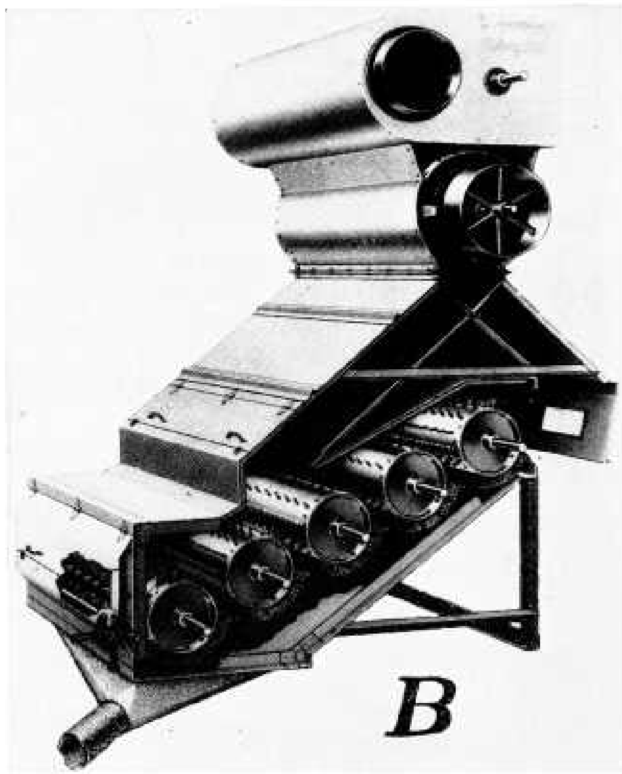
Gravity-type cleaners, when fitted with vacuum-wheel discharges, are commonly used as "airflow" cleaners, whereby the cotton is conveyed pneumatically to the cleaner and the air thenceforth is separated through the screens. Airline cleaners permit both air and seed cotton to pass entirely through and thus differ from gravity cleaners. Airline cleaners are principally employed in pneumatic systems, but they may be used advantageously to simplify the equipment or to conserve space by being placed over the truck runway. Such cleaners are popular in the High Plains of Texas and in western Oklahoma as an effective means for removing sand from cotton and breaking the bolls prior to cleaning.

Extracting units are more effective in removing burs, sticks, and other foreign matter from roughly harvested cotton than cleaners. In modern gins,

[3] MOORE, V. P., and MERKEL, C. M. CLEANING COTTON AT GINS AND METHODS FOR IMPROVEMENT. U. S. Dept. Agr. Cir. 922, 50 pp., illus. 1953.



A



B

FIGURE 9.—Inclined gravity-type cleaner installations: *A*, With separator in low position; *B*, with separator and bypass in elevated position.

even with the best system of cleaners employing concave screens and beaters, the amount of trash removed is seldom more than 33 percent of the total in the seed cotton as it came to the gin. On the other hand, all of the extracting processes

TABLE 1.—*Results obtained with cotton that has been harvested and ginned under various conditions and the fiber dried to moisture contents of 4 to 9 percent*

Harvesting, ginning, and kind of cotton	Ginning and fiber data of seed-cotton fiber dried to moisture content of—			
	9 percent	7 percent	5 percent	4 percent
Moderate ginning, with 1 to 2 driers, of early-season, green or damp, hand-picked cotton (12 to 14 percent moisture content).	Rough preparation	Normal preparation	Smooth preparation	Smooth preparation.
	Slow ginning rate	Normal ginning rate	Slow ginning rate	Slower ginning rate.
	Good pressing			Static problems.
	Chokages probable	Good pressing	Difficult pressing	Difficult pressing.
				Reduced bale weight.
	Low grade	Increased grade	Increased grade	Increased grade.
	Full staple length	Full staple length	Reduced staple length	Reduced staple length.
	Loses weight in storage	Weight constant in storage	Gains weight in storage	Gains weight in storage.
	High mill waste	Normal mill waste	Normal mill waste	High mill waste.
	Reduced yarn appearance	Good yarn appearance	Good yarn appearance	Reduced yarn appearance.
	Fiber damage possible			Increased cost of spinning.
Standard ginning, with 2 or 3 driers, of midseason machine-picked or late-season hand-picked cotton (12 to 15 percent moisture content).		Smooth preparation	Smooth preparation	Smooth preparation.
		Normal ginning rate	Slow ginning rate	Slower ginning rate.
		Good pressing	Difficult pressing	Difficult pressing.
				Static problems.
				Reduced bale weight.
		Good grade	Good grade	Top grade.
		Full staple length	Reduced staple length	Reduced staple length.
		Weight constant in storage	Gains weight in storage	Gains weight in storage.
		Average mill waste	Increased mill waste	High mill waste.
		Good yarn appearance	Average yarn appearance	Reduced yarn appearance.
				Increased cost of spinning.
Elaborate ginning, with 2 or 3 driers, of late-season, hand-snapped (above 15 percent moisture content) or machine-stripped (11 to 14 percent moisture content) cotton.		Normal preparation	Smooth preparation	Normal preparation.
		Normal ginning rate	Slow ginning rate	Slower ginning rate.
		Good pressing	Difficult pressing	Difficult pressing.
				Static problems.
				Reduced bale weight.
		Low grade	Improved grade	Improved grade.
		Normal staple length	Reduced staple length	Reduced staple length.
		Weight constant in storage	Gains weight in storage	Gains weight in storage.
		High mill waste	High mill waste	High mill waste.
		Average yarn appearance	Average yarn appearance	Reduced yarn appearance.

along so-called carding principles may remove up to 40 percent. Large extracting machines may be used in overhead positions as master extractors to serve the entire ginning battery, or small machines may be used as unit extractor-feeders to supply individual gin stands and to replace older forms of cleaning feeders.

General trends in the installation of cleaners and extractors are toward simplicity and compactness, with a view to having an adequate amount of cleaning apparatus. For this reason, special extractor-cleaner units are frequently substituted under the distributor for overhead cleaners and master extractors.

Modern combinations of overhead cleaning and extracting machinery for use in districts where cotton is usually roughly harvested are shown in figure 10. In the Southeastern States, the placing of unit extractor-feeders above existing plain gin stands is a simple and economical step toward modernization. Where new gin stands are purchased, it is frequently desirable to obtain huller stands and combine them with unit extractors as shown in figure 10, *B*. This arrangement is a popular practice in the central cotton States and in the western part of the Cotton Belt.

If possible, selection of cleaning and drying equipment should be made at the same time. With proper planning, cleaning and drying equipment can be installed together more cheaply than separately.

A recent improvement in cleaning and extracting is the United States Department of Agriculture design of a machine for removing sticks from machine-stripped cotton.[4] Its position in a cotton gin has been indicated in figure 6, and its construction is more fully described in Appendix, figure 38.

Two forms of conveying systems are common to ginning establishments—mechanical and pneumatic. Conveyor-distributors are widely employed to transfer seed cotton to and from big-bur or master extractors; pneumatic conveying is usually preferred between driers and cleaners. With the mechanical system, the seed cotton is also fed to each bank of feeders and gin stands, and any

[4] Public patent applied for.

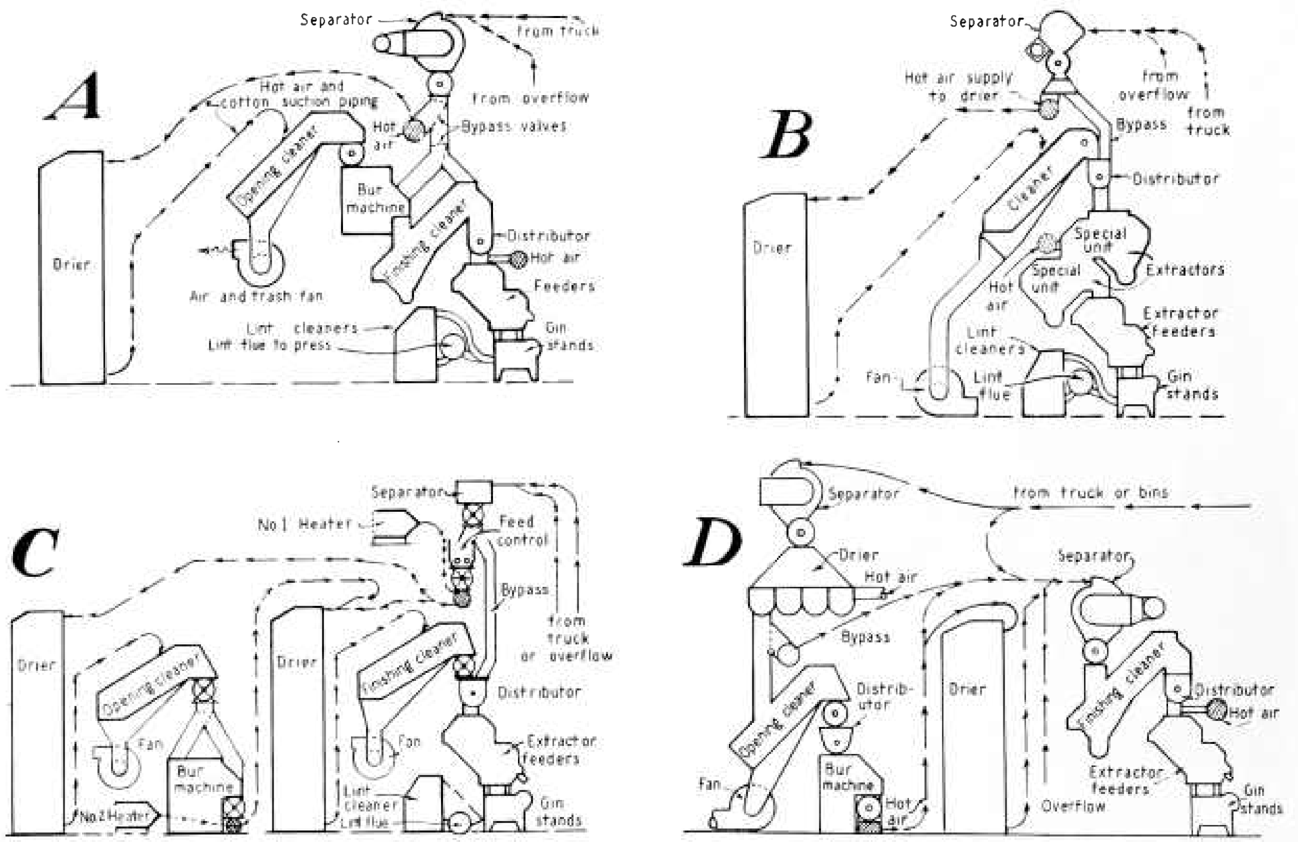


FIGURE 10.—Arrangements of cleaning and extracting machinery in gins that handle roughly harvested seed cotton: *A*, Overhead cleaning and extracting units, together with extractor feeders, huller gins, and lint cleaners; *B*, bulk drying and cleaning prior to distributing, followed by cleaning, extracting, and feeding at individual gin stands, together with huller gins and lint cleaners; *C*, modern arrangement with bulk feed control, multiple drying, and lint cleaning at floor level; and *D*, multiple drying, cleaning, and extracting at floor level.

surplus seed cotton is discharged at the overflow, from which it may be returned to the handling system. Both systems are therefore suitable for use with many combinations of conditioning, cleaning, and extracting machinery. Distributing systems are further discussed in the section, Separators and Distributors, page 24.

Feeders and Gin Stands

Plain gin stands have been superseded by double-rib huller gins, whose fronts remove appreciable quantities of leaves, stems, and minor items of foreign matter even when elaborate cleaning and extracting processes have preceded them. The picker rollers on huller gins of the latest models are equipped with lever-shifting devices, so that the position of the roller may be adjusted to the immediate condition of roughness in the seed cotton. Gin stands of all-steel construction that are precision built and afford a superior protection to the cylinders and brushes or nozzles came into use after 1930.

Inasmuch as the older wooden-frame cotton gins are difficult to keep in good condition and cannot be fitted with late-model fronts or bearings, it is advisable to replace them with stands that have been manufactured since 1940.

Sectional views of feeders of the big-drum and cleaner-extractor types are shown in figure 11. Largely as a result of research by the United States Cotton Ginning Laboratories, improvements in cotton gin stands have included improved moting arrangements and increased saw speeds that now range between 650 and 700 revolutions per minute. During recent years 90-saw stands have been replacing 80-saw or smaller stands. Improved shapes of saw teeth have resulted in efficient forms having either slightly curved or straight backs, with number of teeth varying between 264 and 282 per 12-inch diameter saw. When the saws have been reduced by ⅟₁₆ inch from their original diameter by wear and sharpening, ginning capacity is frequently decreased by 20 percent or more. The entire saw cylinder should then be refilled with new saws. For good doffing, tip speeds of gin brushes should be approximately 6,666 linear feet per minute, and air-blast nozzle doffing pressures should be approximately 12½ inches on the water gage to give jet velocities up to 13,000 feet per minute.

By means of its keen angle grids that shuttle back and forth behind the gin saws, a reciprocleaner moting attachment for air-blast gins significantly enhances moting and lint-cleaning

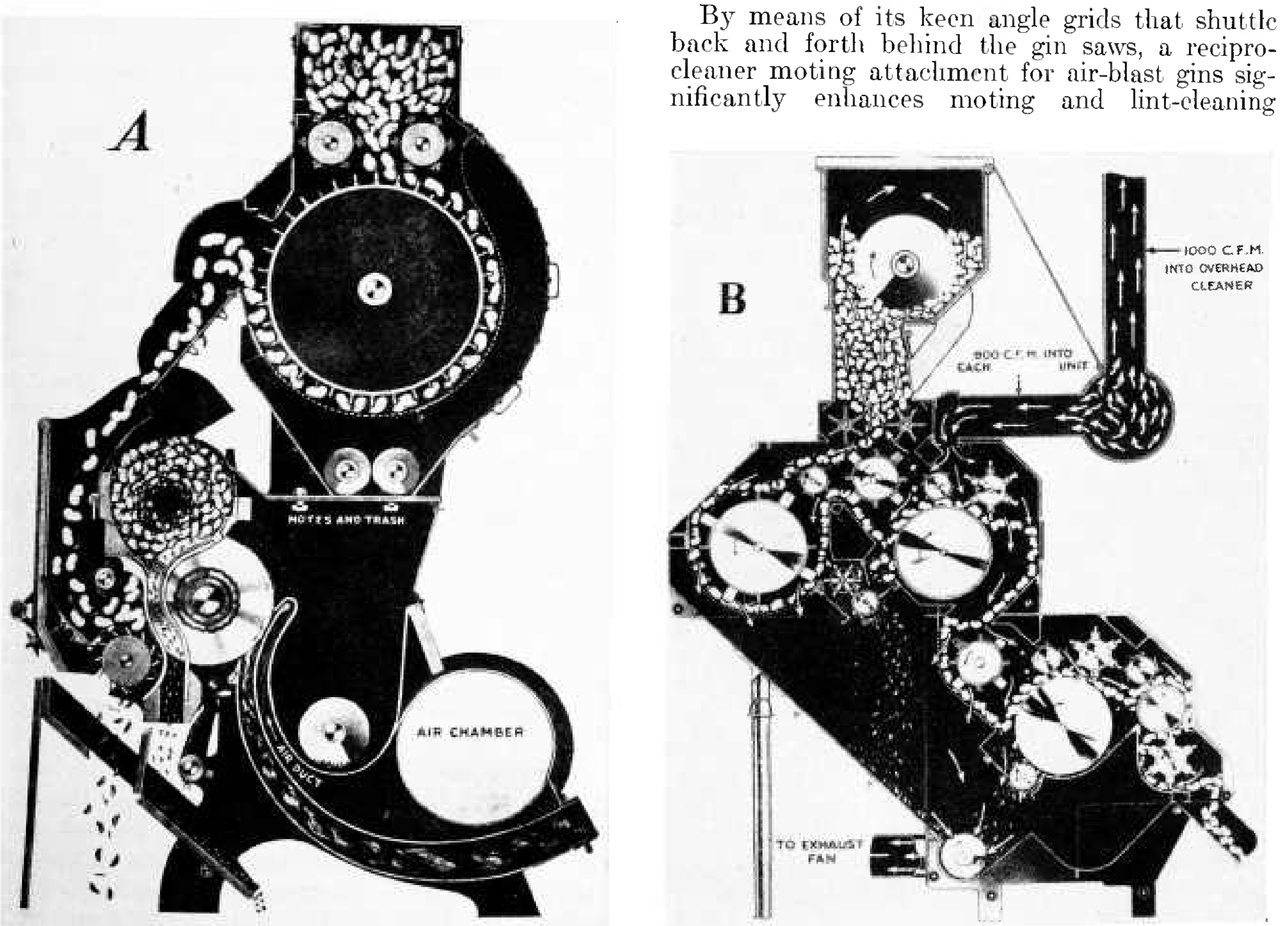


FIGURE 11.—Sectional views of feeders: *A*, Big-drum feeder; *B*, large-size cleaner-extractor-feeder with hot-air supply.

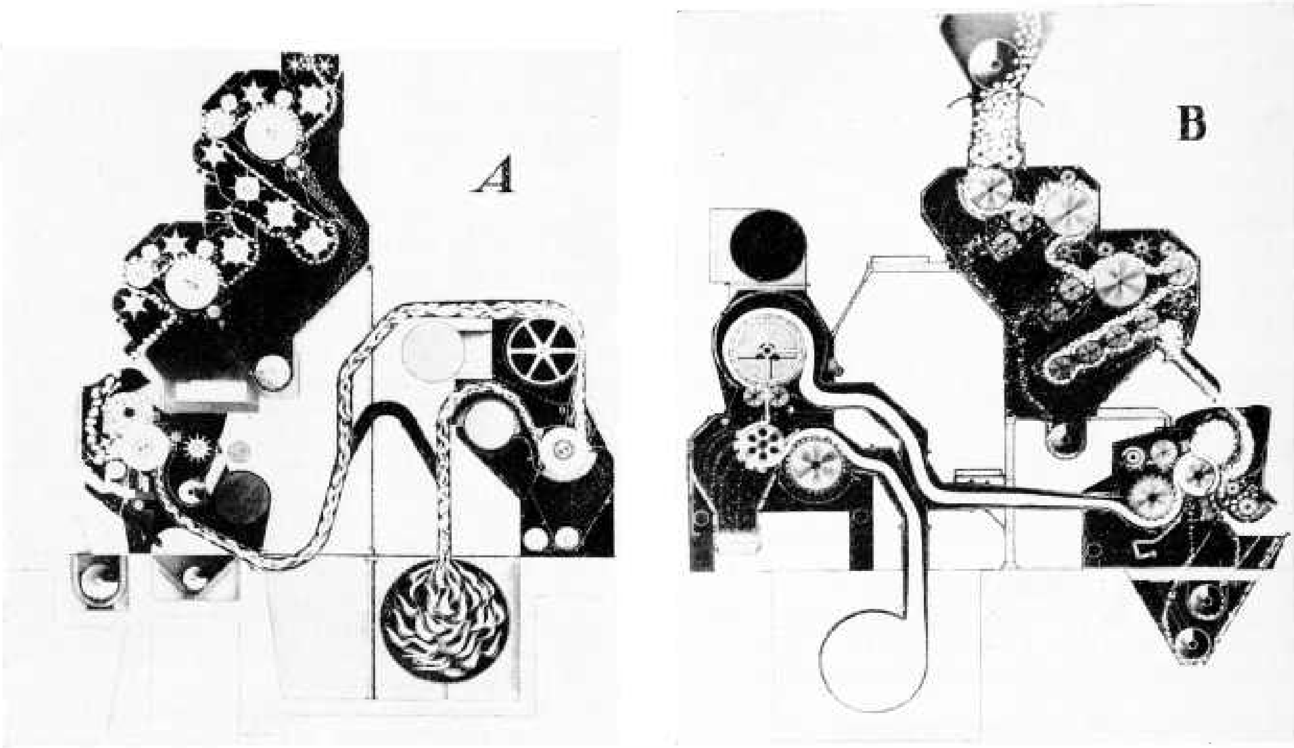


FIGURE 12.—Sectional views of saw-cylinder lint cleaner: *A*, Air-blast gin and air-blast lint cleaner; *B*, brush gin and brush lint cleaner.

actions.[5] A public patent on this attachment makes it free for use by the public, and working drawings are obtainable from the USDA Cotton Ginning Research Laboratory, Stoneville, Miss.

Lint Cleaners [6]

Lint cleaners are revolutionary devices for cleaning cotton in the gin. For best results they should be operated in accordance with recommended procedures and kept in good repair and proper adjustment. To obtain maximum grades and to preserve fiber quality with lint cleaners, the cotton should be dry and the gin stands operated at moderate rates of feed and with loose seed rolls. Tests have shown that the effectiveness of lint cleaners may be reduced by heavy rates of feed, which in turn cause an increase in the nep count of the lint. Lint cleaners have not replaced seed-cotton cleaners and extractors at modern gins, but they have been effective in removing as much as 8 percent by weight of the trash that originally came to the gin with machine-picked seed cotton and could not be taken out prior to lint cleaning.

Typical saw-cylinder lint cleaners, shown in figure 12 and Appendix figure 43, use a condenser or an air-screen separator ahead of the cleaning saws to bleed off air conveying the lint cotton from the gin stand. The manufacturers' recommendations for balancing this air should be closely followed in order to maintain greatest effectiveness.

If a lint cleaner uses an air-blast doffing system, it is important that the gin-stand doffing pressure be kept low, consistent with good stand operation, to clean the gin saws and transfer the lint to the lint cleaner. Minimizing the air to be handled by the lint-cleaner condenser will in turn reduce the possibility of backlash in the gin stands.

