CARBONIZING

INTRODUCTION

1. There are two methods in general use for removing the vegetable matter with which all wools are more or less impregnated, namely, the *mechanical* and the *chemical processes*. The **mechanical process,** which consists in the removal of the burrs and other vegetable matter by means of some form of machine, such as is described in *Burr Picking*, has already been dealt with. The **extracting,** or, as it is commonly called, the **carbonizing process,** removes the vegetable matter by means of chemical action whereby the structure of the vegetable matter is destroyed so that it may be easily shaken or dusted from the wool. Wools filled with small burrs, shives, etc., are cleaned much more easily and cheaply by extraction than by burr picking. Wools that have only comparatively few burrs adhering to them are usually run through a burr picker only, while wools that are quite burry are sometimes burr-picked to remove the larger burrs and afterwards carbonized to destroy all the minute burrs and other vegetable matter, as shives, dust, chaff, etc. that may have escaped the burr picker.

The carbonizing process is now becoming very common and is largely replacing the use of burr pickers, although it may be said to be more of a European than an American practice. Where wools are mixed with a large amount of fine chaff and straw, carbonizing, or extracting, is indispensable for their complete removal. In some mills, it is the custom to throw aside the most burry portions of the fleece during sorting and carbonize these portions alone, the rest of the fleece simply being run through a burr picker.

2. The principle of carbonization depends on the action of certain chemicals that will destroy the vegetable matter, but will not injure the wool if the process is properly performed. It is evident that alkaline chemicals are not suitable for carbonizing purposes, since they readily destroy the wool fiber without injuring the vegetable matter. A 2° Baumé (hydrometer) solution of caustic soda will dissolve wool completely if boiled, but it will not affect burrs or even cotton fibers. Acids are, however, particularly adapted for carbonizing, since, if not too strong, there is no injurious effect on the wool, but even a dilute solution will effectually destroy burrs, chaff, cotton, or any other vegetable material. Besides acids, several other substances are used for carbonization; the principal agents in use, however, are sulphuric acid (oil of vitriol), hydrochloric acid (muriatic acid), aluminum chloride, magnesium chloride.

CARBONIZING PROCESSES

SULPHURIC-ACID PROCESS

3. Commercial sulphuric acid, or oil of vitriol, contains varying amounts of water and also other impurities, notably arsenic, iron, lead, sulphur dioxide, etc. In addition, the acid is often discolored by organic dust that has been charred by the action of the liquid. The commercial product, however, is usually pure enough to meet the requirements of carbonizing. In using acid on wool, care should be taken to have the solution weak so that the fiber of the wool will not be injured in any way; for though acids have no appreciable effect on the fiber when dilute, yet if they are strong and any heat is applied, a weakening of the fiber will result, and the stock will have a harsh feeling and a yellow color.

A 1° Baumé solution of sulphuric acid would be sufficient to destroy the smaller particles of vegetable matter in wool, but for effectually carbonizing large burrs, etc. a stronger solution is found to be necessary in actual practice. The strength of the solution should vary from 2° to 6° according to the coarseness of the stock that is being treated and the number of burrs that it contains. Stock that is naturally tender should be carbonized with as weak a solution as possible, while stronger stock may be treated with a stronger solution. In actual practice it is found that a strength of 4° or 4½° Baumé is about right for wool carbonizing solutions in the majority of cases. In diluting acid with water, the acid should always be poured into the water in a thin stream; water should never be poured into strong acid, since a large amount of heat is generated when the acid and water unite, and if a large quantity of acid is present the solution is liable to explode and cause terrible burns if it comes in contact with the workman. Care should be taken also to stir thoroughly the liquor with a pole, as otherwise the acid, being heavier than the water, will settle to the bottom of the tank and the solution, when tested with the hydrometer, will indicate a weaker solution than is actually present. Again, if the liquor is not well mixed, some of the wool is liable to be injured by the action of that part of the liquor where the acid is too strong, while other portions of the stock will not have the burrs effectually carbonized because of their being in contact with only a very weak solution.

METHOD EMPLOYED

4. The operation of carbonizing with sulphuric acid consists of steeping the wool in the dilute sulphuric-acid solution in large wooden tanks. The length of time that the stock is immersed in the acid solution depends on the strength of the acid, which in turn should be governed by the character of the fiber. The strength of the acid solution most commonly used is about 4° or 4½° Baumé, and an immersion of 40 minutes in a solution of this strength is generally sufficient for the most burry stock. The wool should be kept under the solution while it is in the acid tank, as if portions of it are exposed to the air the fibers thus exposed are considerably weakened, owing to the concentration of the acid on them by evaporation of the water. It does not harm the wool to any appreciable degree to stay in the acid solution for some time, provided that the acid is not too strong and the stock is completely submerged. Although it is desirable to have the stock thoroughly saturated with the acid solution, no attempt should be made to pole the stock around in the soaking tank, as the benefit derived is not great enough to compensate for the danger of felting the stock.