Pneumatic types of lint cleaners, shown in figure 13, are widely used. Manufacturers' recommendations as to air volumes and velocities should be followed. Leaks in suction condensers and lint flues must be avoided, and settings should be maintained through periodic inspection. These units should be regularly cleaned of accumulations of cotton and foreign material.

It is generally possible to install either the saw- or pneumatic-type lint cleaners in old gins, through certain modification of drives, the condenser, and lint flues. Each installation requires a special engineering layout to obtain the most effective operation. Accessibility to all moving or vital parts of the lint cleaner is always important if uninterrupted service is to be maintained.

[5] MERKEL, C. M., and MOORE V. P. AN IMPROVED MOTING SYSTEM FOR COTTON GINS. U. S. Dept. Agr. Cir. 974, 23 pp., illus. 1955.

[6] STREDONSKY, V. L., and SHAW, C. S. THE FLOW-THROUGH LINT-COTTON CLEANER. U. S. Dept. Agr. Cir. 858, 30 pp., illus. 1950.

MOORE, V. P., and MERKEL, C. M. CLEANING COTTON AT GINS AND METHODS FOR IMPROVEMENT. U. S. Dept. Agr. Cir. 922, 50 pp., illus. 1953.

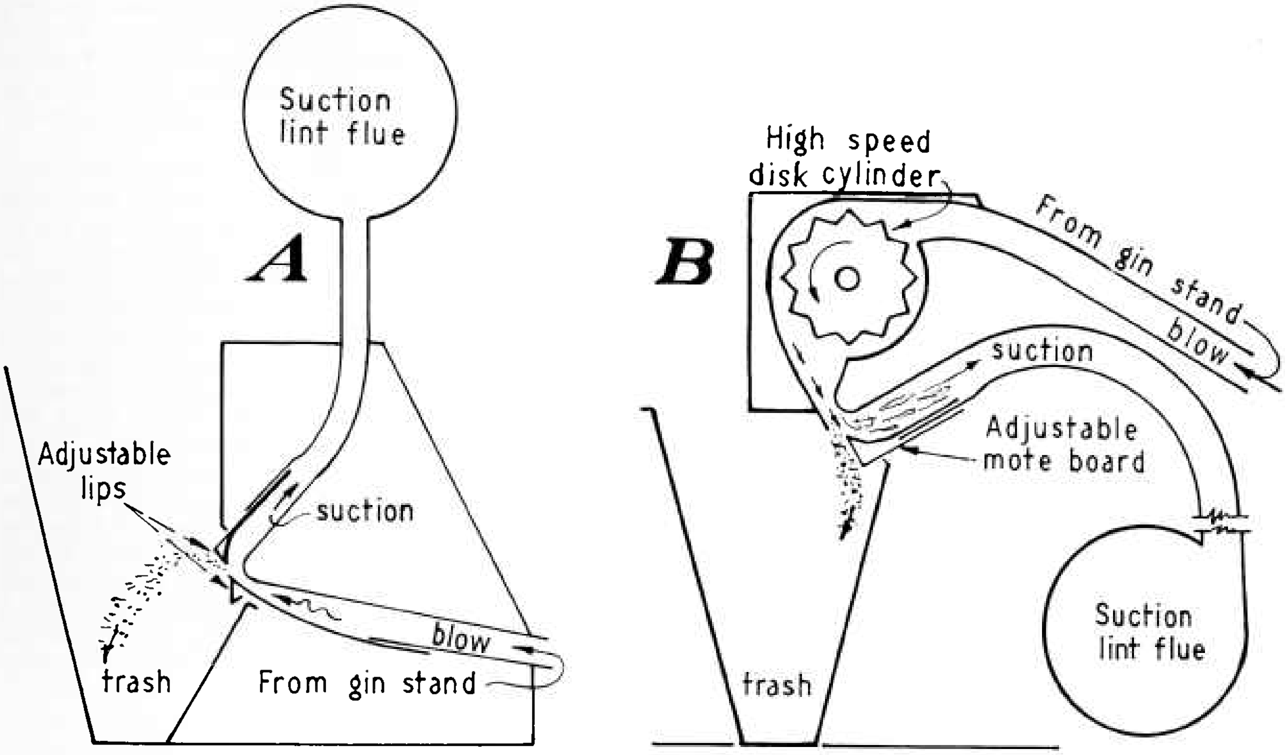


FIGURE 13.—Sectional views of pneumatic lint cleaners: *A*, Air-blast gin and superjet lint cleaner; *B*, air-blast gin and air-centrifugal lint cleaner.

In installing lint cleaners, attention to the lint flue leading from the gin stand to the cleaner is necessary to insure that all inside surfaces are perfectly smooth. No rough edges of metal or bolt heads should project into the flue, as they would cause cotton tags to accumulate. Bypass valves should be examined to see whether they close properly. Any tags or lint accumulations that break loose from pipes or valves and enter the cleaner can seriously damage the saws and grid bars.

The interiors of all lint-cleaner condensers and air-vent flues should be cleaned regularly each day to insure against chokage and back pressure. Wherever condensers are used, proper maintenance of their doffing rollers is necessary to insure satisfactory operation of the lint cleaners. The rollers should be kept in adjustment and their flights replaced when they have lost their effectiveness as an air seal. Too much air blowing past the doffing rollers will disturb the batt of cotton entering the feed rollers, causing chokes at the rollers and the loss of usable fibers with the lint-cleaner trash. The revolving separator cages and screens should be inspected to ascertain whether the surface is smooth, so as to eliminate the possibility of lint building up on rough spots.

Inspection and maintenance procedures for lint cleaners should include the following:

1. Saws should be checked daily. Sticks, stems, and other foreign matter attached to the teeth should be removed.
2. Saws should be kept sharp and in good operating condition.
3. Grid bars and air-blast nozzles should be inspected regularly for alinement and proper clearance. If a brush is used instead of air blast, the same care and maintenance should be given it as to the gin stand. For proper doffing, the brush should mesh with the saw to the depth of the saw tooth, unless wobble saws are used. In such cases, the tips of the bristles should barely touch the saws.
4. The trash-disposal unit should receive periodic attention. Conveyor belts should be kept tight, and dropper wheels should be inspected for wear and damage.
5. All glass inspection doors should be replaced immediately when broken; otherwise, air movement in the cleaner will be disturbed.

Handling Seed and Trash

Seed and trash may be handled readily by gravity, belts, screw conveyors, or pneumatic piping. There are several methods for handling seed so as to keep it pure. The belt and blowpipe types of seed conveying are self-cleaning, but screw conveyors must be hand-cleaned between the ginning of different varieties. For other than single-variety gins, the use of belt or blowpipe [7] conveyors is therefore desirable where an appreciable quantity of seed is to be saved for planting.

[7] BENNETT, C. A., and FRANKS, G. N. COTTONSEED HANDLING WITH SMALL AIR PIPES. U. S. Dept. Agr. Cir. 768, 8 pp., illus. 1948.

The following conveying devices are among those now in use:

1. A horizontal, flat seed belt in a smooth trough below the stands, delivering either to an inclined belt or to a seed-blowing pipe through a vacuum-wheel seed feeder.
2. A horizontal skeleton drag belt operating in practically the same way as the flat belt described above.
3. A reversible horizontal flat seed belt beneath the stands, operating in one direction to deliver gin-run seed, and in the other to deliver pure seed, each discharging into bins or sackers by various means.
4. Two individual conveyors beneath the stands, gin-run seed being handled in the rear system and pure seed in the front one—each system having its own lifts and deliveries.
5. Gravity chutes with hinged covers in front or below each stand, diverting pure seed by gravity into funnels and sacks below, while a standard screw conveyor is generally used on gin-run seed.
6. Gravity chutes similar to those described above but delivering pure seed into a blowpipe by means of a rotating vacuum-wheel seed feeder.

Where vertical lifts are employed, screw elevators are generally more efficient and sturdy than wooden-bucket elevators, whose troubles with slipping belts and faulty alinement are well known. In some instances seed and trash may be conveyed by belts and piping. Conveying seed by air in small pipes is now the most efficient and economical method.

Means for disposing of foreign matter from the cotton gin are not only desirable but within incorporated communities may be required by ordinances and health regulations.

The hazards from dust, fire, insect infestation, and spreading of certain plant diseases and fungi must be considered among the problems of gin trash disposal. Means of trash disposal (see fig. 41, Appendix) include use of a collection bunker for hauling an incinerator for immediately burning the combustible portions of the trash, and a compost pit for converting the materials into plant food, or merely blowing all foreign matter to a so-called bur pile, which should be a safe distance from the ginning buildings.

To reduce handling costs when trash is to be immediately composted or burned, the air discharge from the first cotton unloading fan may be utilized as a conveyor to the incinerator or pit. All other trash fans then deliver to a cyclone-collector located next to the gin building, from which the trash is fed into the conveying line by means of an oversize, nonchoking vacuum-wheel dropper

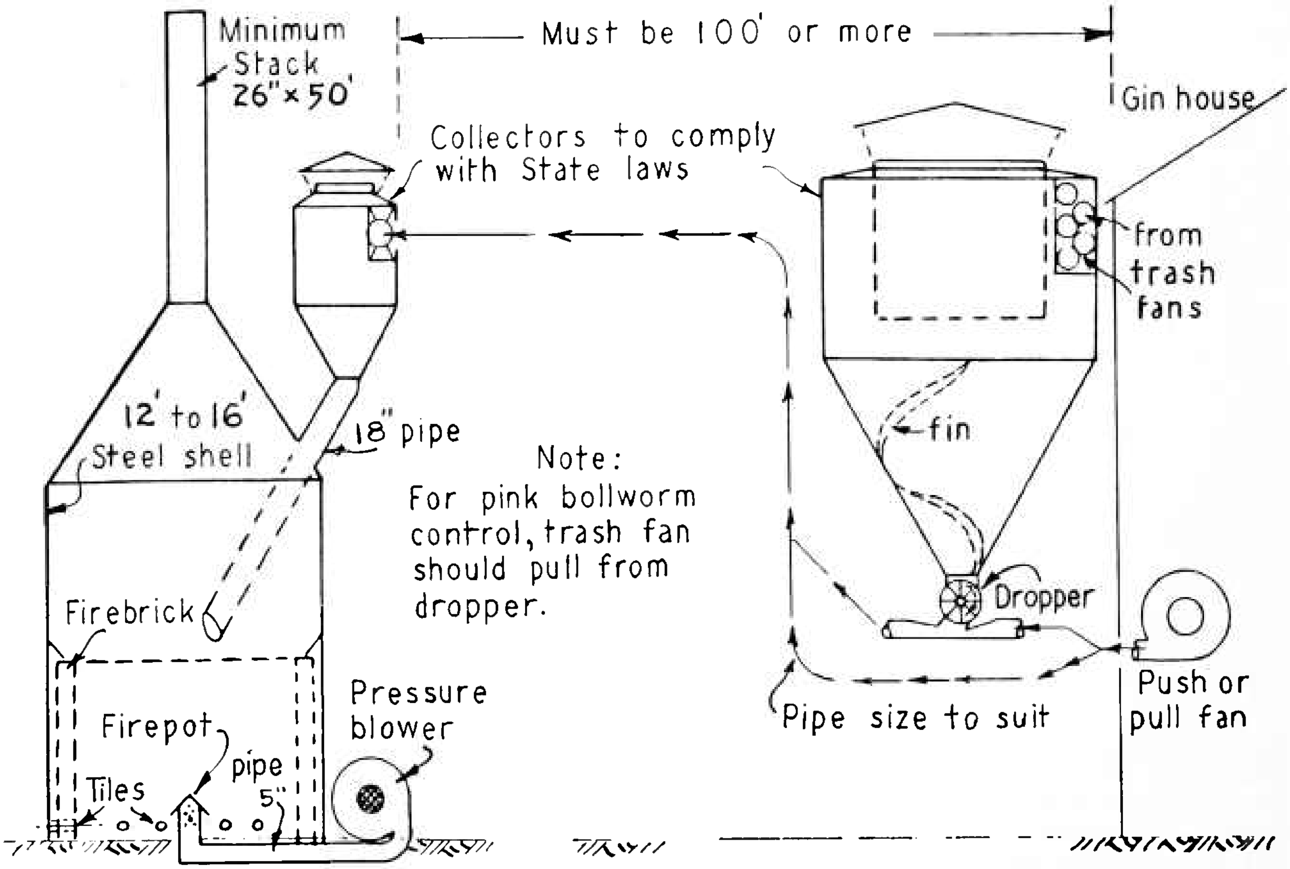


FIGURE 14.—Schematic diagram of a good system for collecting cotton gin trash and pneumatically delivering it to an incinerator. A different design of incinerator is shown in Appendix, figure 42.

(fig. 14) and second fan if quarantine regulations on pink bollworm apply.

The use of a secondary cyclone-collector for feeding the incinerator or compost pit prevents an excessive dispersion of dust. The operation of any incinerator is subject to some smoke nuisance, but this may be reduced to a large extent by utilizing a small-pipe, turbo-blower air supply to the center of the burning material within the incinerator (see fig. 42, Appendix). This makes for more rapid and hotter combustion, like a blacksmith's forge, and increases the capacity of the incinerator.

The incinerator shown in figure 14 is designed to handle approximately 5,000 pounds of trash per hour. The unit may be either round or square. If more than 5,000 pounds per hour is to be handled, an increase in size to 24 by 24 feet, outside dimensions, is recommended. The superstructure of the unit should be air-cooled to prevent the intense heat of the furnace from causing the metal framing to warp and buckle. A tall smokestack is desirable but not essential to satisfactory incineration. It may, however, enable the ginner to reduce low-level drifting of very fine ash and some objectionable smoke.

Burning of trash does not bring a profit to the ginner, except in the vicinity of Lubbock, Tex., where the operation is often used as a source of power and produces caustic alkali solids that have sales value. The feeding of the edible portions of the trash to livestock has shown some promise for mixtures requiring bulk. Composting of the material to provide a fertilizer or plant food for spreading on land has been widely tried, but thus far has not been extensively adopted throughout the Cotton Belt.

AIR PIPING AND FANS

Pneumatic systems consume from 50 to 65 percent of all the power required in modern cotton gins. They also determine whether the ginner is to experience smooth operation or continuous trouble. It is of the greatest importance, therefore, to plan, select, and install piping and fans with a view to economical and efficient operation.

The problems of piping and fans will be more readily understood by keeping in mind that the flow of air in a pipe in cotton gins is similar to the flow of water in a pipe. Airflow, however, is measured in units of cubic feet per minute instead of gallons per minute as for water. Pressures within the air pipes are measured in units of inches of water on a U-tube gage or manometer, rather than in pounds per square inch. The majority of cotton-gin fans operate against static pressures (resistances) below 27.8 inches of water, which is the equivalent of 1 pound per square inch.

The number, size, and operating rate of gin stands will determine the required rate of flow of seed cotton to the gin. This and the layout of the ginning establishment should determine the dimensions and arrangement of the piping. The air volume needed to overcome the resistance of equipment and pipes and to supply the gins will determine what fan capacity is needed.

Table 2 shows average pipe diameters, air volumes, and power required at given static pressures for various ginning layouts. The figures given are representative only and subject to variation because of differences in pressure and volume frequently encountered in individual gins.

Methods of computing requirements for both piping and fans are explained in the following two sections.

Piping for Seed Cotton

From 800 to 1,000 cubic feet of air per minute is usually required at the unloading telescope to supply seed cotton to each gin stand, depending on the type of system and the length of suction piping. If a cotton-house suction pipe is included, a modernized piping layout may be designed to give the same friction loss and constant volume from the cotton house as from the unloading telescope, thus affording a satisfactory conveying velocity in the largest pipe.

In such a system, the telescope suction velocity may be maintained at 5,000 to 6,000 linear feet per minute so that smaller piping on this short run will give the same resitance as the longer line of larger piping to the cotton house. The selection of fan size and speed is thus simplified and more economical operation assured.

Diagrammatic plans of piping for the two systems—with and without cotton-house pipe—are shown in figure 15. Table 3 gives information on ranges of air volumes, fan-wheel diameters, and speeds required for satisfactory operation of various sizes of ginning fans. In the cotton-house system of figure 15, approximately the same resistances or static pressures are used for both unloading at wagon and for the cotton house. Improved types of separators having less leakage than allowed for in tables 2 and 3 will reduce the fan speed and power requirements correspondingly.

In these systems, the unloading and overflow telescopes may be of different sizes, but where cotton-house suction and overflow employ the same piping in part, the full size of the cotton-house line should be continued to the separator, with reduced size takeoff and valve for the overflow connection. Valves in all seed-cotton suction lines should be placed in a vertical position to prevent unequal distribution of seed cotton into the separator. Piping diameter from the separator to the fan should be more than one-half of the fan-wheel diameter, without reduction into the fan inlet. In all cases the diameter of this piping should be equal to or greater than that for the seed-cotton suction line.

TABLE 2.—*Average pipe diameters, air volume, and power required at given static pressures for various cotton gin piping systems having 80-saw stands* [1]

Piping system and static pressure	Three-stand battery			Four-stand battery			Five-stand battery		
	Pipe diameter	Air volume	Power required	Pipe diameter	Air volume	Power required	Pipe diameter	Air volume	Power required
Cotton unloading:									
Suction from truck or bin to separator with free discharge (static pressure 12½ inches)	*In.* 10	*C. f. m.* 4, 000	*Hp.* 16	*In.* 11	*C. f. m.* 5, 000	*Hp.* 19	*In.* 12	*C. f. m.* 6, 000	*Hp.* 22
Suction from truck or bin to separator but blowing trash (static pressure, 15 inches)	10	4, 000	20	11	5, 000	24	12	6, 000	28
Cotton drying:									
Suction through combined tower and cleaner (static pressure, 18 inches)	16	6, 000	34	16	7, 000	39	16	8, 800	50
Blow-through combined tower and cleaner (static pressure, 15 inches)	16	6, 000	25	16	7, 000	33	16	8, 800	41
Air-blast piping: To nozzles of gin stands and lint cleaners (static pressure, 12½ inches)	16	4, 500	18	16	6, 000	22	18	7, 500	27
Trash blowing: To cyclone at gin wall (static pressure, 10 inches)	10	2, 750	10	10	2, 750	10	12	4, 000	14
Seed blowing: Rotary pumps or turbo-blower, small-pipe system (static pressure, 56 inches)	4	400	5	5	670	10	6	1, 050	15

[1] Pipe diameters and power requirements are shown to the nearest whole number. When resistances are less than those indicated, the power can be reduced to the minimum by correctly setting the intake dampers on fans and blowers.

TABLE 3.—*Air volumes and velocities, fan size and speed, and power required for operation of various ginning systems with and without cotton house and with various sizes of pipe for 80-saw stands*

Arrangement and size of ginning system	Volume of air required at fan inlet	Wheel diameter of 18-blade suction fan	Fan speed[1]	Approximate power required	Suction piping [2]			
					Unloading telescope line [3]		Cotton-house line [4]	
					Diameter	Velocity	Diameter	Velocity
With cotton house:	*C. f. m.*	*In.*	*R. p. m.*	*Hp.*	*In.*	*F. p. m.*	*In.*	*F. p. m.*
3 stands	4, 000	26	1, 620	16	11	6, 060	13	4, 350
4 stands	5, 000	30	1, 680	20	12	6, 370	14	4, 700
5 stands	6, 000	33	1, 720	25	13	6, 500	14	5, 650
Without cotton house:								
3 stands	4, 000	26	1, 450	16	10	7, 300	----	----
4 stands	5, 000	30	1, 560	19	11	7, 600	----	----
5 stands	6, 000	33	1, 620	24	12	7, 650	----	----

[1] Average of several makes of 18-blade shrouded fans. Tip speeds up to 15,000 feet per minute are considered to be safe.
[2] For diagram of piping, see fig. 15.
[3] Equivalent length, including elbows, 50 feet from separator to nose of telescope.
[4] Equivalent length, including valves and elbows, 150 feet from separator to cotton-house suction point and 50 feet from separator to nose of telescope.

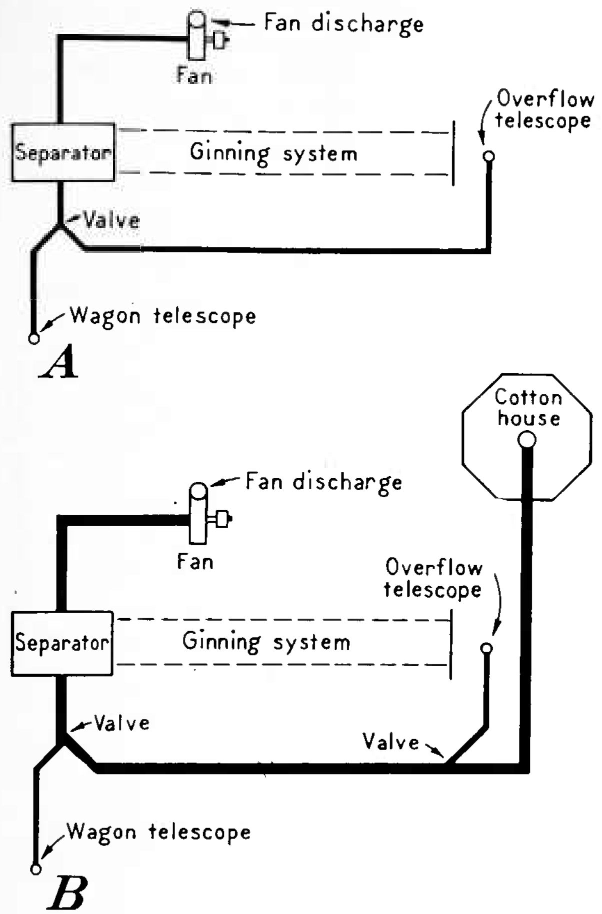


FIGURE 15.—Schematic diagrams of typical cotton-gin piping systems: *A*, With unloading and overflow suction only; *B*, with unloading and overflow suction together with cotton-house piping.