5. When the wool is thoroughly saturated with the acid solution it is taken out and the moisture partly removed in a hydro-extractor. The basket of the hydro-extractor should be galvanized or made acid-proof in some manner if used for carbonizing work; otherwise, the acid will attack and destroy it. The liquor driven out of the wool in the hydro-extractor should be allowed to run into a tank, from which it can be pumped back into the soaking tubs and used over again. The excess of acid may be removed before drying by means of a pair of squeeze rolls instead of a hydro-extractor, if so desired. The wool is now dried at a temperature of from 160° to 165° F. in an ordinary hot-air dryer, after which it is run through a second dryer and subjected to a temperature of from 200° to 230° F. A temperature of 210° F. in the second dryer is usually about right for wool that has been properly treated with acid. When wool is dried in this manner, it usually occupies about 20 minutes in running through each dryer. A two-compartment dryer is more convenient than two single dryers for drying wool after acid treatment, the temperature in the first compartment being kept at about 165° F. and in the second at about 210° F. The temperature for drying is sometimes made as high as 250° F., but this does not act so mildly on the wool, and is liable to make the fiber of fine wool tender and of a yellow color. Instead of using two single dryers or a two-compartment dryer, as explained above, some mills have a room where the stock can be subjected to the high temperature after being dried in an ordinary dryer. This method is inconvenient, however, as the stock has to be spread on racks by hand and removed in the same way—a laborious operation as compared with the continuous progress of the stock in a machine dryer.

The temperature in drying must be raised to at least 180° F. or carbonization will not take place. It is always best first to dry the wool, as previously explained, at a somewhat lower temperature and then increase the heat for a short period in order to complete the carbonization. The wool is sometimes dried in an apron dryer with an attachment of crush rolls for pulverizing the charred vegetable matter, in order that it may be more easily removed by the *carbonizing duster* through which the stock is passed after being dried. This machine, which will be explained later, is generally equipped with a series of crushing rolls for crushing the carbonized vegetable matter, as well as means for dusting the crushed matter from the stock. For drying acid-treated stock, it is necessary that the aprons and other metal work of the dryer that are in contact with the stock shall be heavily galvanized, in order to prevent the acid from attacking and destroying them. In order to obtain the best results, the stock should not be exposed to the air for any length of time between acid treatment and drying.

The action of the acid during the drying process—for this is when carbonizing really takes place—is as follows: As the moisture is evaporated, the acid, which has a great avidity for water, attacks the burrs and other vegetable matter, which naturally hold the moisture longer, and extracts it from them, in so doing changing the nature of their structure and converting them into particles of carbon, which crumble to the touch. If the wool is examined carefully, it will be seen that the burrs and other vegetable matter, although they have not lost their form, are in a very brittle state and on being squeezed, or crushed, crumble to a fine dust or powder. When the wool has been dried, it is passed between a series of heavy crush rolls and the carbonized vegetable matter is pulverized and easily shaken or beaten out. The wool is then immediately treated with a soda solution to neutralize any acid that may remain in the fibers. Great care should be taken with the process of **neutralizing,** which is accomplished by immersing the wool in a solution of soda of about 4° strength (never more than this) and allowing it to be in the solution for a sufficient time to be saturated thoroughly. Afterwards the wool should be rinsed in pure water.

Wool carbonized with sulphuric acid will gain from 12½ to 15 per cent. in weight after being stored for a sufficient length of time. This is due to the fact that in carbonizing the natural moisture, which is driven from the wool by the intense heat, will be regained if the wool is allowed to stand for some time. No appreciable deterioration of the wool itself takes place if the process of carbonization is properly performed; in fact, it has been found that wool properly treated with acid seems actually to have gained in strength of fiber. One of the chief dangers to guard against is overheating in the dryers, which will yellow the stock and also make it tender.

HYDROCHLORIC-ACID PROCESS

6. Hydrochloric acid is used for carbonizing, mainly in the form of a gas. The process is one that is never applied in America, but is in use to a limited extent in Europe; it is confined mainly to carbonizing rags, as it is a failure on new wool, owing to the tendency it has of turning the fiber yellow. Carbonization by this method is performed by spreading the rags on racks in a chamber heated from 200° to 230° F., where they are treated with the fumes of the hydrochloric (muriatic) acid. The action is exactly the same as that of the sulphuric-acid process and a 2-hour or 3-hour treatment is sufficient, after which the stock should be dusted and neutralized.

Carbonization by the dry, or gas, method is sometimes accomplished in a large, rotating, iron cylinder, which is surrounded by a coil of steam pipes, in order to obtain the necessary heat. The air is removed from the cylinder by a vacuum pump and the fumes of the acid passed in. The rotating cylinder turns the stock over and exposes all parts of it to the action of the gas.