In a pneumatic-elevator system (having no mechanical separator) the above suggestions will also apply. However, if no ginned seed is to be blown by the fan discharge, a cutoff valve of the butterfly or stove-damper type on the fan inlet will save power by reducing the load on the fan when the gins are idling.

Where lengths of piping are different from those given in table 3, the cotton-piping chart (fig. 16) will be of assistance in working out the friction losses, in order to balance or give equal losses to the unloading and cotton-house lines.

The following example illustrates how the chart is used. A 2-stand 90-saw outfit is to be installed with a 10-inch unloading telescope and suction line, and with a length (including straight-line equivalents for all elbows) of 50 feet between the nose of the telescope and the valve at the separator inlet. It should require not more than 3,000 cubic feet per minute, including separator leakage. It is desired to lay out a system similar to that in figure 15, *B*, in which the cotton-house suction piping will have 80 feet of straight pipe and five 90° elbows. The necessary calculations are given in the following tabulation:

Unloading suction line

1. From figure 16, the friction loss per 100 feet of 10-inch piping handling 3,000 cubic feet of air per minute is 4.80 inches.

   Since length of the unloading suction line is 50 feet, its loss is 2.40 inches.

Cotton-house suction line

2. To balance the loss from the unloading line (first column), the friction loss of the cotton-house line must be 2.40 inches.
3. Equivalent lengths of proposed piping as fractions of 100 feet—straight pipe, 0.80; five elbows at 10 feet each, 0.50; total, 1.30.
4. The loss per 100 feet must therefore be 2.40 inches divided by 1.30, or 1.85 inches on the U-tube gage.
5. Figure 16 shows that a 12-inch pipe will be needed to deliver about 3,000 cubic feet per minute with this friction loss.

There must always be an adequate "velocity head" to provide an ample flow of air. Velocity head is a special measure of pressure that will produce a desired velocity. It is given in inches of water at the left of figure 16 to correspond with the mean velocities shown. It must be counted in, but is not separately indicated on the readings of a gage.

In the foregoing example, the dotted line for 1.85 inches of water resistance per hundred feet of piping intersects the line for 12-inch diameter pipe (which extends diagonally upward to the right) between the 3,500- and 4,000-feet-per-minute diagonal lines of velocity. This is not a particularly strong suction, but is considered sufficient to warrant the use of the 12-inch pipe, which requires a 1-inch velocity head in order to obtain a velocity of at least 3,650 feet per minute.

General Rules for Piping

Certain general rules for successful installations of seed-cotton handling systems have been established after many years of experience. Some of these rules are:

1. Make the piping as simple and direct as possible by eliminating unnecessary elbows and valves.
2. For good suction in a seed-cotton pipe, maintain velocities of 4,000 to 7,000 feet per minute.
3. For blowing trash and seed, the velocity in the pipe should be at least a mile a minute, and hence the pipe diameter should be kept between 10 and 13 inches. This does not apply to small-pipe seed-blow systems where the velocity is held to approximately 4,250 feet per minute, while the pressure is greatly increased and the volume of air is reduced.
4. Piping for cottonseed and seed cotton should not slope downward in the direction of flow. Downward slopes may cause chokes.
5. Allowing 45 cubic feet of air for each pound of material, unloading and overflow suction piping should be such

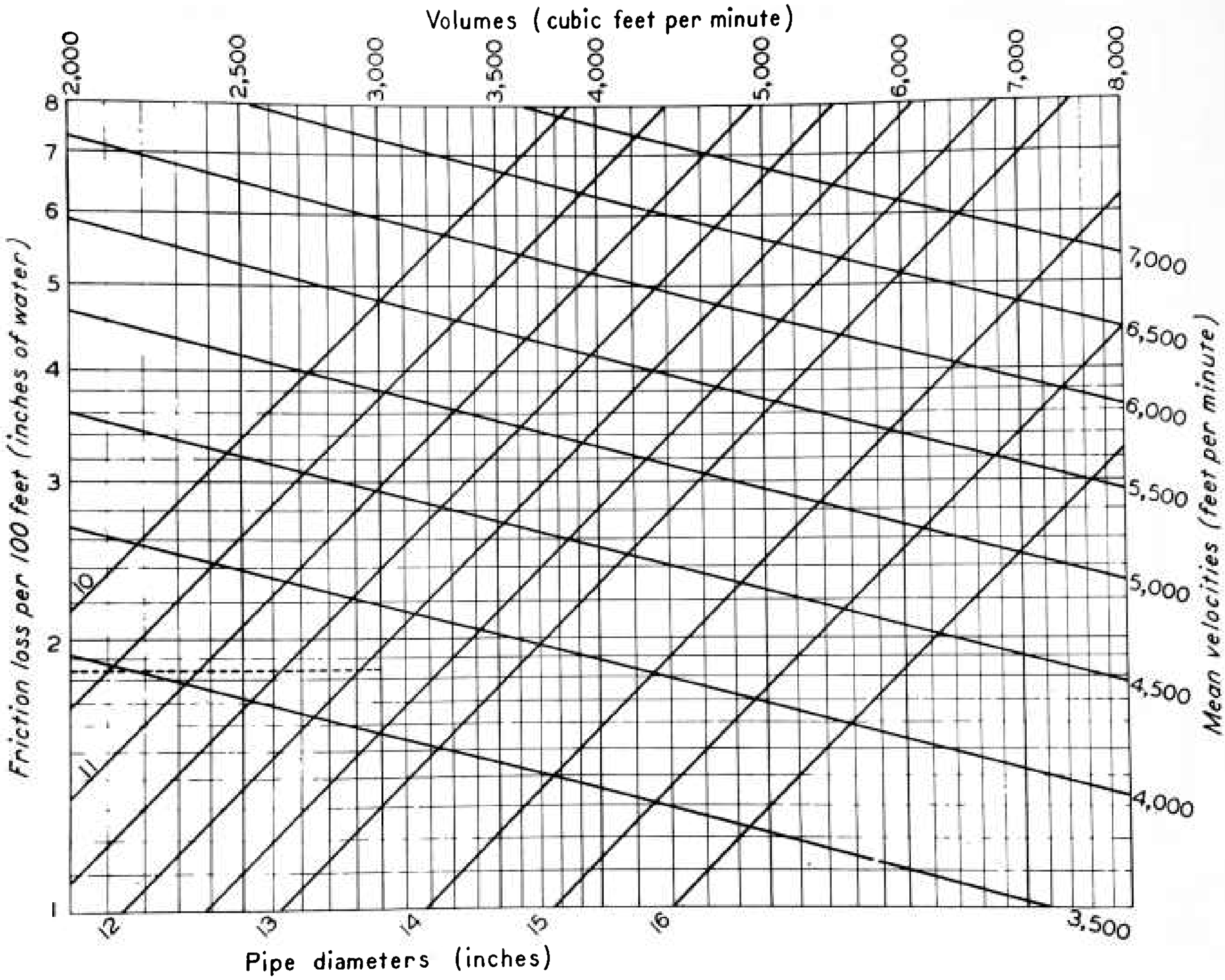


FIGURE 16.—Cotton-piping chart, giving friction losses in inches of water per hundred feet of piping for different pipe diameters, air volumes, and air velocities.

as to obtain the highest velocity with the required air volume. A 10-inch suction line is adequate for 3-stand, 80-saw gins, an 11-inch line for 4-stand gins, and a 12-inch line for 5-stand gins; but for 90-saw gin stands, piping sizes 1 inch larger than for 80-saw units are suggested.

6. For cotton houses, a rembert-type fan is simple and economical for handling seed cotton, but a standard fan and separator with correct piping can be employed satisfactorily when used with a belt or screw conveyor in horizontal houses and with a revolving discharge chute into bins of octagonal houses. Fire hazards must be avoided in both systems.

7. The friction loss in cotton piping from the cotton house to the gin should equal approximately that in the unloading-suction line, so that a constant speed of the cotton fan can be selected that will be equally efficient for both.

Fans

Fans are used in cotton gins chiefly (1) to convey seed cotton from the truck, trailer, or other conveyance, or from the cotton house to the ginning machinery, (2) to operate cotton conditioners or driers, (3) to supply necessary volumes of air to the doffing nozzles of air-blast gins, and (4) to convey seed, hulls, and trash.

Two kinds of fan wheels—the standard type and the rembert type—are shown in figure 17. Housings or casings for fans should be of the universal type so they may be mounted from either right or left and be adjustable to at least eight positions. Standard-type wheels may be used in cast-iron casings of various designs, but rembert-type wheels should be used in a flat, scroll casing for best results in handling seed cotton through the fan.

Standard-type fans are used primarily in the ginning system and may have plain, flat blades (fig. 17, *A*) or shrouded blades (fig. 17, *B*). Straight-blade fans have a wide range of interchangeability and a long service life not usually found in multiblade shrouded wheels. They may handle trash [8] through the fan wheel, but rembert-type wheels (fig. 17, *C*) should handle neither trash nor seed cotton through the fan.

Table 4 shows the approximate range in volume that can be expected from both types of standard No. 40 (33-inch diameter) fan. Maximum advisable speeds are also shown. The data are averages of the characteristics of several makes of fans.

[8] Refer to Appendix, fig. 41, for quarantine code fan-wheel diameters and speeds required for handling trash containing pink bollworms.

Rembert-type fans are most commonly employed at cotton houses for cotton conditioners as well as for unloading seed cotton from trucks to storage bins. The cone fan designed by the USDA Cotton Ginning Research Laboratories is very efficient for such purposes, because it provides ample air volumes and does not crack seed. For long service the cone of the casing should be lined with rubber sheeting to reduce abrasion and wear. It has been an occasional practice to use such fans for the ginning systems in order to replace separators and standard fans. In many installations,

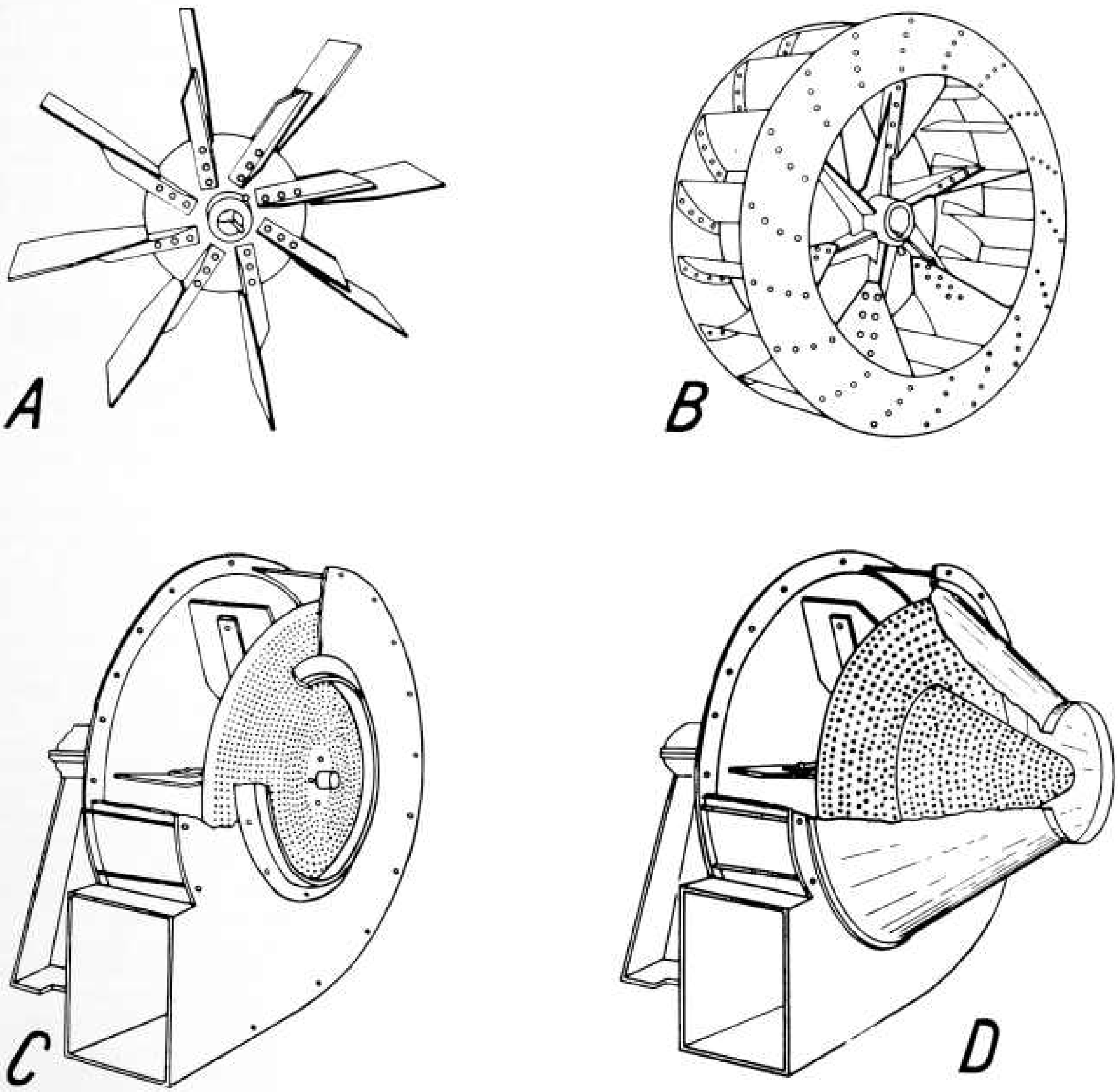


FIGURE 17.—Representative types of cotton-gin fan wheels: *A*, Plain 8-blade wheel; *B*, shrouded 18-blade wheel; *C*, rembert-type wheel, in casing; *D*, rembert-type cone developed by the USDA Cotton Ginning Laboratories (public patent).

TABLE 4.—*Fan speeds, air output, and power required for No. 40 plain 8-blade fan and No. 40 shrded 18-blade fan at 12 inches of static pressure* [1]

Plain 8-blade fan			Shrouded 18-blade fan		
Fan speed (R. p. m.)	Air output	Power required	Fan speed	Air output	Power required
	C. f. m.	*Hp.*	*R. p. m.*	*C. f. m.*	*Hp.*
1,450	2, 540	12. 3	1, 681	3, 140	12. 8
1,500	4, 370	18. 5	1, 690	4, 250	19. 6
1,600	6, 100	26. 4	1, 720	6, 000	23. 0
1,700	7, 670	35. 5	1, 730	6, 500	24. 5
1,760	8, 500	41. 0	1, 740	7, 000	26. 0
			1, 762	7, 683	29. 1
			1, 775	8, 000	30. 7
			1, 790	8, 382	32. 0

[1] Data from manufacturers' tables.

electric motors are connected directly with rembert-type fans. As a general rule, flat-disk, rembert-type fans of a given wheel diameter seldom have as much capacity as standard-type fans one size smaller, running at the same speed.

The so-called high-efficiency fans have greater wheel diameters and narrower blades than standard-type fans and are operated at slow speeds. Their greater first cost is offset by lower power consumption.

In selecting the proper type and size of fan for a specific purpose, manufacturers' performance tables should be consulted. Before such tables can be used, however, it will first be necessary to ascertain the pressure, or friction loss, against which the fan is to operate and the total volume of air to be handled.

The total friction loss is the resistance in the unloading pipe, plus a velocity pressure, or head,[9] usually ranging from 1 to 3 or more inches, plus friction losses in the separator and piping to the fan inlet, plus any losses in the discharge piping of the fan. Separators may introduce a friction loss of as much as 4 inches of water, with a leakage of from 1,000 to 2,000 cubic feet per minute. The piping losses from the separator to the fan inlet plus those from the fan discharge may comprise another 3 inches.

In the system shown in figure 15, friction losses, including a 4-inch loss at the separator, usually amount to approximately 14 or more inches. Manufacturers' tables on 14 or more inches of static pressure and 5,000 or more cubic feet per minute capacity would therefore be taken as the normal basis for fan size and performance.

[9] Velocity pressures in inches of water and pipe mean velocities in feet per minute frequently encountered are, respectively: 1.2 inches at 4,000 f. p. m.; 1.5 inches at 5,000 f. p. m.; and 1.8 inches at 6,000 f. p. m.

Where fans are to be replaced in an existing piping system, it is advisable to obtain measurements of air velocity and volume before removing the old fan. These will provide a simple and dependable basis for determining the required speed of the new fan. A method of making such measurements is described in the section, Air-Blast Systems and Gages, page 20.

In buying a fan, it is better to specify the kind of wheel, wheel diameter, number of blades, and kind of casing (cast iron or steel plate, for example) than to use vague terms such as "No. 35" or "35-inch." A No. 15 fan of one company may correspond to the so-called 35-inch fan of another. It is wise to specify a fan wheel with a diameter approximately twice as large as that of the main pipe leading to the fan inlet. Such fans do not require excessive speed in either standard or rembert types.

Another factor to be remembered in choosing fans is that decreases in air density with increases in altitude affect their performance. As an example, a fan operating at an elevation of 3,500 feet requires a speed increase of about 13 percent to deliver the same quantity of air by weight as at sea level.

AIR-BLAST SYSTEMS AND GAGES

The increasing use of air-blast gages is well warranted. They enable the ginner to keep informed of nozzle pressures during operation, and thus to reduce energy requirements and maintain the output of high-quality lint.

Two distinct forms of air-blast gages are available, one for portable use on individual gin stands and the other for stationary or permanent observation at some accessible place in the vicinity of the gin.

The portable gage (fig. 18) may be made with the material shown in table 5. The instrument board may be of hardwood or softwood, finished all over, and varnished to prevent warping. The glass tubing is usually obtainable at drug stores or supply houses. Where possible, the sharp edges of these tubes should be rounded off over a bunsen burner or gas flame. Straight copper tubing should be used and the tip finished as shown in figure 19. The amount of bending required will depend on the make of cotton gin. The other items are self-explanatory.

Before putting on the dust cap, water or antifreeze solution, colored with dye or red ink, is put into the U-tube with a medicine dropper

The level of the liquid in both tubes should be brought to the zero line of the scale. If the liquid evaporates, or if difficulties in filling the U-tube prevent bringing the liquid to the desired level, then the scale may be moved to the desired position by means of the slots and adjusting screws.

TABLE 5.—*Material required for a portable air-blast gage*

Number required	Material	Description
1	Wood	Instrument board, ¾ by 3 by 24 inches.
2	Glass	Tubing, ¼ inch inside diameter by 22 inches long.
1	Copper	Tubing, ¼ inch inside diameter by 24 inches long.
1	Rubber	Tubing, for bottom of U, ¼ inch by 4 inches long.
1	Rubber	Tubing, ¼ inch by 60 inches.
1	Wood or metal	Scale, in inches.
4	Sheet tin	Straps, to fasten glass tubing.
8	Metal	Screws for clips, to suit.
2	Metal	Screws for scale, to suit.
8	Felt	Packing strips for glass and straps.
	Shellac	For cementing rubber tubing to glass or copper.
1	Paper	Dust cap with pinholes.

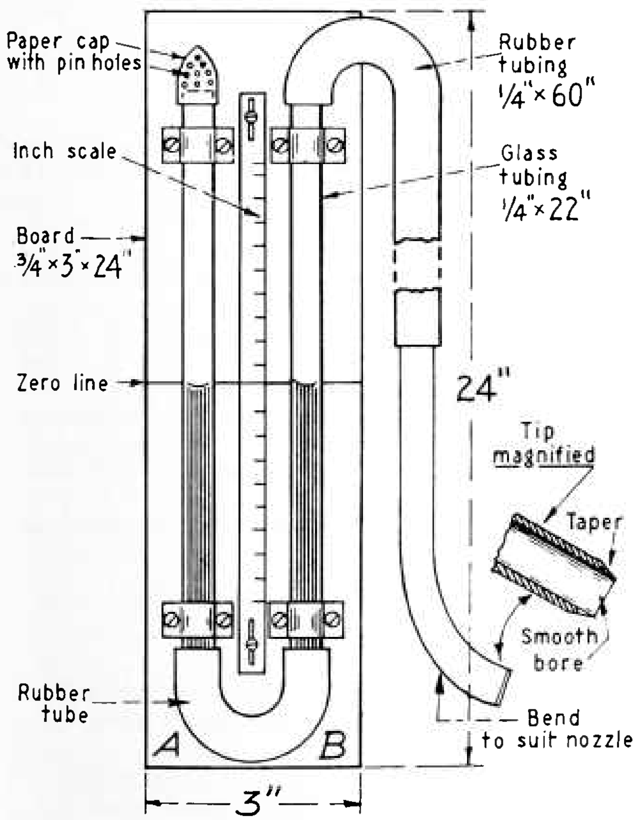


FIGURE 18.—Portable air-blast gage.

For airtightness, it is best to shellac all joints between rubber and glass or copper before slipping the rubber tubing into place.