ALUMINUM-CHLORIDE PROCESS

7. The use of aluminum chloride for carbonizing the vegetable matter found in wool is being introduced into some of the best mills and carbonizing plants, superseding the older method of carbonization by the use of sulphuric acid. Aluminum chloride is a milder agent than acid and acts less harmfully on the wool fiber; therefore, there is less danger of injury to the stock. Another advantage of aluminum chloride is that it does not attack the iron that is used more or less in the construction of dryers, hydro-extractors, etc. If wool that has been saturated with sulphuric acid comes in contact with iron before it is dry, the acid attacks the iron and a rust spot is made on the wool. Aluminum chloride also possesses antiseptic properties, to some extent.

8. The wool to be carbonized is saturated, in a box or tank, with a 6° to 8° (Baumé) solution of the chloride from 40 minutes to an hour, and is afterwards partly dried in a hydro-extractor and then completely dried as in the sulphuric-acid process. This completes the carbonization. The wool is then passed through a carbonizing duster and the carbonized vegetable matter crushed and removed. After the wool has been dusted, it is washed with clear water or water with a small quantity of fuller's earth added, as the residue from the chloride is easily removed. *Fuller's earth* is a clay-like substance that is used in the scouring and fulling of woolen cloth.

The action of the aluminum chloride depends on the fact that when a solution of this substance and water is evaporated, the chloride is decomposed and hydrochloric acid is liberated. The acid attacks the vegetable matter and is the real carbonizing agent. Wool carbonized with aluminum chloride will, after being stored for some time, gain about 5 per cent. in weight.

9. The **advantages** claimed for this process, summed up in as few words as possible, are as follows:

1. It is the simplest method and one attended with the least inconvenience to the workmen, there being no disagreeable acid fumes for them to breathe.

2. Wool carbonized with aluminum chloride retains its elasticity, softness, and natural feeling to a greater extent than wool extracted with acid; nor is there the danger of weakening the fiber by overheating that attends the acid treatment.

3. The danger of staining the wool with iron rust is eliminated, as the chloride does not attack iron as does acid. The wool may thus be dried by steam pipes without danger of injury.

10. Among the **disadvantages** of the use of aluminum chloride as a carbonizing agent may be mentioned the following points:

1. The process is apt to be somewhat uncertain, owing to the tendency of the aluminum-chloride solution suddenly to lose carbonizing strength, whereas the sulphuric-acid process is unfailing.

2. Stock carbonized with aluminum chloride will not take certain colors so well as stock carbonized with sulphuric acid.

3. Aluminum chloride has a tendency to decompose into a sticky, greasy compound that coats the inside of the dryers and dusters, and can only be removed by the use of sharp scrapers. This is a disadvantage in dusting, as the duster should at all times be clean, in order to obtain the best results. No compound of this nature results from the use of sulphuric acid as a carbonizing agent.

COMPRESSED-AIR CARBONIZING APPARATUS

11. The aluminum-chloride process of carbonizing is occasionally performed with apparatus designed to be operated by compressed air. With this apparatus, as usually arranged, the carbonizing liquor is not only forced through the wool by compressed air, but the latter also furnishes power for removing the stock from the soaking tanks. The usual arrangement is to have two wrought-iron soaking tanks about 6 feet in depth and 5 feet in diameter. These are connected at the bottom by a suitable pipe provided with a valve and the tanks equipped with perforated false bottoms. The stock to be carbonized is contained in wrought-iron cages perforated on the bottom and sides and so arranged as to be lowered into the soaking tanks and rest on the false bottom. The carbonizing liquor is stored in a supply tank so placed that the liquor may be run into the soaking tanks by gravity. The compressed air is obtained by means of an air compressor and is stored in a wrought-iron storage tank connected with the soaking tanks by suitable pipes. The compressor automatically maintains a pressure of 60 pounds per square inch in the storage tank.

In operation, the stock to be carbonized is placed in the cage in the first soaking tank and the carbonizing liquor run in from the supply tank until the stock is completely submerged, the connection with the second soaking tank being closed during this operation. The cover is now securely fastened on to the first soaking tank. The second tank is then filled with stock and the connection between the two tanks opened; at the same time the compressed air is admitted to the first soaking tank from the storage reservoir. The pressure thus obtained in the first tank drives the liquor down through the wool in the first tank and up through the stock in the second tank. To resist the tendency of the wool in the second tank to be forced up by the air, a wooden frame is placed across the top.