To use the gage, first see that it is plumb and that the surface of the liquid in both glasses is at

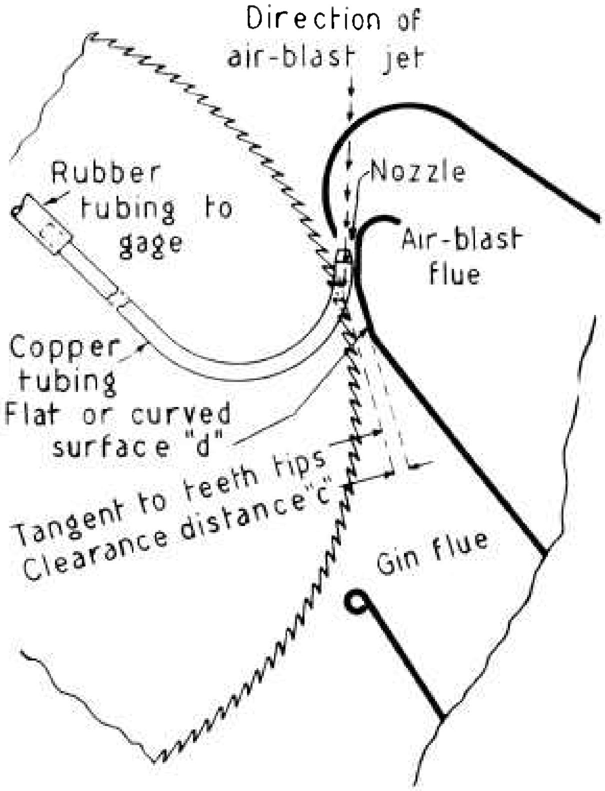


FIGURE 19.—Positions of tip of copper tube for checking air-blast nozzle pressure.

the zero limit. Then hold the tip of the copper tubing so that it almost touches the nozzle of the air-blast flue, as shown in figure 19. The air blast must blow into this tip in a straight line. The liquid in the adjacent leg of the U-tube will then fall below the zero line, while that in the opposite leg will rise an equal distance above it.

The distance between the two levels of the liquid in the U-tube gives the pressure reading. For instance, if the liquid rises 6½ inches above the zero point in one leg and falls 6½ inches in the other, the pressure at the nozzle is 13 inches of water.

Readings at both ends of a gin stand on its air-blast nozzle should be the same, and all readings at the various nozzles in a battery of stands should be reasonably alike. If the nozzle pressures are too low for satisfactory operation, it does not necessarily mean that the air-blast fan must be speeded up. Other mechanisms in the ginning plant may be at fault. The distributing partitions that supply the nozzles may not be airtight, may be choked up, or may be loose at some point near the nozzles. The air-blast piping may also be leaky, may have too many bends and restrictions, or may be choked with foreign matter. The nozzles may be warped or damaged, and they may not be parallel to the saw cylinders or set at the correct distance from the tips of saw teeth. This position depends upon the angle at which the air blast is intended to blow against the saw teeth, which varies with the make of gin.

As shown in figure 19, the clearance between nozzles and tips of saw teeth is usually measured at *c*. This is taken on the curved or flat surface, *d*, below the nozzle opening. It is advisable to adjust this distance to suit the pressures, atmospheric conditions, and kinds of cotton handled.

When an old fan is to be replaced in an operating system, actual readings with an air-blast gage will provide the most reliable measure of the total load against which the fan must operate. Such readings should be taken before the old fan is dismounted. To make this test, two 1/16-inch holes with smooth edges should be drilled into the pipe, one near the fan intake and the other near the discharge. Readings can be made by removing the copper tube from the gage and pressing the open end of the rubber tube over the hole. A test should be made at each of the holes and the two readings added to a velocity head of 1 inch to show the total load on the fan. Manufacturers' performance tables will show the correct fan size for the pressure load thus found and the horsepower required to propel the fan.

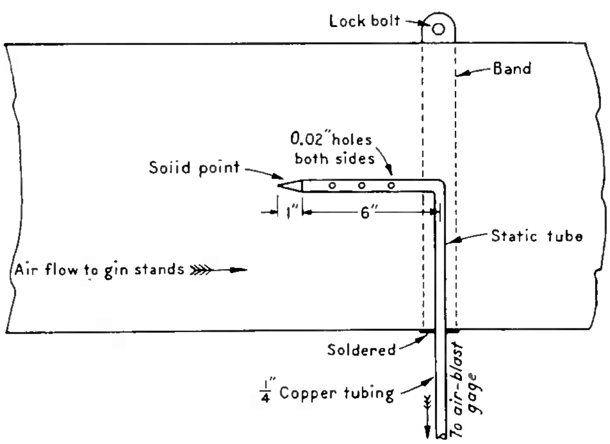


FIGURE 20.—Details of static tube and installations.

The stationary gage (fig. 20) is identical with the portable one, except that the tip 6 inches of the copper tube is bent at a right angle, the open end filled with a pointed plug, and three evenly spaced holes, 0.02 inch in diameter, are drilled through the tip arm of the tube.

This copper static tube should be mounted at the end of the air pipe, and it is essential that the tip arm be centered in the air pipe and pointed toward the fan, that is, into the air current. For this mounting a longer rubber tubing is usually needed than for the portable gage. Sometimes the rubber tube is dispensed with and the metal tube run to the gage proper, but rubber tubing probably withstands vibrations longer without leaking.

Air-blast nozzle pressures can be readily controlled by changing the area of the fan intake, and the stationary air-blast gage should be positioned so that pressures may be observed while adjusting the control device. Figure 21 is a sectional view through fan intake and screen box, showing the air-blast pressure control devised at the ginning laboratory. This arrangement gives the ginner fingertip control at all times without the necessity of changing fan speed. On sunny days with dry cotton, the air-blast pressures at sea level may be reduced as low as 10 inches on the water gage; damp weather and wet cotton may necessitate a higher pressure to get the best ginning.

Where a slide damper is used instead of the cone valve on the intake pipe, it should be placed as far away from the fan as possible, to minimize cavitation and air eddies that tend to prevent uniform entrance of the air into the fan housing. It should also be borne in mind that slide dampers do not regulate air volume in exact proportion to the size of the opening. In other words, a half-closed damper only reduces the air volume to 65 percent of that admitted at a full opening. Adjustment of the damper while observing the air-blast gage will, however, enable the ginner to obtain the desired pressure for best operation.

If it becomes necessary to speed up an air-blast fan, it is important to remember that capacity varies directly with the speed, that pressure varies with the square of the speed, and that power varies with the cube of the speed. Suppose, for example, that an outfit of three 90-saw stands is supplied by a fan operating at 1,404 revolutions per minute, with 11.7 horsepower, and delivering 3,868 cubic feet of air per minute with a pressure of 11 inches on the gage. Speeding up the fan to 1,520 revolutions per minute increases the power consumption to 14.8 horsepower, the pressure to approximately 13 inches, and the delivery of air to 4,187 cubic feet per minute.

These fan relation ratios may be stated as follows:

$$\frac{\text{Original volume}}{\text{Final volume}}=\frac{\text{Original speed}}{\text{Final speed}}$$

$$\frac{\text{Original pressure}}{\text{Final pressure}}=\frac{\text{Original speed squared}}{\text{Final speed squared}}$$

$$\frac{\text{Original horsepower}}{\text{Final horsepower}}=\frac{\text{Original speed cubed}}{\text{Final speed cubed}}$$

The air-blast fan is, at best, a rather inefficient pump. Its intake should therefore be arranged so that air will flow smoothly into the casing. Discharge piping should be as simple as possible. Control of volume and pressure is much more economical on the inlet than on the outlet of these

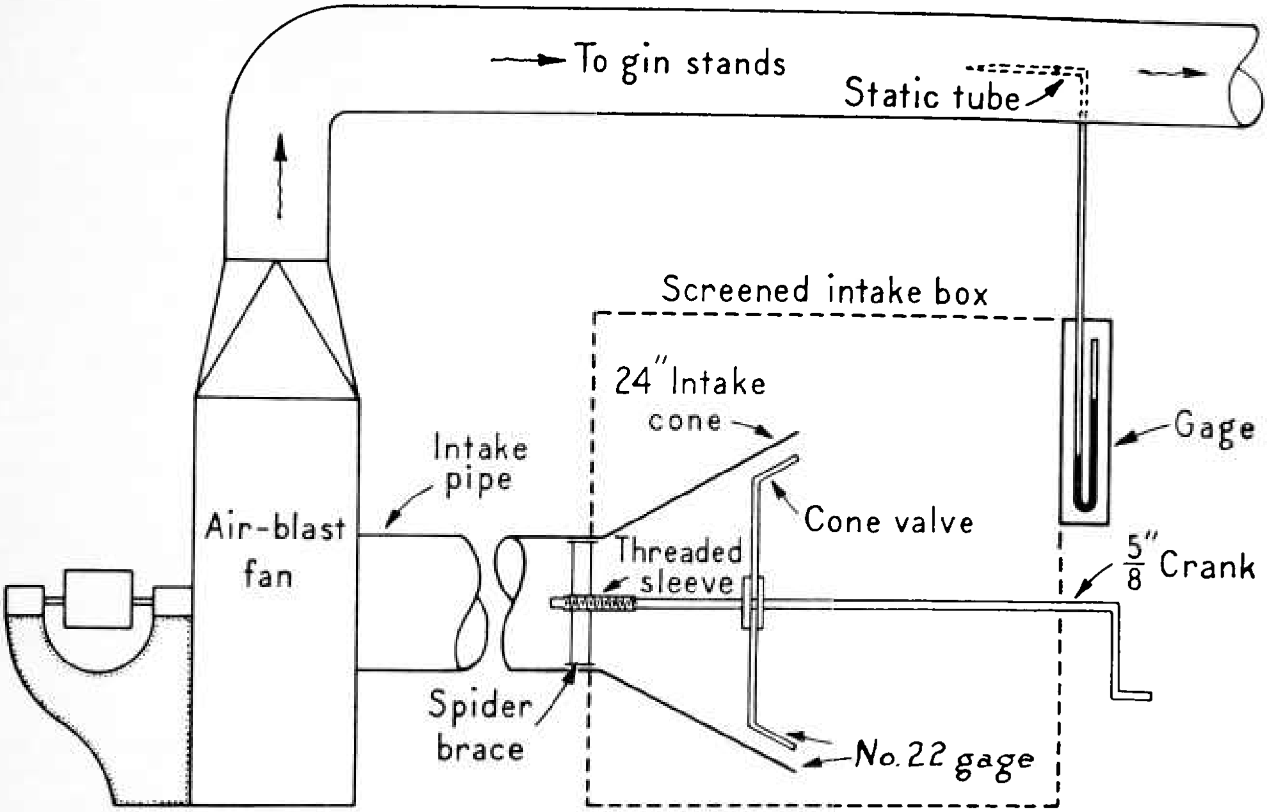


FIGURE 21.—Features of the air-blast fan-intake control and gage designed by the USDA Cotton Ginning Research Laboratories.

fans, and for this reason it is not good practice to insert any dampers in the fan discharge.

GIN-MACHINERY AUXILIARIES

The profitable operation of a cotton gin depends in part on such auxiliaries as power units, bearings, belts, and pulleys. They should therefore be selected with care.

Power Units

The principal characteristics desired in cotton-gin power units are constant speed, ample capacity to handle overloads, durability, and cheapness in operation and maintenance. The most common sources of power are electric motors and steam, diesel, gas, and gasoline engines. Each has significant advantages and disadvantages.

Several factors need to be considered in selecting a power unit for a given installation. Among these are: Amount of power required, first cost of the equipment, cost of fuel or electric energy, cost of lubrication, kind of labor needed, expense of maintenance, probable length of life, and decrease in power capacity resulting from use.

A safe engineering method of estimating total nominal horsepower needed from engine or motor in a modern cotton gin is as follows: Allow for each gin saw (*a*) for hand-picked cotton, 0.45 horsepower; (*b*) for machine-picked cotton, 0.93 horsepower; and (*c*) for machine-stripped cotton, the roughest type, 1.25 horsepower. Thus, a three-stand 80-saw (3/80) cotton gin for (*a*) would need 108 horsepower; a 4/80 for (*b*), 300; and a 5/90 for (*c*), 563 horsepower.

The amount of electrical energy required will vary considerably, depending on how constant and intermittent loads are handled and upon the extent of the use of fans and other accessories. In electrically operated gins, it is highly advisable to carry the various loads[10] of intermittent work of pumps, presses, and seed loading with separate motors rather than from the main motor. Electric-power companies usually give consulting and testing services to their patrons.

Steam gins are decreasing in number, because they are not conveniently adaptable to intermittent and prompt service and because supplies

[10] Refer to Appendix, table 6, for amount of horsepower needed for various ginning units and gin batteries.

of cheap fuel are disappearing. Furthermore, some State regulations are increasingly stringent in that steam boilers are now subjected to periodic inspection and licensed operation. However, modern steam engineering has made such rapid improvement in construction and practices that large commercial gins might obtain very effective and economical installations. Where steam is available for ginning cotton it has the added advantage of being on hand for conditioning and sterilizing equipment and for extinguishing fires.

Diesel, gas, and gasoline engines have much to commend them for the seasonal service of cotton ginning. In selecting such engines the purchaser should allow for a liberal margin in power over that which is actually required. Most manufacturers now list their engine ratings at the maximum power produced when the engines are new, and the purchaser should bear in mind that the capacity will decrease with service.

Power Transmission

Ball or roller bearings should be substituted wherever possible for friction-type bearings because of numerous advantages. All frictionless bearings must be carefully guarded against damage from grit and dust, and approved commercial types designed for such service should be selected.

The alinement of shafting and bearings is important to the uninterrupted and economical operation of any gin, and this necessitates suitable pedestals or other anchorages for the bearings. For 2-story gins, concrete pedestals are desirable on the ground floor; but for 1- or 1½-story gins, adjustable iron floor hangers are frequently preferable. Where the shafting is built up of separate lengths coupled together, it is much better that the drive should be made at the center rather than at one end so that torsion and breakage may be minimized. Couplings should be of the safety type shown in figure 22.

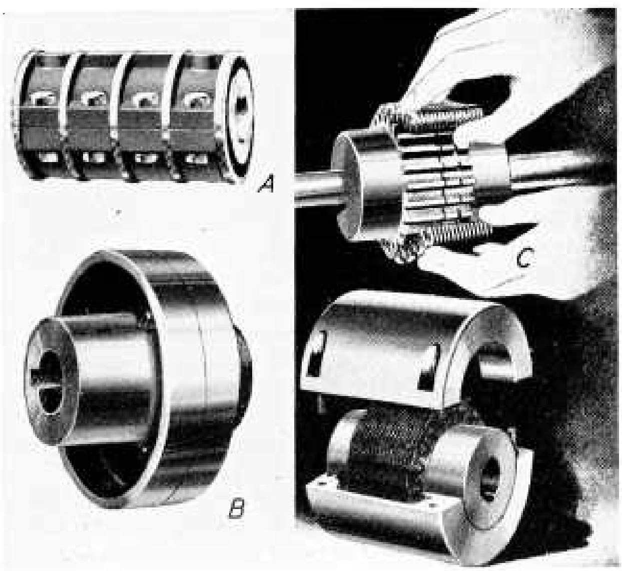


FIGURE 22.—Safety shaft couplings: *A*, Marine type; *B*, flange type; *C*, flexible-chain type.

In installing new shafting as many belts and pulleys as possible should be eliminated, because they constitute sources of expense, trouble, and power loss. While flat belts of adequate center lengths are about as efficient as V-belts, properly selected V-belts make very neat, safe, short drives, and under certain circumstances are satisfactory for right-angle drives.

Either flat or V-belts must be selected with maximum capacity in excess of the actual load to be propelled. It is far better to have oversized flat belts or a few extra V-belts in any drive than to face the delay, expense, and possible damage that may arise through the use of undersized belts. Composition beltings of various kinds may be used for seasonal service, but the greatest economy does not necessarily lie in the cheapest belt. The duty of each drive should be carefully considered in deciding on the kind, capacity, and other specifications of the belt.

Separators and Distributors

The air-handling systems in cotton gins are usually operated in conjunction with separators, pneumatic chutes, distributors, lint flues, and condensers. The general requirements for the seed-cotton suction and air-blast piping have already been discussed. The allowance of 800 to 1,000 cubic feet of air per minute per gin stand, previously made for the unloading system, does not include an estimated 1,200 or more cubic feet per minute for air leakage and losses at the piping joints and separators, which frequently have faulty vacuum wheels or poorly fitted distributor seals. Improved forms of separators now on the market employ revolving screens and vacuum wheels that handle much damper and trashier cottons with lower air losses and fewer chokages than will older types with stationary screens. The working width of every separator in a cotton gin should equal that of the cleaner or hopper upon which it is placed, and the free area of its separating screen surfaces should be more than double that of the suction pipe to fan.

Various types of modern separators are shown in figure 23. Separators with revolving vacuum wheels have proved superior to those depending on a belt distributor with solid flaps to maintain an air seal. A vacuum wheel is essential when beltless forms of distributors are used, or when one separator is used for two purposes, as in several kinds of modern drying installations.

Distributors of various forms have comprised the backbone of ginning outfits since the introduction in 1883 of air piping for handling seed cotton. The marked improvement in separators that began

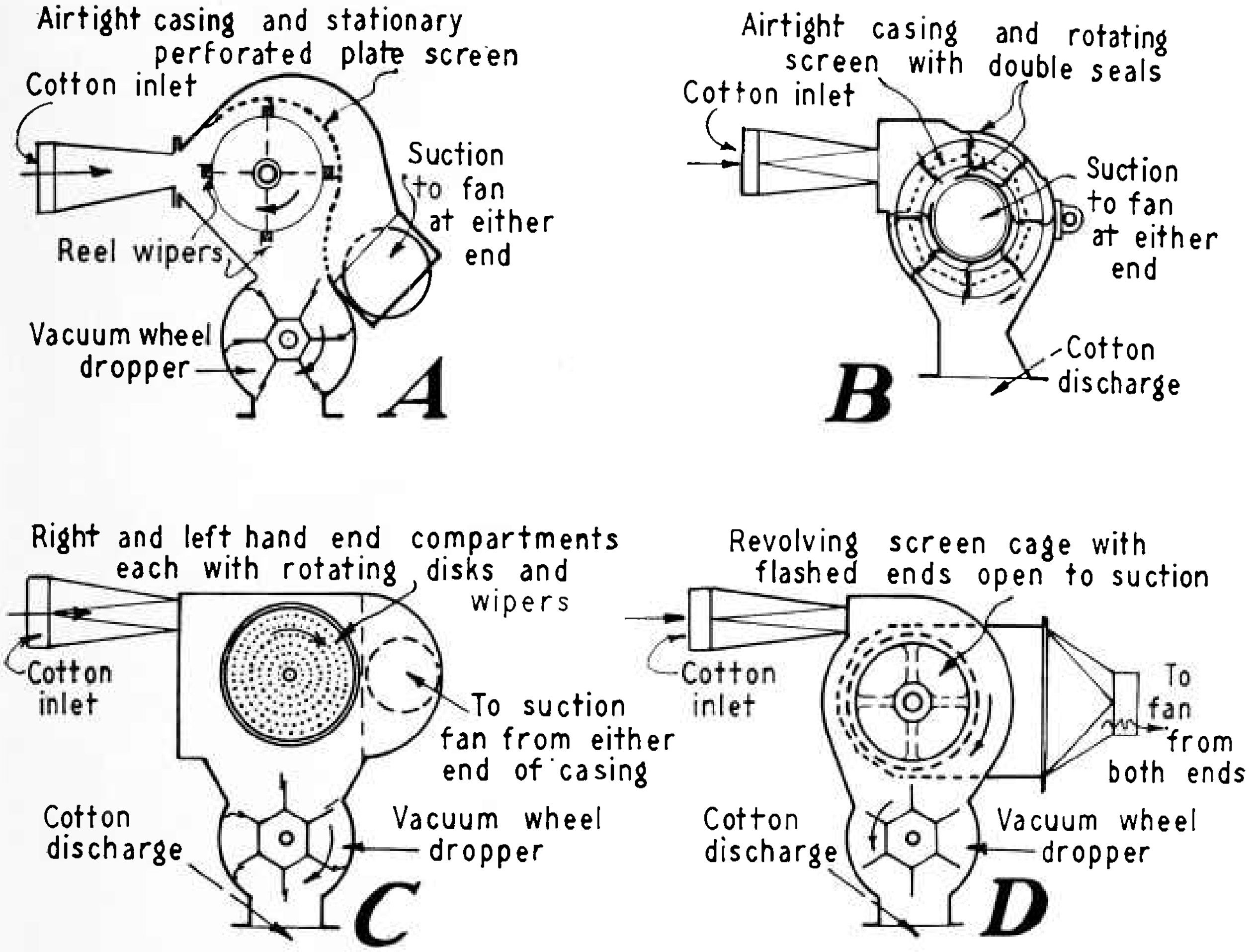


FIGURE 23.—Modern types of separators: *A*, Stationary curved screen with wiping reel; *B*, revolving cylindrical screen with trash conveyor; *C*, vertical double-perforated disk with wipers; *D*, revolving drum screen.

about 1928 was accompanied by the immediate development of better distributors—the principal forms being those in all-steel design of screw and gyrator type to replace belt and pneumatic-elevator distributors. Screw distributors or conveyors are on the market with both single and double flights, ranging usually from 10 to 16 inches in diameter and making from 100 to 150 revolutions per minute in a sheet-metal trough, in the bottom of which are pivoted change-bale valves to control the feeding of units beneath. Gyrator distributors incorporate a tedding or kicking action through spring-steel wires for moving the seed cotton along a sheet-steel trough to the change-bale valves and overflow.

Modern distributors require little attention beyond periodic lubrication, are rigid and self-alining to a great degree, use less power than belt distributors, and reduce fire hazards.

Lint Flues and Condensers

Lint flues may be located either above or below the level of the operating floor in a cotton gin, as shown in figure 24. Although the majority of lint flues are above the floor, in some recent installations lint flues have been placed below the floor to conserve space.

When properly installed, either dust backs or cleaning screens connected with condensers have proved a satisfactory aid in removing pin and pepper trash from the ginned lint. They should be cleaned daily, however, and kept in first-class condition.

The maintenance of proper static pressures in lint flues is very important, because too much pressure will produce backlash and its attendant troubles, especially if the condenser is not large enough. Lint-flue pressures should not exceed ½-inch of water for brush gins or ¾-inch for air-blast gins. Where ginners omit some of the gin stands in order to begin their operation of a new gin, it is desirable to obtain the proper size of lint flue for the full number and install the stands nearest the press first, so that extensions of the lint flue can be made as additional stands are installed.

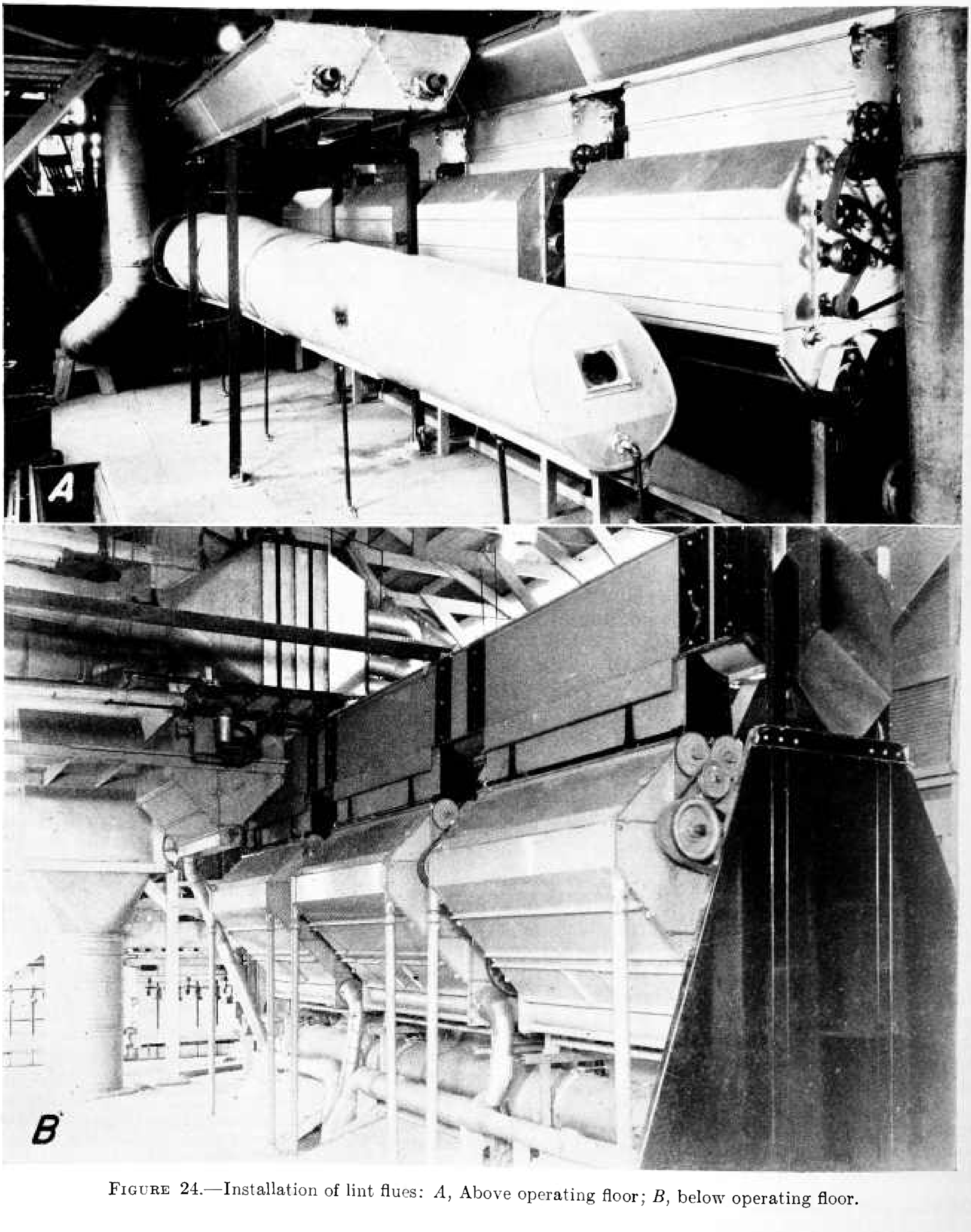


FIGURE 24.—Installation of lint flues: *A*, Above operating floor; *B*, below operating floor.

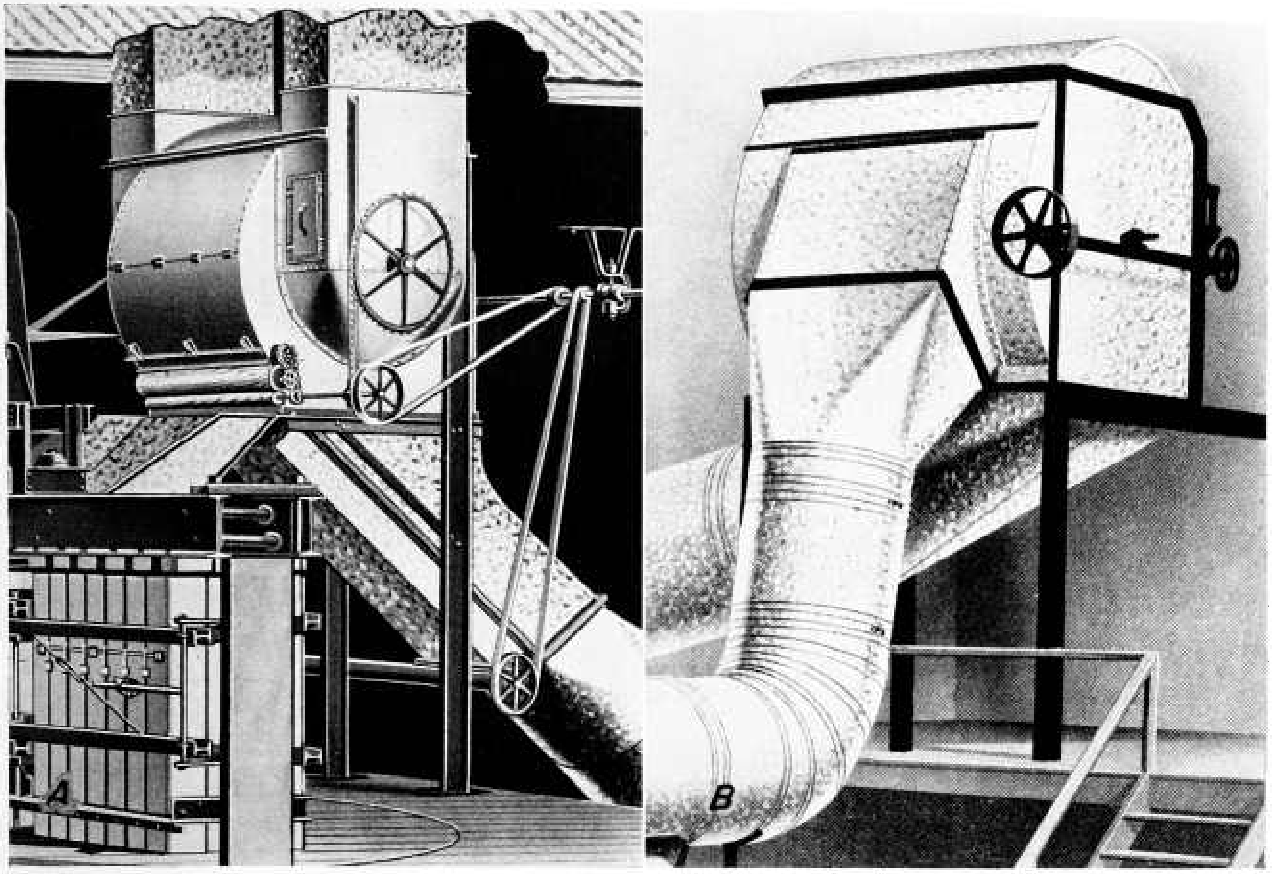


FIGURE 25.—Condensers: *A*, Up-draft; and *B*, down-draft.

All-steel condensers may now be obtained for either up or down discharge, and, when of adequate size and properly installed, should be little affected by prevailing winds if properly shielded by dust caps or dust shed. Diagrams of typical up-draft and down-draft blow-type condensers are shown in figure 25.

Modern cotton gins are making use of suction condensers for handling fiber from lint cleaners and roller gins. They are readily adaptable to all kinds of gins and have several advantages over blow-type condensers by eliminating backlash and giving a more easily controlled, uniform batt.

Presses, Trampers, and Pumps

The trend in modern cotton-gin presses has been toward all-steel construction, hydraulic pressing, mechanical tramping, and toward standard-density gin compressing,[11] where the bales move over long distances directly to consuming mills. Double-box types have supplanted most of the single-box presses in all except a few of the older small gins and are on the market in up-packing and down-packing designs.

[11] BENNETT, C. A., HARMOND, J. E., and SHAW, C. S. STANDARD-DENSITY COTTON-GIN PRESSES. U. S. Dept. Agr. Cir. 733, 16 pp., illus. 1945.

Hydraulic power for pressing has to a large extent replaced screw power, because it is simpler and more powerful and it eliminates shafting drives with clutches. With it, presses are readily adaptable for either up-packing, such as is usually found in 1½- and 2-story gins, or for down-packing, as found in 1-story gins where the bales are tied out almost at ground level.

Hand-controlled trampers are obsolete; and few steam ones are being purchased, although years of experience have proved them dependable.

Modern double-box presses have departed from the down-swinging doors that require counterweight. Instead, improved side-swinging doors with hand-wheel locks and other safety attachments are used.

The form of hydraulic pump used in modern gins depends largely on the kind of power used. It may be a motor-driven individual unit or belted to the main-line shaft. As a rule, triplex pumps and new forms of rotary pumps are most popular because of their smooth operation and freedom from trouble. Piston pumps may be either vertical or horizontal and may be provided either with tight-and-loose pulleys or V-belts, so that they may run steadily or idle between bale pressing.

It is generally advisable in motor-driven gins

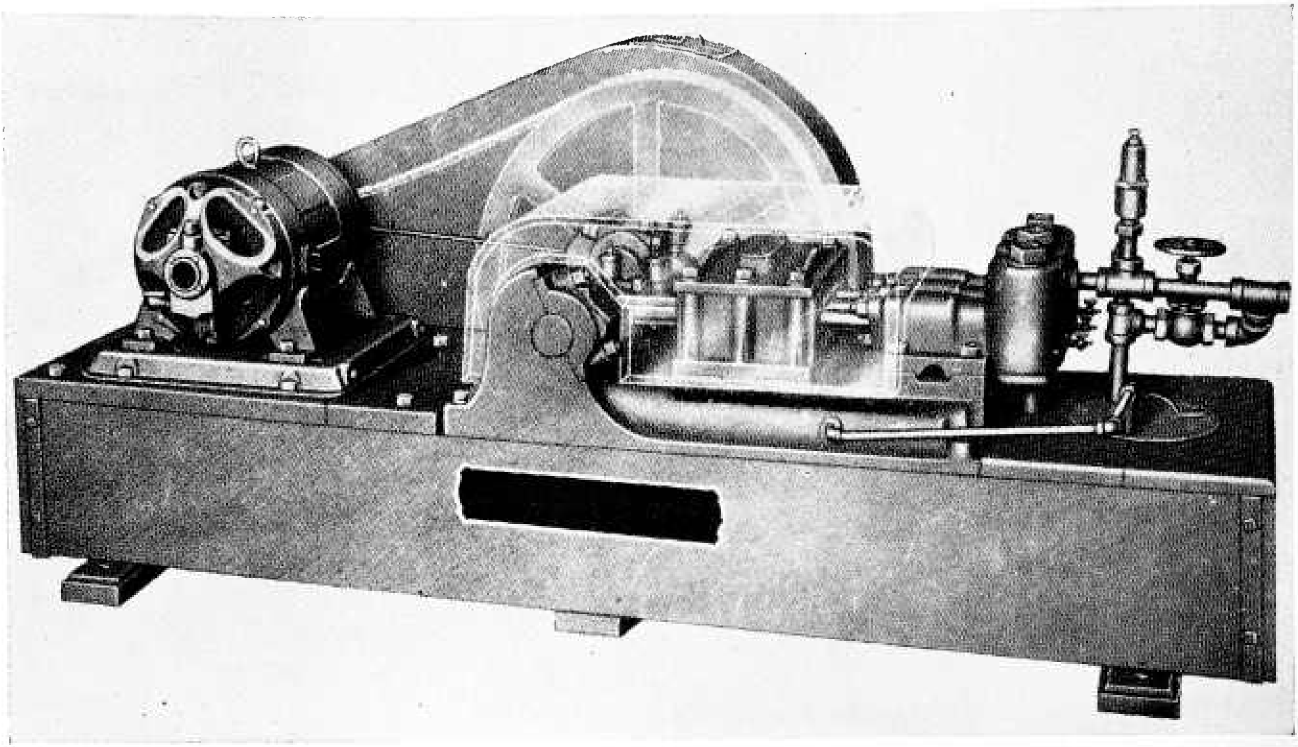


FIGURE 26.—Motor-driven hydraulic pump.

to operate the press pump with a separate motor, so that variable peak loads are not imposed upon the main motor and so that power consumption may be reduced during periods when the pump is not needed. Figure 26 illustrates such a pump.

Scales for Trucks, Bales, and Seed

Methods of weighing seed cotton, seed, and ginned lint vary widely in different sections of the country. Some gins employ only one set of truck scales for weighing seed cotton and seed. Others use truck scales to weigh the incoming loads of seed cotton, another scale to weigh outgoing loads of seed, and yardarm scales near the press to weigh the bales. The most modern installations employ (1) a truck scale for weighing incoming loads of seed cotton and outgoing loads of seed; (2) platform or yardarm bale scales located adjacent to the press; and (3) special seed scales located between the gin stands and the press so that the weight of seed per bale can be obtained during the ginning process. Figure 27 shows the method of installation of a modern seed scale in a single-story gin. After the seed has been weighed in the seed scales, it is conveyed by air, augur, or lift to wagon bin, seed storage, railroad car, or for special treatment, such as sterilizing and delinting.

Moisture Restoration and Treatments

Continuing research at the Cotton Ginning Research Laboratories of the United States Department of Agriculture is producing methods and apparatus for regulating the moisture content of the fiber to optimum amounts for each stage in the ginning processes.[12] Better cleaning results have been evidenced when the moisture content of the fiber of seed cotton is approximately 5 percent or less, while gin stand operations require approximately 7, and pressing upward to 9 percent. (See table 1.)

Artificial or natural drying usually meets the cleaning needs, and approved misting nozzles over the gin lint slide supply satisfactory regulated quantities of wetting agent solution to condition the freshly ginned fiber for sampling and pressing. Methods for the desired 2 percent addition between cleaning and ginning are now undergoing tests and further investigation.

EXAMPLES OF MODERNIZATION

The essential features of a modern gin and the improvements that can be made in selection of bulk feed controls, driers, cleaners, extractors, distributors, feeders, gin stands, and lint cleaners have been discussed in connection with figures 6 to 11, inclusive, in which figure 10 gave diagrams of elaborately equipped cotton gins.

The essential mechanical steps in processing

[12] Refer to Appendix, fig. 40, for diagram of lint slide misting system.

cotton, summarized from thousands of tests and sample evaluations, are listed in order of performance in the tabulation that follows. The "workflow" is itemized separately for processing of clean

Clean hand-picked	*Rough or mechanized harvest*
1. Bulk drying, usually one unit, with feed eontrol.	1. Controlled bulk feeding.
2. Bulk eleaning, also made uniform by initial feed control of 1.	2. Controlled bulk drying in stages.
	3. Green boll and rock trap with magnet.
	4. Controlled bulk "opening" cleaning, 5 to 7 eylinders.
	5. Controlled bulk major extraeting.
	6. Controlled bulk "finishing" eleaning, 7 to 30 cylinders.
3. Distributing to banks of gins.	7. Distributing to banks of gins.
4. Regulated feeders.	8. Regulated drier-extraetor-eleaner feeders.
5. Ginning.	9. Ginning.
	10. Lint eleaning.
6. Diseharge of fiber, seed, and foreign matter.	11. Diseharge of fiber, seed, and foreign matter.
7. Packaging and pressing.	12. Paekaging and pressing.

hand-picked cotton and of rough- or machine-harvested cotton and excludes accessory operations, such as weighing, blowing, pumping, and generating of power.

Figures 28 to 31 more fully illustrate, by line diagrams, examples of modern cotton gins, from the minimum for hand-picked cotton to the elaborate arrangements for hand-snapped and mechanically stripped cottons.

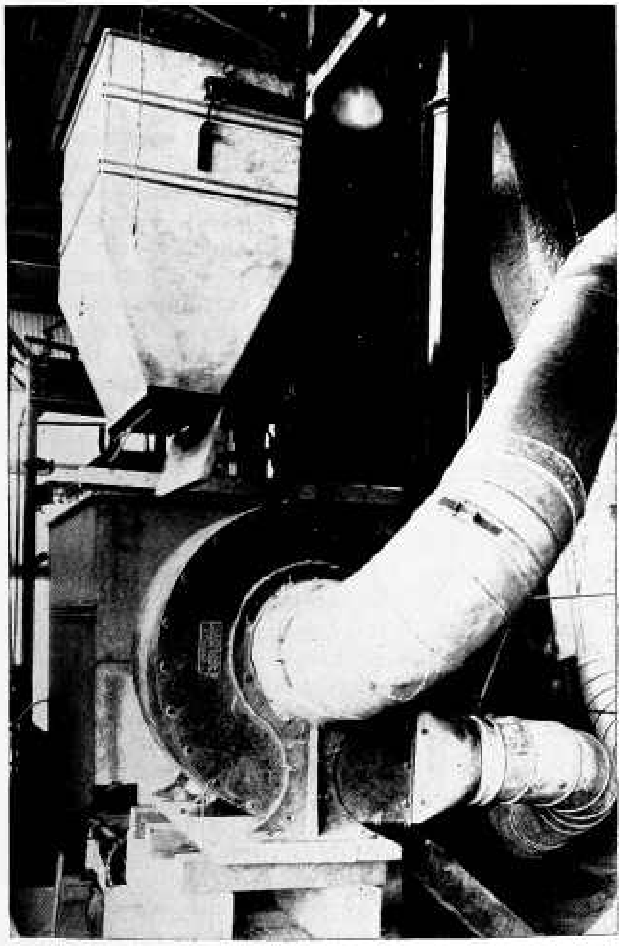


Figure 27.—Seed scales employed in a modern cotton gin.

The relationship between banks of gins, power overflow, and press has varied from the old standard plan shown in figure 32 to that of a so-ealled reverse setting shown in figure 33.

The maehinery diagrammed in figure 31 is also shown on the plan of figure 33, to indieate how the major units are kept at ground level. Sueh a modernization permits optional use of all "annex" machinery, so that any kind of eotton harvesting ean be handled eeonomically and with power saving on machine-pieked or clean hand-picked eottons.

Need for improvement in gin-building construction has long been recognized; marked advances have been made in reeent years. Typieal old-time wooden and sheet-iron 2-story gin buildings are shown in figures 34 and 35. Some of the later gins also have gable ventilating fans to reduce overhead dust and eolleetions of unsightly fly fiber. The buildings are now of greater width and height than formerly, as shown in figure 2.

Progressive ginners find it profitable to have adequate facilities for storing seed cotton in buildings or trailers before ginning and equipment for handling the seed eotton with a minimum amount of labor. An inadequately equipped old-style rectangular seed-eotton storage house, a modern octagonal sheet-metal house fitted with pneumatic unloading system, and modern reetangular and oetagonal houses equipped with a rembert-fan assembly for unloading are illustrated in figure 36.

MAINTENANCE OF GINS

Lubrication

Good lubrieation prolongs the life of the moving parts of cotton-ginning maehinery.

The value of a lubricant depends on its film-forming capaeity at any operating temperature as well as on its viscosity; henee, oils of the highest viseosity are not necessarily the best lubricants. It is advisable to select eaeh lubrieant with a view to its viscosity and film-forming capacity under the specific conditions to which it will be subjected in use. The lowest viseosity oil that will maintain

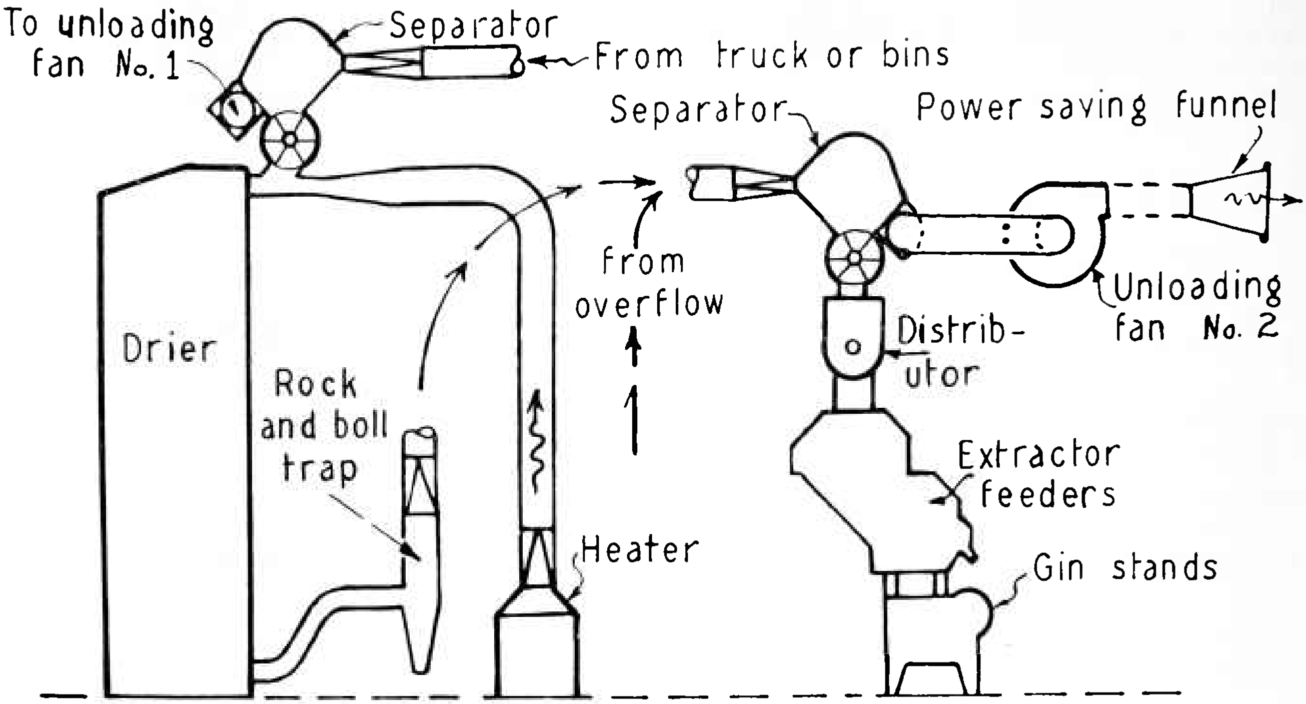


FIGURE 28.—A 3- to 5-stand gin for hand-picked cotton.

an unbroken oil film on the bearing surfaces is usually best, because oils of greater viscosity consume more power than necessary in retaining the film and in overcoming the internal resistance of the oil itself. The value of greases likewise depends on the pressures, speeds, and temperatures of the operating parts, as well as on their body weight and apparent greasiness. Greases are usually more economical lubricants than oil.

Other things to consider in lubrication are the location and types of the oil cups or grease plugs. Some bearings are not accessible for greasing or oiling except when the machine is idle, and these bearings should be of a type that will hold enough lubricant to last for some time. Bath or ring-oiling bearings are superior to friction-type bearings, because they have ample reservoirs and do not require constant attention. Roller or ball bearings require still less attention, and the savings on power will usually more than pay for their installation.

The use of good grades of oil and grease saves money. Breakdowns and hot boxes caused by inferior lubricants frequently result in unwarranted operating expense and time loss.

Lubrication charts are now generally available from most oil companies, to aid in the selection of oils and greases for various purposes. These usually indicate that shafting and machinery operating at normal temperatures and moderate speeds can use mineral oils with or without a low percentage of neutral animal or vegetable oils. In general, the heavier the machine, the slower the speed and the greater the viscosity recommended. For ball bearings and chain drives a rather thick nonrunning oil or grease is necessary. Generally, a No. 2 grease can be used for ball bearings wherever a light or medium oil is specified, and stiffer or high-temperature greases can be substituted for heavy or extra-heavy oil. For good operation, greases must have the same temperature ranges as the oils for which they are substituted. Bearings of the babbitt and sleeve type usually operate best with oils, while greases are preferable for ball and roller bearings for normal service up to 3,600 revolutions per minute. Periodic cleaning and renewal of lubricant are essential for all types of bearings.

High-speed sleeve bearings for motors require thin lubricating oils, and if the bearings are of ample size pure mineral oils may be used to advantage; but if the bearings tend to run hot, it may be necessary to use a special lubricant that contains about 10 percent of "fixed" oil to minimize wear without increasing friction.

The approximate quality and properties of most lubricating oils can be determined without using any special testing apparatus. Impurities may be roughly detected by smearing a piece of writing paper with oil and holding it against the light; the blot will be equally transparent throughout if there are no impurities; otherwise, solid particles will show. Another method is to dilute the oil with kerosene and then filter it through filter paper, which will catch any solids or impurities. To test for acids, some of the oil may be placed in a bottle and copper oxide added. If the oil retains its original color, it is free from acids; but if there are acids present, the color will become greenish or bluish. Another simple test for acid is to drop some of the oil on a piece of clean bright sheet copper or sheet brass, and examine it a week later. There will be a green spot on the surface of the sheet if the oil contains acid. It is important to consult the manufacturers of the bearings if any doubt exists as to the best lubricant to use.

Repairing

The ginner should make preseason preparations for first-class operation, including cleaning and inspection. The best time to do this is at the end of the preceding season's run, before he forgets the troubles recently encountered.

Certain operating and maintenance practices are vital from a ginner's standpoint. First among these is to have a clean gin, because it is profitable to the owner and tends to eliminate fire hazard and many mechanical troubles. At the beginning of the season and frequently thereafter the ginner should clean the plant, and it should be left clean when the last bale has left the press box.

The old-style distributor and its belt frequently cause trouble. Wooden gin buildings may settle or become warped, and if the distributor is rigidly braced to the walls it may be pulled out of line and become a pair of snake-like boxes in which the upper box serpentines in one direction and the lower box in the reverse direction. The weight of cleaning machinery on the distributor may still further aggravate this twist and misalinement. These factors cause the paper pulleys to wear off on one part faster than elsewhere. The spikes of the belt in turn are ground off on the underside of the belts when the pulley grooves disappear, and the spikes may fall into the machinery.

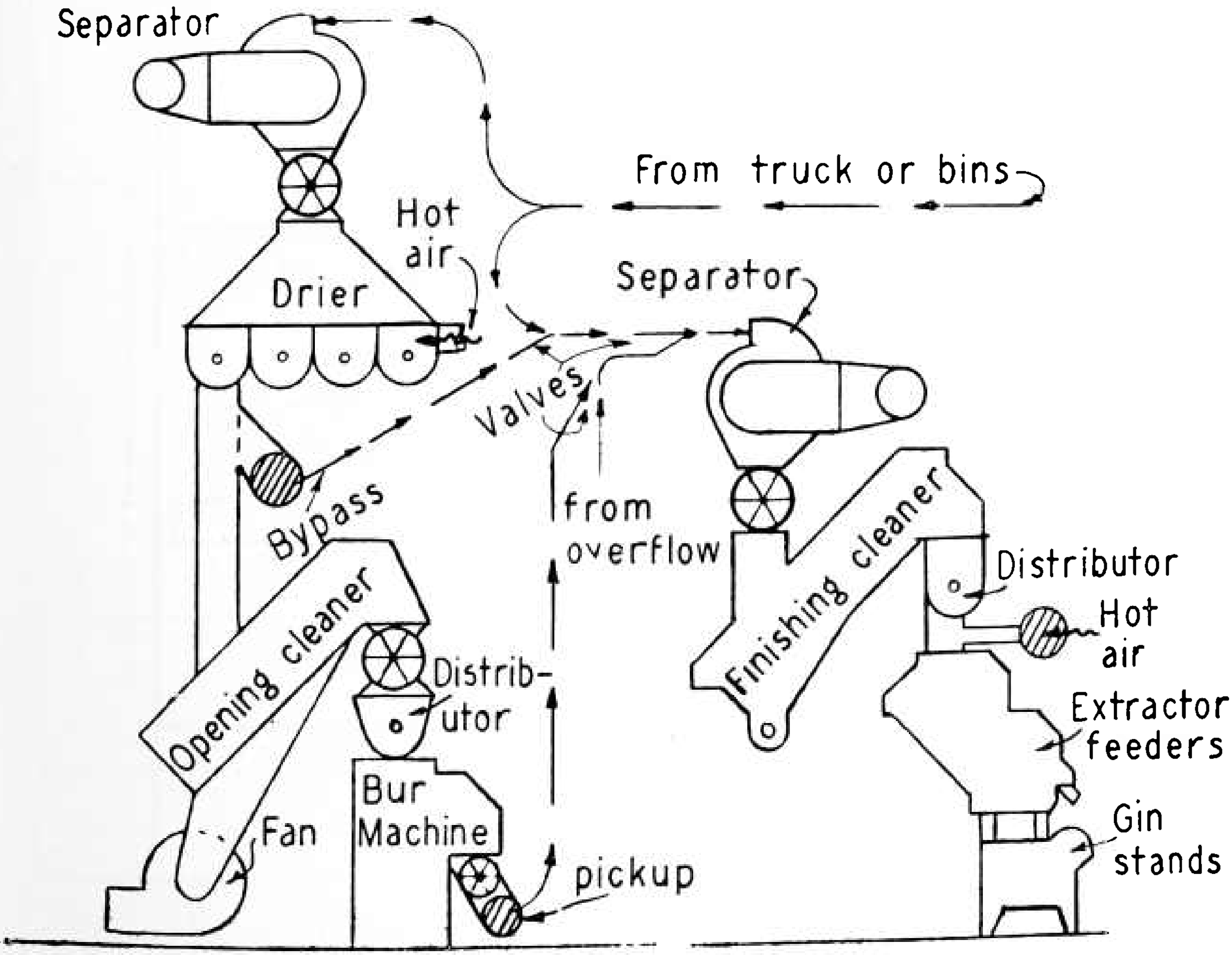


FIGURE 29.—A minimum gin for spindle-machine-picked cotton.

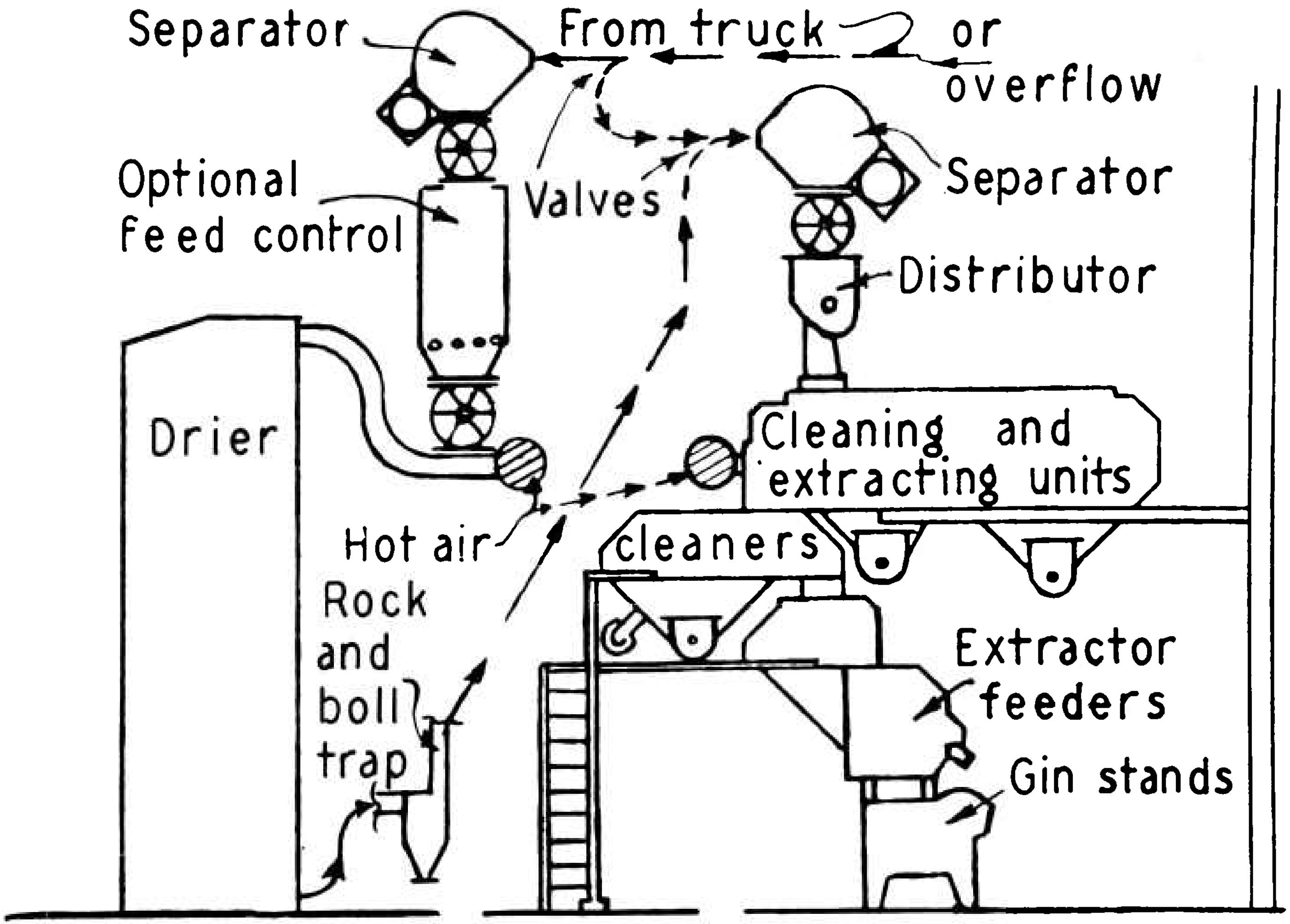


FIGURE 30.—An alternative 3-stand minimum gin for spindle-machine-picked cotton.

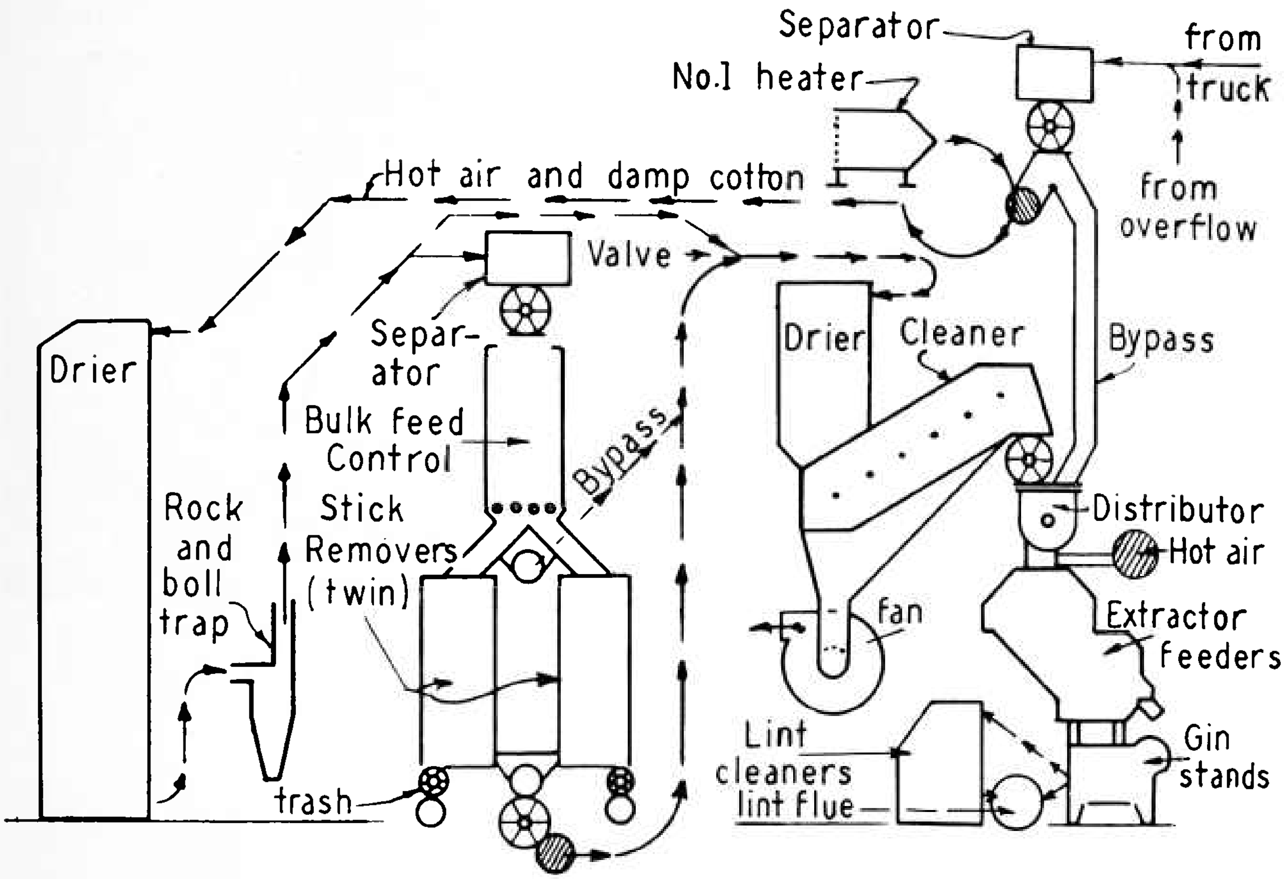


FIGURE 31.—An elaborate arrangement for 4 to 5 90-saw stands with bulk feed control, multiple drying, cleaning, extracting, ginning, and lint cleaning.

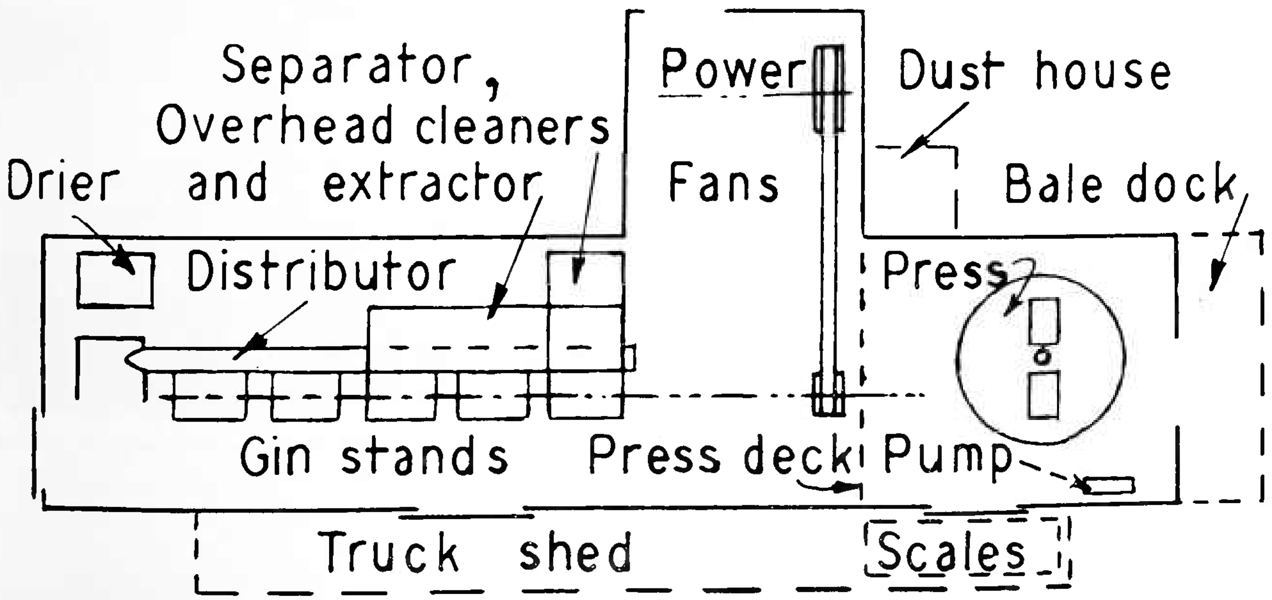


FIGURE 32.—Floor plan of old-style cotton gin, with power drive between gins and press.

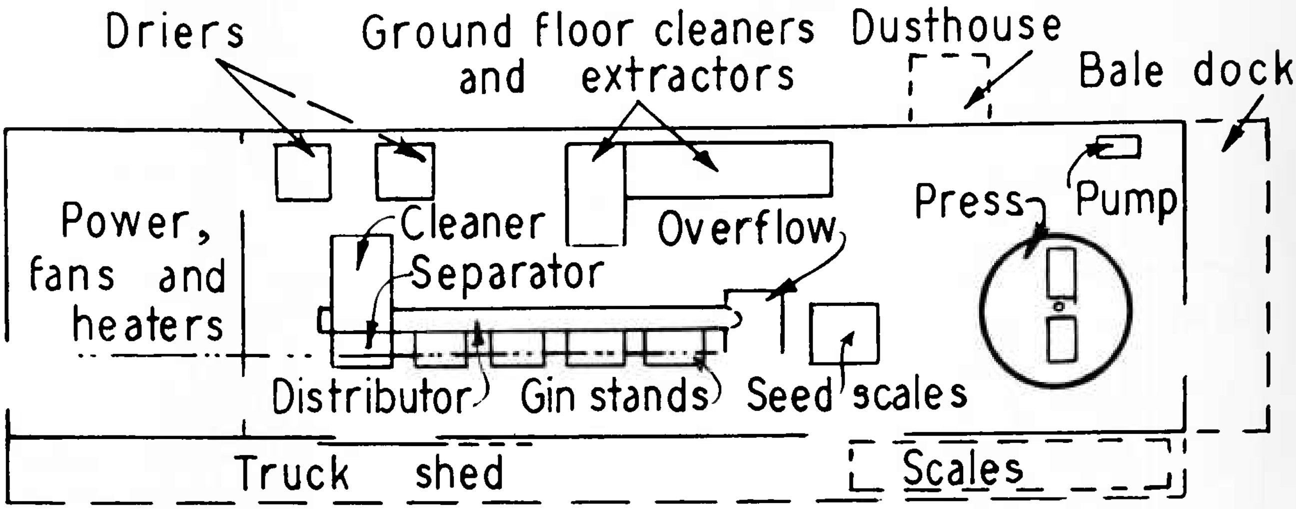


FIGURE 33.—Floor plan of modern cotton gin, using reverse setting so that overflow and seed scales are between stands and press, while power, heaters, and fans are in closed compartment at far end.

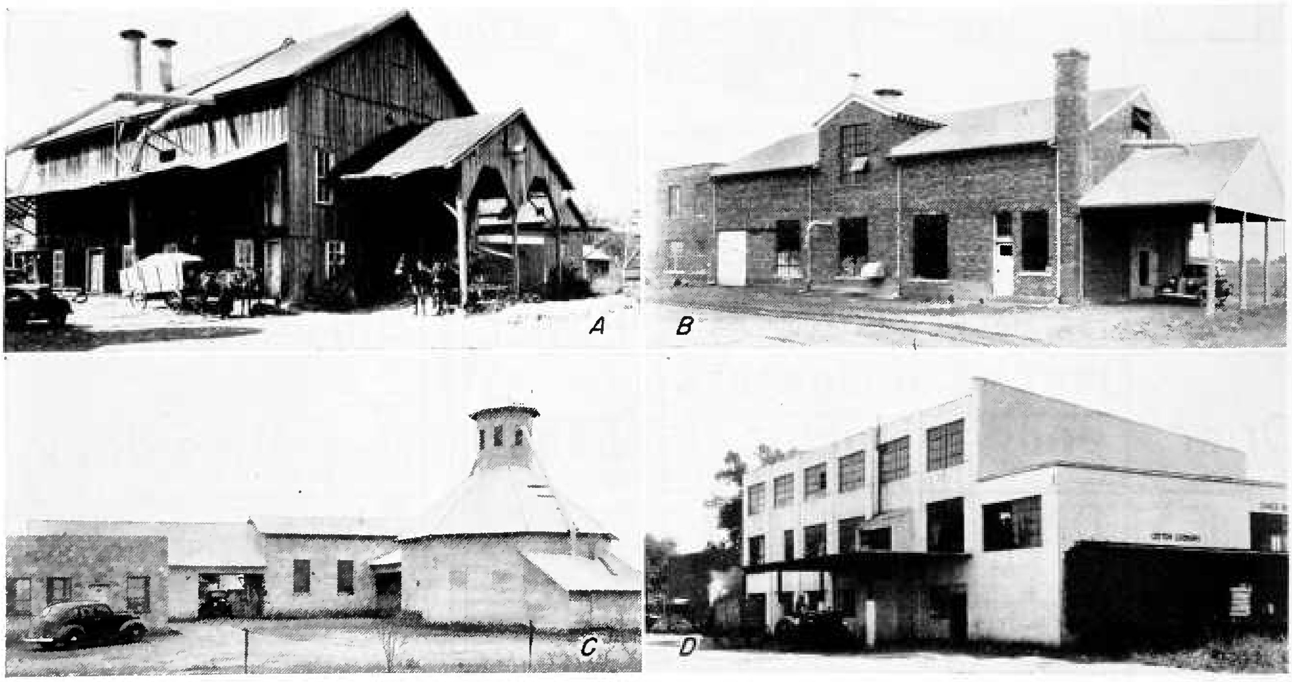


FIGURE 34.—Cotton-gin buildings: *A*, Old-type wooden construction; *B*, brick; *C*, hollow tile; *D*, concrete.

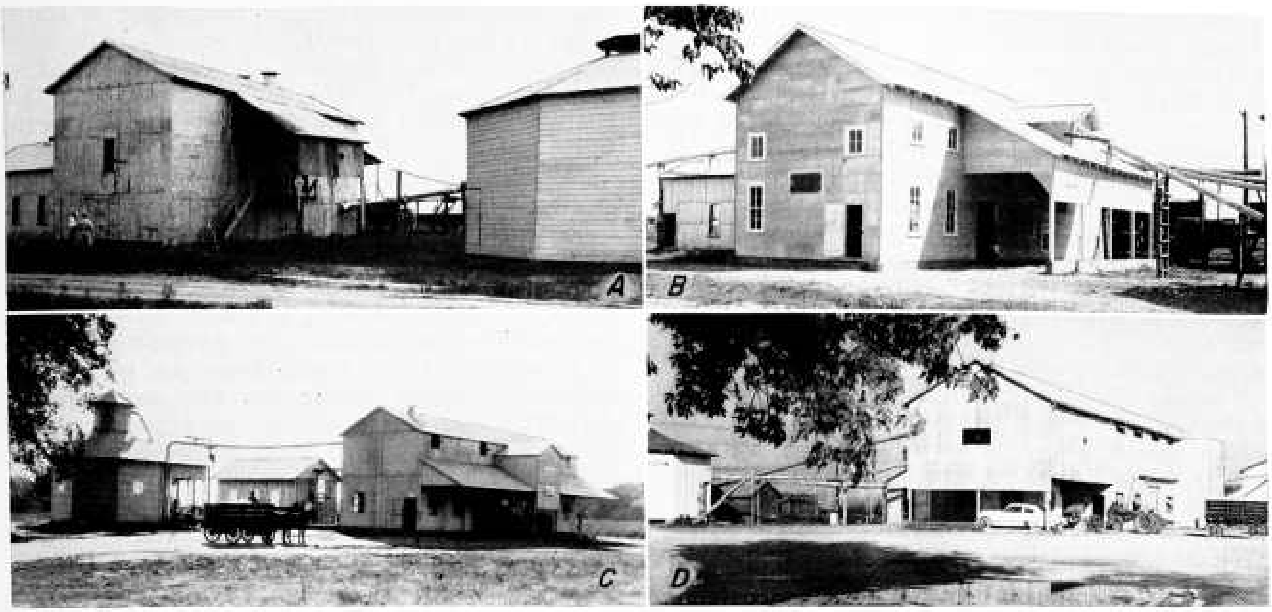


FIGURE 35.—Cotton-gin buildings: *A*, Old-type 2-story steel-sheathed building; *B*, 1½-story steel siding on wooden framing; *C*, all-steel, inside and outside with cantilever wagon shed; *D*, all-steel inside and outside, with 24-foot plate and high roof.

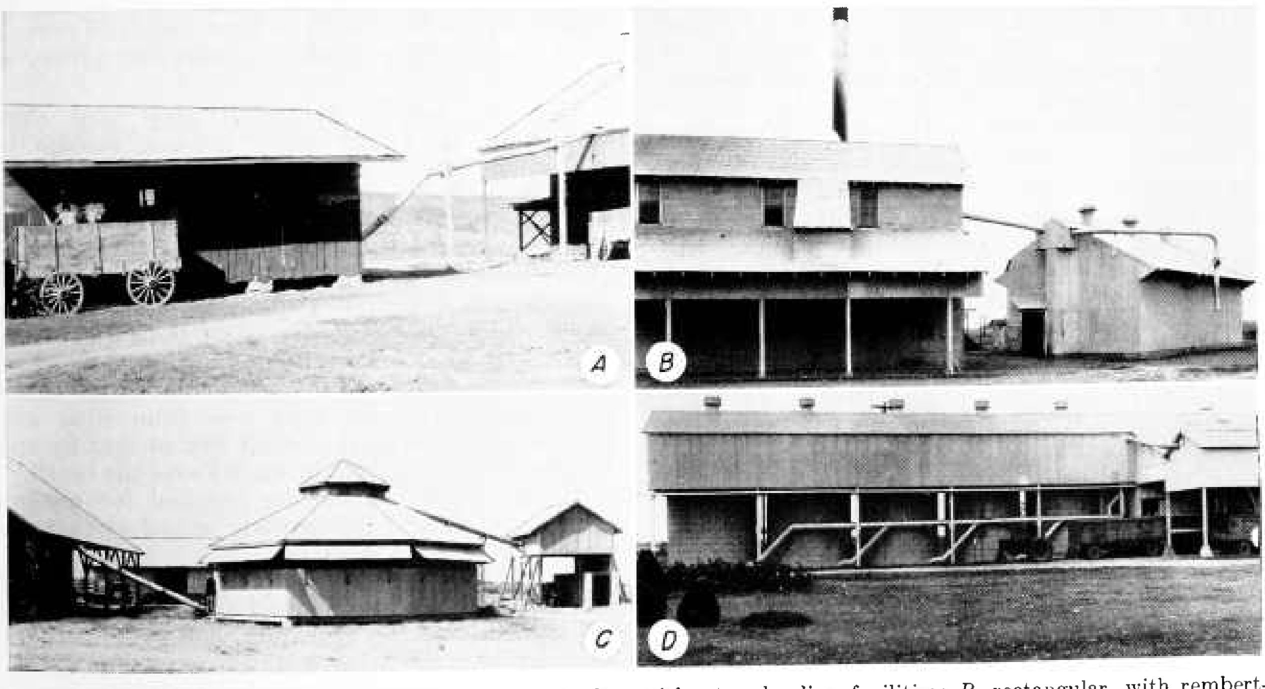


FIGURE 36.—Seed-cotton storage houses: *A*, Rectangular, without unloading facilities; *B*, rectangular, with rembert-type fan for unloading; *C*, octagonal, with rembert-type fan for unloading; *D*, specialized type, using silos and runway protected by roof.

Supports and fastenings of all overhead machinery should be kept tight.

The cleaning screens in cleaners and extractors need checking. Screens too close to the cylinders may cause "machining" of the cotton, and, if too far away, they may cause "roping" and rolling. Extractor saws or teeth receive severe abuse from rocks, sticks, and foreign matter. These teeth should be realined and kept in good shape.

The feeding mechanism that governs the rate of feed into the system and stands may need adjustment, operating arms may be sprung, pinions may be worn, or other repairs and replacements may be needed.

The gin stands themselves may be overlooked, unless they have been continually inspected. The saws must be sharpened as often as the work in any particular locality requires, which may range from once per 100 bales to once per 400 bales per gin stand. In gumming and filing gin saws, the pitch and concentricity must be maintained as close to the factory setting as possible. Pitch of the saws may be checked by using the gages or gin-saw segments furnished by the manufacturers. If neither of these is available, the leading edge of the saw tooth should be made to pass through the ribs parallel with the surface of the ribs or with the point of the tooth very slightly in advance. Even the best filing and gumming machines made are not automatic; they require careful setting-up and operation. With either plain gummers or combined gumming and filing machines, gin-saw teeth are tapered on the sides so that the tips are about one-half as thick as the saw disk, or base of the tooth.

Ginning ribs may become so badly worn that seed will readily pass through the rib space or slot along with the lint. For efficient ginning, ribs should have clean, straight edges with the sharpness barely removed, and the saw slots should not vary more than 0.02 or 0.03 of an inch from the standard width. Repairs to gin ribs consist of (1) inserting new segments in a cutaway socket in the rib; (2) welding new material upon the worn spots to build up the rib, followed by grinding to correct dimension and shape; or (3) covering the worn surfaces with hardened plates of suitable width and minimum thickness to give well-defined edges to the ribs once more. Improper saw-rib relationship, which produces dragging of saws against the ribs in one or several stands of a gin plant, interferes with the production of lint of uniform quality.

Defective brush cylinders or improperly adjusted air-blast nozzles are sources of damage to the lint. If the bristles of the brush are badly worn or the brush has shifted from its required relationship to the saws so that effective doffing of the fibers from the saws of one or several of the stands is not obtained, some of the fibers engaged by the saw teeth will again be carried back through the outer rib and roll box. Thus, nappy or poorly prepared lint may result, particularly with damp or wet cotton. Brushes should be protected from dampness, vermin, and rodents, and they should be refilled when necessary and then carefully balanced. Ball-bearing balancing rigs or knife-edge balances may be homemade by the ginner if he is familiar with ways and means for such work. Heavy wear of brushes sometimes occurs when they mesh too deeply into the saws or wobble sidewise. If entire brush assemblies are badly damaged, it is advisable to have them reconditioned at the factory or a repair shop.

Air-blast gins with nozzles restricted by accumulations of foreign matter and rust may produce defective samples somewhat in appearance like those from brush gins in poor condition. Air-blast nozzles require periodic adjustment to provide adequate doffing of the lint from the saws. The nozzles should not only be given occasional inspection to insure correct position and freedom from chokes but should also be tested with a U-tube water gage during the operation of the gin to maintain correct doffing pressure.

The adverse effects of a defective doffing mechanism are intensified by obstructions in gin and lint flues, such as rust, and by joints and rivets that accumulate cotton and affect the flow action of fiber and air. Therefore these flues, as well as condenser drums, should be kept clean and smooth to prevent backlash, which lowers the quality of the cotton.

Dividing boards in brush gins need close inspection to guard them against change in position or wear. This board divides the saws and brushes, and it is important that its proportions be maintained. Some manufacturers provide their patrons with inexpensive metal covers for this purpose. Worn dividing boards change the volume and direction of the brush blast upon the saws, which may seriously affect both the doffing and the moting action. The backboard or windboard, which is above the brush at the back of the gin stand, must be kept free from wear and sufficiently close to the brush tips so that fly and lint do not accumulate in wads above the brush.

Picker rollers should be checked for missing spikes and should be properly alined so that the spikes center between saws.

Collections of lint and fly may build up on fan blades, thus destroying the balance of the wheel, contributing to the vibration, and eventually becoming a menace to life and property. Fan wheels, blades, and bearings should be carefully inspected to reduce hazards incident to their use.

Seed elevators and conveyors of the screw or helical type require periodic attention to insure satisfactory operation.

Press rams should be properly packed at reasonable intervals and petroleum oils should be used as the hydraulic fluid instead of water. Although such oils involve a slight expense, they prevent corrosion and protect the polished plunger surfaces and the working parts of the pump.

Gland packing on the rams, or plungers, of presses should be given sufficient attention to avoid breakdown and leaks.

Fire and Safety Precautions

Fire is a continual threat to cotton gins. This necessitates installation and periodic inspection of fire-extinguishing apparatus.

Expenditures for the care of the buildings and premises to avoid roof leaks, protect the machinery, and lessen fire hazards by frequently removing all clinging lint and dust are a good investment.

The use of sight-feed oilers on plain bearings and the exercise of care in filling oil reservoirs on other types of bearings, in addition to effecting a saving in lubricants, will minimize the hazards of fire caused by surplus oil that runs onto the floor and machines. Hot boxes cause gin fires and may be avoided by adequate lubrication of bearings.

In gins equipped with a boiler for power or conditioning, steam-smothering pipes may be attached to the distributor and lint flue. Patented extinguishers using carbon dioxide and other gases are also available.

The wisdom of other precautions, such as preventing smoking or carrying of matches, and the keeping of an adequate force of labor on hand to meet fire emergencies are obvious. Cotton-house fires are common, and the same protection should be arranged for them as for the gin building.

Whenever there is any likelihood that a bale has fire inside (i. e., "fire-packed") it should be placed at once on the open lot at a safe distance from all buildings, wagons, and other cotton. Constant vigilance is the best precaution against fires, and clean premises will generally prevent spontaneous combustion or careless setting of fires.

Safety precautions should include the education of all employees in safety-first measures, the installation of sturdy guards to protect employees from moving machinery, and the posting of conspicuous signs prohibiting anyone from attempting to remove chokages on the underside of gin ribs during operations. Much loss of life and limb is caused annually by saw cylinders catching the clothing or arms of employees while they are getting under an operating gin stand.

APPEARANCE OF GINNING ESTABLISHMENTS

The buildings and grounds of a modern ginning establishment present a clean, businesslike appearance in contrast to the unkempt atmosphere of obsolete gins. Trash and refuse are not allowed to accumulate. Surplus machinery is neatly stored under shelter. Condenser vents are kept free from fibrous streamers of dirty lint. Paint is applied to improve appearance as well as for preservation.

Muddy lots seldom are found at modern gins, and customers may drive their loads on graveled roadways beneath shelter sheds to await their turns. Good drinking water and clean toilet facilities add greatly to the comfort of the customers.

For metal buildings in the South, zinc paints of the American Zinc Institute formulas or aluminum paints with oil or asphaltum bases are probably the most durable, if the surfaces have weathered for a few months before painting.

For wooden surfaces, metallic oxide paints in reds, browns, and greens appear to be very durable. The same colors are generally available in composition shingles for such structures as shelter sheds and storage buildings.

Planting trees and shrubs about the gin lot adds greatly to its attractiveness.

APPENDIX

For general handbook data, largely supplied by the Cotton Ginning Research Laboratories of the United States Department of Agriculture, the reader is referred to the Arkansas-Missouri Cotton Ginners Association Handbook by Tom J. Johnston, Mississippi Extension Cotton Ginning Specialist.

The following illustrations—figures 37 to 43—provide additional data of some of the results of ginning research work by the United States Department of Agriculture. Table 6 supplies data for the power required in ginning units. A glossary of cotton ginning terms is given on page 45.

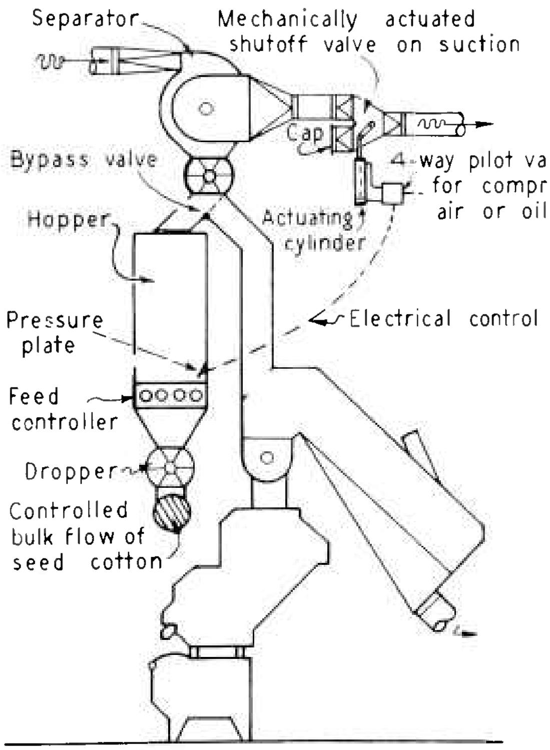


FIGURE 37.—USDA design of bulk seed-cotton feed-rate controller. Seed cotton may be poured into storage hopper without regulating flow until adequately filled, when the suction is cut off by the special valve behind the separator. This cutoff mechanism also again opens in ample time to continue steady operation. Its closure provides marginal capacity to prevent chokes. A seed control at the base of the storage hopper supplies seed cotton to the ginning system at predetermined rate to suit the ginner and the rate is not influenced by the suction-pipe attendant. With 1955 prices, a feed-control system of this type represents an investment of $1,500 to $2,000.

TABLE 6.—*Allowable horsepower consumption in cotton gins for various units and assemblies*

Ginning units	Horsepower per unit	Horsepower per battery for—		
		3/90	4/90	5/90
Gin stand, saws and picker roller	6	18	24	30
Brush gins, add per stand	2	6	8	10
Air-blast gin, add for fan	----	18	22	27
Mote conveyor per stand	½	----	----	----
Hull conveyor per stand	½	----	----	----
Seed conveyor per stand	½	----	----	----
Feeder, large extractor-cleaner-feeder	3	9	12	15
Stacked units over feeder	3	9	12	15
Conveyor-distributor	2	6	8	10
Seed-blowing regular fan	----	12	14	16
Turbo-blower pressure	----	7½	7½	10
Feeder hot-air supply	2	6	8	10
Trash fan, feeders, and stands	----	7½	10	12½
Separator, cotton suction	5	----	----	----
Suction fan for separator	----	16	19	22
Condenser	3	----	----	----
Tramper	----	10	12½	15
Press pump, flat bale	----	15	20	25
Cleaners, conventional screen per cylinder	1	----	----	----
Cleaner, impact Continental Gin Co., 54-inch	10	----	----	----
Vacuum wheel, seed cotton	3	----	----	----
Vacuum wheel, cottonseed	1	----	----	----
Big-bur machine per foot of length	1	----	----	----
Jembo overhead units, per cylinder	3	----	----	----
Tower or vertical drier:				
Full length, push-pull	40	----	----	----
Full length, suction or blow	----	34	39	50
Stub length, push-pull	30	----	----	----
Stub length, suction or blow	----	25	33	41
Conveyor-type drier with fans	35	----	----	----
Lint cleaner, saw, airblast:				
To drive each unit	4	12	16	20
Condenser suction	----	20	24	28
Air-blast nozzle doffing fan	----	20	24	28
Trash suction fan	----	12	15	18
Lint cleaner, saw brush:				
To drive each unit	----	7½	10	12½
Air-foil fan on condenser	----	7½	10	12½
Trash conveyor or belt	----	3	4	5
Lint cleaner, air-jet of ABC:				
Booster jet fan	----	15	20	25
Suction condenser fan	----	20	25	30

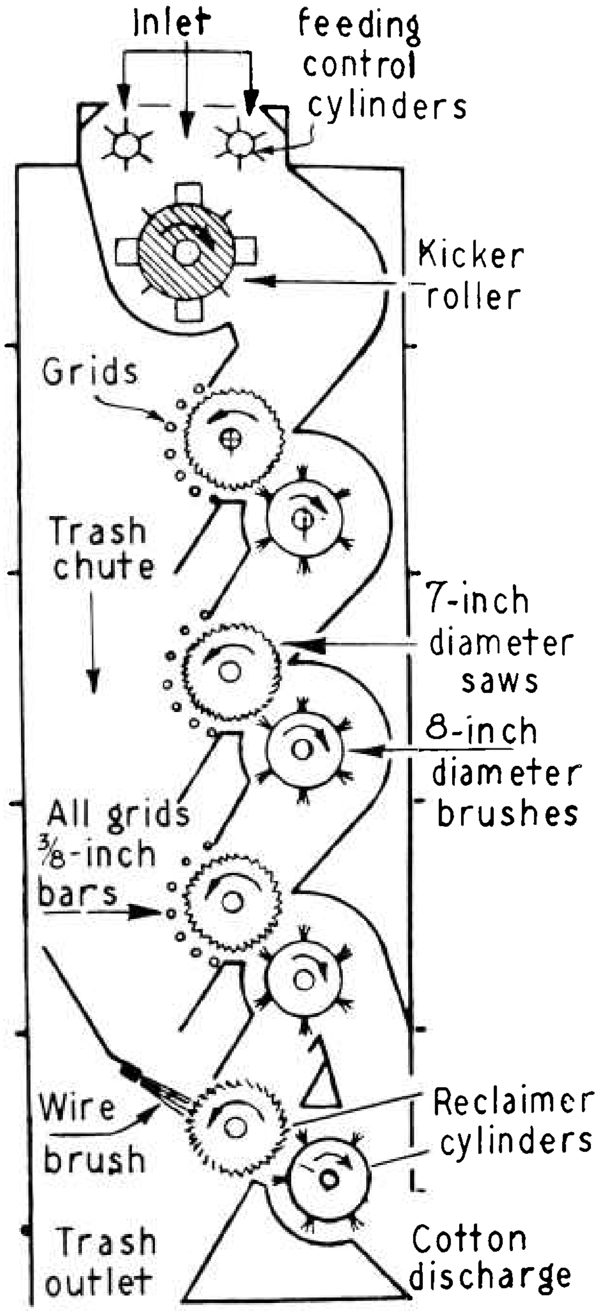


FIGURE 38.—Cross section of USDA design of cleaner and new principle for stick remover, showing special features of the device. (Public patent applied for.) The peculiar action and outstanding effectiveness of this cleaner from older extracting principles are sixfold: 1, The regulated flow of seed cotton descends vertically and contacts the extracting saws at each stage without spreaders or interference; 2, the saws carry the locks within the arcuate-restricted space between their teeth and the bar grids, scrubbing the locks as they pass the grids; 3, the centrifugal force of small-diameter high-speed cylinders and locks "slings off" all burs, sticks, stems, and motes, and much pin-and-pepper trash is likewise whipped off by the bar-and-tooth action; 4, the doffing mechanism uses no metallic stripped blades, but it obtains a more gentle action on the seed cotton with the brush cylinders; 5, the reclaiming element of the machine prevents loss of good fiber; and 6, the vertical trash chute moves the foreign matter without further contact with the cleaned cotton.

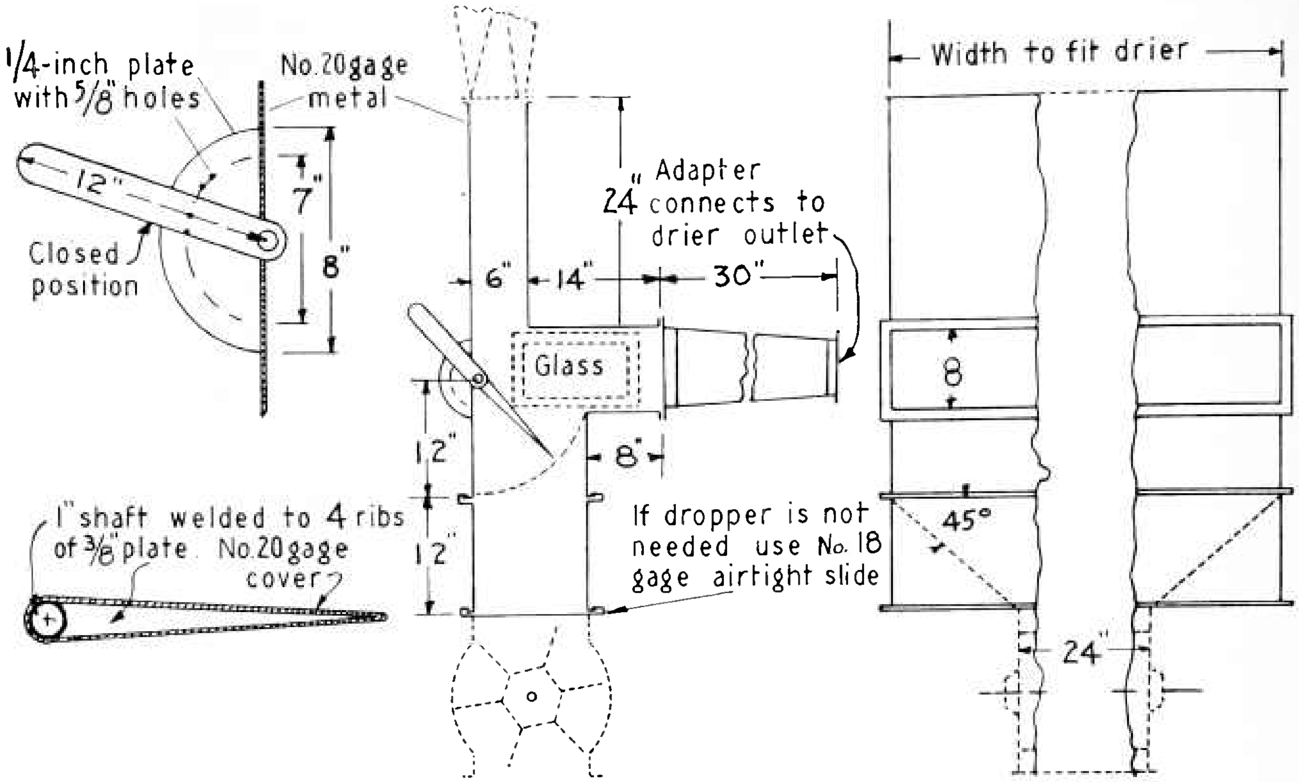


FIGURE 39.—USDA design of green-boll and rock trap, showing construction. This unit enables the modern cotton gin to eliminate very troublesome unopened green bolls before they are smashed into masses of sticky vegetable pulp that produce chokes and much trouble. Tramp iron, rocks, bottle caps, and other injurious elements are also taken out by the trap. The details show no magnet. For its use, please refer to figure 8.

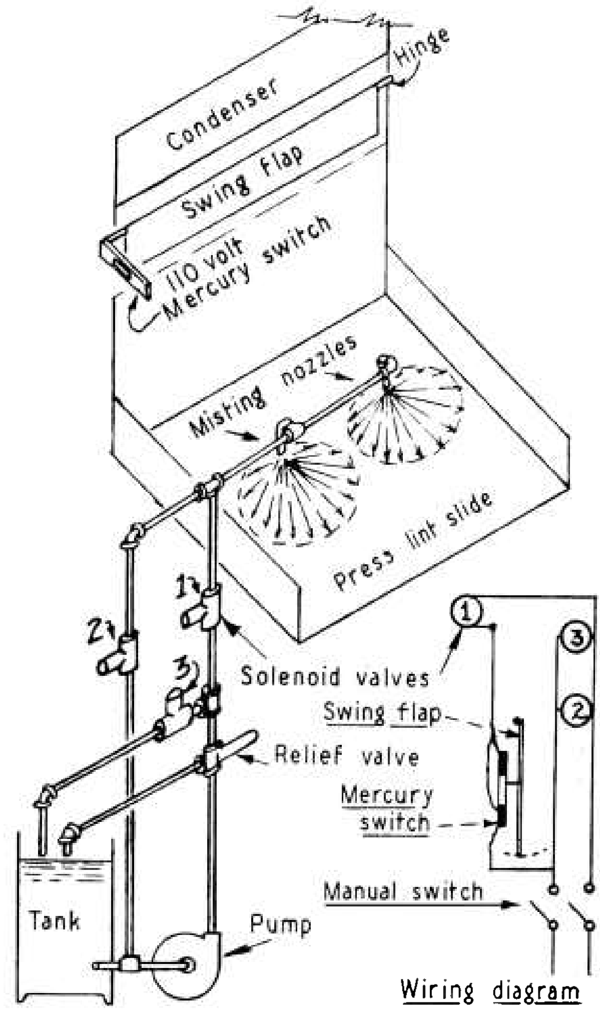
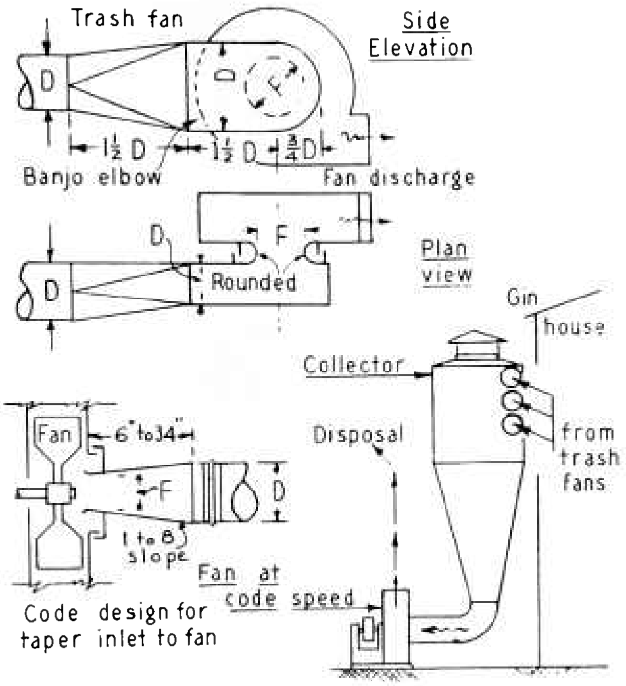


FIGURE 40.—USDA nondrip design of moisture restoration to overdried cotton fiber on the gin lint slide. This system restores approximately 4 pounds of moisture per bale (less than 1 percent of the bale weight) to offset partially the producers' loss of 3 percent by drying. Only approved chemical solutions of nonstaining, hygroscopic wetting agents are to be used. Each nozzle shall be a guaranteed calibrated unit of not to exceed 2.2 gallons' capacity per hour at 40 pounds' gage pressure. Two nozzles are ample for 3 or 4 stands, and 3 nozzles will fully serve a 5-stand, 90-saw outfit. In operation, when the manual switch is closed and cotton lint raises the swing flap (not shown) to which the mercury switch is attached, valve No. 1 opens while valves Nos. 2 and 3 close simultaneously. Whenever the flow of lint cotton ceases from the condenser, valve No. 1 closes and valves Nos. 2 and 3 open to drain the nozzles.



Pink Bollworm Quarantine Regulations for Single Fans Handling Gin Trash

Minimum inlet diameter (inches)	Fan wheel diameter	Minimum low speed	Highest safe speed
	Inches	*R. p. m.*	*R. p. m.*
10	19	2,760	3,020
	20	2,620	2,860
10½ to 11	20½	2,560	2,790
	21	2,490	2,730
	22	2,380	2,610
	23	2,280	2,490
11½ to 12	23½	2,230	2,440
	24	2,180	2,390
	25	2,090	2,290
	26	2,060	2,200
	26½	2,020	2,160
12½	27	1,980	2,120
	28	1,910	2,050
	29	1,840	1,980
	30	1,790	1,910
	31	1,725	1,850
	32	1,700	1,790
	32½	1,700	1,760
	33	1,700	1,760

FIGURE 41.—Pink bollworm quarantine handling of cotton gin trash; single-fan system and details. Gin trash infested with pink bollworm must be treated in some manner to kill the worms before removal from the gin lot. This figure illustrates fan speeds, fan connections, and a collection system that has been approved by the Plant Pest Control Branch, Agricultural Research Service, for treating gin trash for local release as stock feed and for soil improvement. For complete information on pink bollworm quarantine, please consult the Plant Pest Control Branch, ARS, United States Department of Agriculture, Washington 25, D. C.

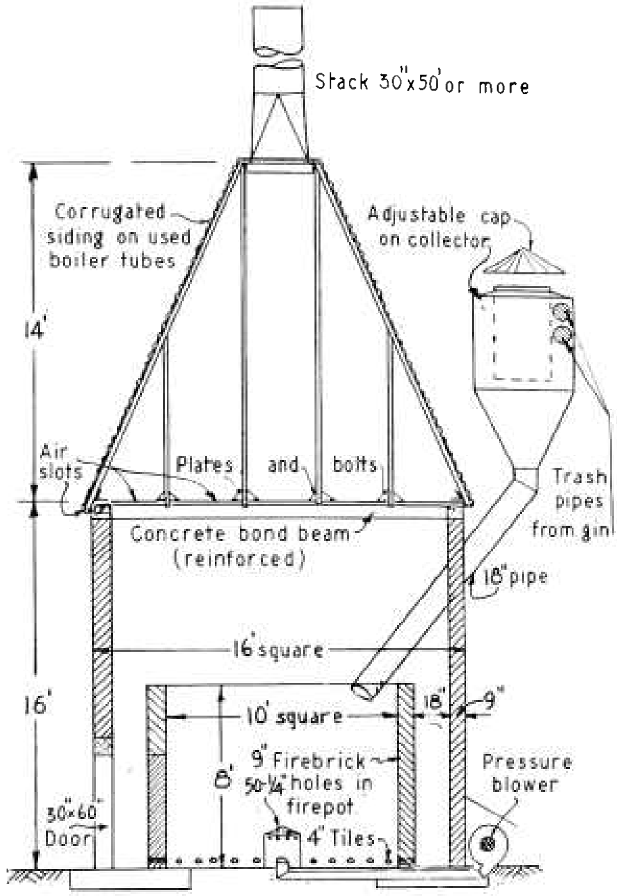


FIGURE 42.—Cotton-gin trash incinerator. This design has a square cross section with square base and masonry walls, upon which any sort of dome structure may be erected. The normal capacity of this unit is approximately 5,000 pounds of trash per hour. The superstructure here shown will receive some cooling by means of a 3-inch air-inlet slot extending around the edge of the bonding. The trash cyclone should be of a size to suit the number of trash pipes and to provide for dust elimination. A tall, large-diameter guide stack will remove objectionable smoke from the vicinity.

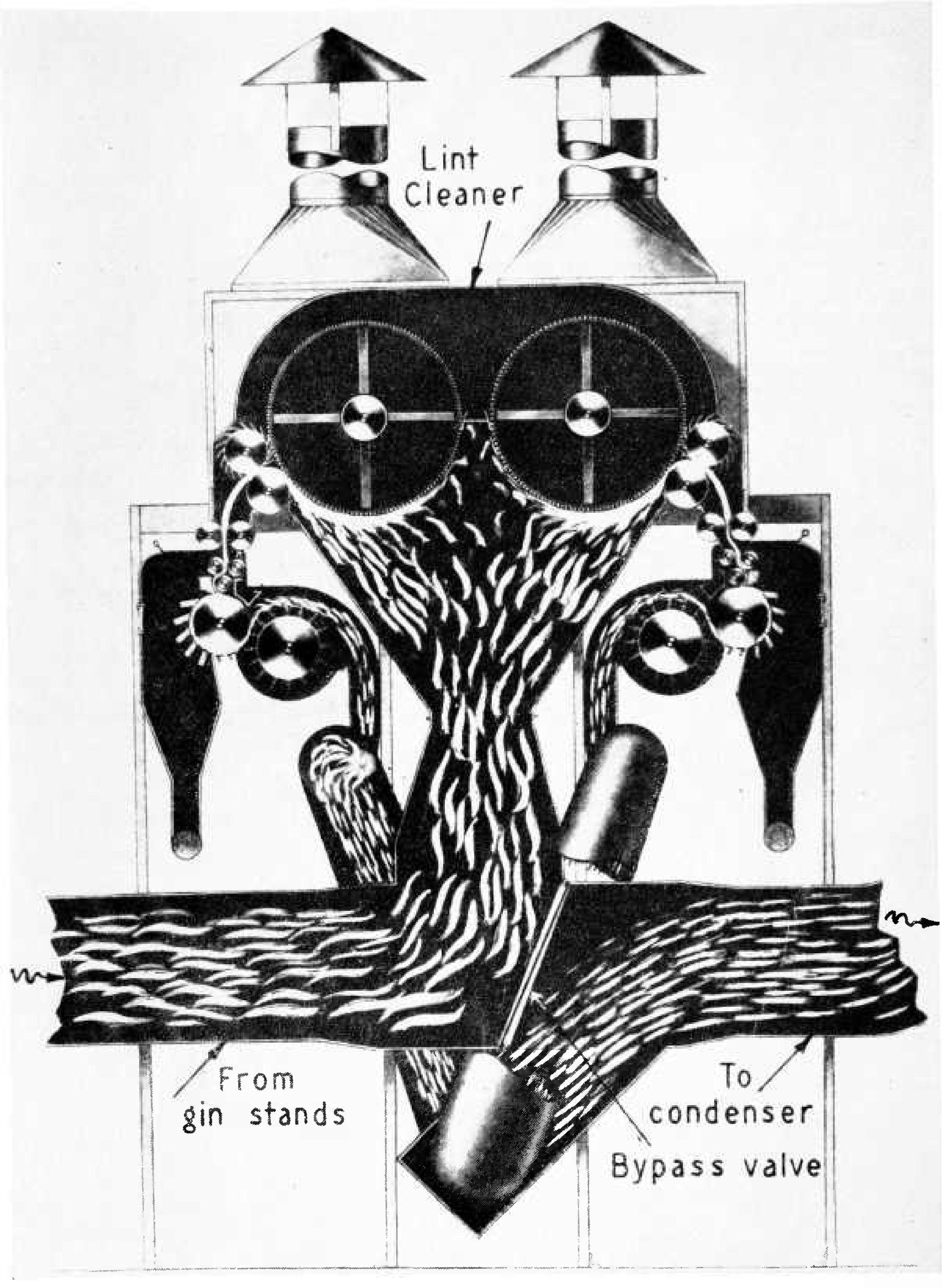


FIGURE 43.—Master type of lint cleaner for serving a complete battery of four or more gin stands. When lint cleaner is in use, the bypass valve is closed so that freshly ginned lint from the main lint flue is diverted to the lint cleaner. A double-section, large-capacity lint cleaner is shown here. For small gins with three gin stands or less, a single rather than dual cylinder unit is used.

Glossary of Cotton Ginning Terms

AIR-BLAST GIN: One that doffs the ginned lint from the saws by a blast of air.

AIR-DRAFT CLEANER: Air line cleaner made by Lummus Co.

AIRLINE CLEANER: One in which the cotton is conveyed while in the gin suction piping; i. e., in the "air line."

AIR VALVE: The automatic or manual suction-breaker to stop flow of air at the cotton telescope, or to switch flows of air.

BREAST (OR FRONT): Front of a gin stand.

BRUSH GIN: One that doffs the ginned lint from the saws by a brush.

BOOT: The flexible canvas at the upper end or bell of the telescope. May also be made of metal.

BYPASS: A passage around a machine to avoid use of the machine.

CLEANER: A machine for removing dirt and small trash from seed cotton. Does not do "extracting."

CLEANING FEEDER: A cleaner and feeder combined.

CONDENSER: A machine to collect ginned lint into a smooth, endless "bat."

DOFFER ROLLS: Rolls that doff, or strip, the ginned lint from the condenser drum.

DOFFING: The act or process of removing cotton lint from any part of a machine.

DISTRIBUTOR: A device to distribute seed cotton to various machines or cotton gins. Excess cotton from this device is discharged at the overflow. A distributor may be of the belt type or pneumatic or equipped with auger or helical screw.

EXTRACTOR: A device for extracting burs, stems, whole leaf, and other trash from seed cotton. May do some cleaning also, but should not be confused with a cleaner.

EXTRACTOR, UNIT: A small extractor suitable for use in replacing a cleaning feeder over a gin stand. (Usually made in gin stand widths.)

FEEDER: *See* CLEANING FEEDER.

FEEDER APRON: The apronlike discharge pan from feeder into gin stand.

FLOAT BOARD: The flap at back of roll box in an automatic roll-density control on a cotton gin.

HULLER RIBS: The front set of ribs in a double-rib gin.

HULLER BREAST: The front to which the huller ribs are attached.

I. S. & B.: Abbreviation for "Independent saw and brush drive."

LAMBREQUIN: The lever of the seed board.

LINT FLUE: Flue or pipe to carry off ginned lint.

MOTE BOARD: A partition, usually movable, to deflect motes.

MOTING: The casting out of motes. May be done by gravity or by centrifugal force.

PICKER: An extractor. A harvester on the farm.

PICKER ROLL: A special beating or extracting roller in the front, or breast, of a cotton gin.

PRESS: Bale press. May be either "low" or "standard density" type.

PNEUMATIC ELEVATOR: The upper part of a pneumatic gin. Now seldom used in the United States.

RAM: The hydraulic lifting and compressing element of a press.

ROLL BOX: Seed-roll box, a compartment holding the seed cotton in contact with the gin saws.

SEPARATOR: A machine to separate seed cotton from the air currents of the suction fan.

SEED-ROLL: Roll of seed cotton in the roll box.

SEED-BOARD: Adjustable, fingered plate at bottom of roll box.

TELESCOPE: Wagon suction pipe, telescopic, for ready unloading.

TRAMPER: Part of the press mechanism. Known also as a packer.

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