When the liquor is all out of the first soaking tank, which is indicated by its rising to the same height in the second tank, the connection between the two tanks is shut off, as is also the connection between the first soaking tank and the compressed-air reservoir. Then, by means of an exhaust valve, the compressed air remaining in the first tank is let out and the cover removed. The first tank may now be emptied and refilled, the hoisting and lowering of the cage being accomplished by means of compressed air. The cover is then securely fastened down on the second tank and compressed air from the reservoir admitted to the top of the tank, which forces the liquor (the connection between the two tanks having been opened) down through the wool in the second tank and up through the wool in the first, which is the reverse of the initial operation.

These operations are repeated until the entire batch to be carbonized has been treated with the chloride solution, after which the liquor is removed from the soaking tanks and stored in the supply tank. This may be accomplished by closing all the outlet valves except the one to the supply tank and admitting compressed air to the soaking tank, whereupon the liquor will be rapidly driven back to the storage tank.

MAGNESIUM-CHLORIDE PROCESS

12. The process of carbonization with magnesium chloride is very similar to that employed with aluminum chloride, the effects also being of a similar nature. The stock to be carbonized is saturated in a solution of magnesium chloride of from 5° to 6° (Baumé) strength for one-half or three-quarters of an hour, and is then taken out and the excess of moisture removed in a hydro-extractor. The stock should next be dried as in the sulphuric-acid process, and after being allowed to cool, dusted and washed as in the aluminum-chloride process.

13. Extracting, or carbonizing, is not confined to raw stock, as very often the cloth is carbonized after it is woven. Woven cloth is carbonized either by sulphuric acid or by aluminum chloride, the object being to remove motes or minute particles of vegetable matter that have not been removed in the process of manufacture and that otherwise would have to be picked out by hand. The action of the carbonizing agents is not confined to motes and such vegetable impurities, but extends to cotton and other vegetable fibers. This fact is made use of in recovering the wool fibers (known as extract) from manufactured goods that contain both cotton and wool. The process that is generally used is the sulphuric-acid one, although the dry-gas method is sometimes employed. The rags that contain both wool and cotton threads are steeped in the acid, dried, crushed, and dusted after the manner of the raw wool. The cotton is thus removed from the fabric, and the wool that remains is worked over again, i. e., remanufactured.

An interesting method of forming fancy patterns is based on the principle of carbonization. A fabric that contains both woolen and cotton fibers is taken, and a figure or design printed on it with a paste of aluminum chloride, the cloth being afterwards dried at a high temperature. The effect of this is that the cotton is destroyed in those portions of the fabric that were in contact with the chloride, and the cloth in those places becomes so impoverished as to produce a gauze.

MACHINES USED IN CARBONIZING

14. In order to extract the vegetable matter from wool successfully by means of a chemical process, it is necessary to have suitable tanks for soaking the stock in the carbonizing solution. For this purpose wooden tanks of an appropriate size are the most satisfactory, as they are not affected by the solutions and give a maximum of service with a minimum of cost. Round wooden tanks with iron hoops will stand the action of acid better and give longer service than square tanks as usually built with iron rods piercing the wood.

The hydro-extractor used for extracting the excess of moisture from the stock before drying is the same as has been described, with the exception that the basket should be tinned or galvanized in order to render it acid-proof.

In drying wool that has been treated with acid, it will be found impossible to use a dryer that has cotton aprons, as the acid will immediately destroy the aprons. In the case of aluminum-chloride carbonized wool, the stock can be dried with a multiple apron dryer with heated steam pipes between the aprons; but with sulphuric-acid carbonized wool the vapor of the acid will rust the iron pipes, and the wet rust dropping on the wool or the wool coming in contact with the pipes will result in stains. All metal in the dryer that comes in contact with stock that is saturated with acid must be tinned or galvanized. The aprons in some dryers are made of galvanized wire cloth, which makes a good apron for acid-treated wool. A two-section carbonizing dryer is best and gives the most satisfactory results for this work, the machine being arranged to dry the stock in the first compartment and carbonize it in the second.

THE CARBONIZING DUSTER

15. After the wool comes from the dryer, the vegetable matter that was in the stock before carbonization is greatly changed in character. Instead of being tough and clinging to the fibers of wool with great tenacity, the burrs are brittle and may be easily crushed and shaken out of the stock. The object, therefore, of the carbonizing duster is to crush the burrs and other vegetable matter rendered brittle by the agent used in extracting and to remove them from the wool fibers. A duster built especially for handling carbonized stock is shown in Fig. 1. The principle on which this machine operates is similar to that of the cone duster previously described, with the exception that the carbonizing duster is provided with three pairs of heavy crush rolls *b* for the purpose of reducing the carbonized burrs to powder before the stock is subjected to the action of the rotating cylinder. The rolls are connected by gears and have springs and hand wheels *c* for controlling the pressure, which should be regulated so as to be heavy enough to crush the carbonized burrs, but not enough to cut the wool. The arrangement of the six rolls in this machine, and in fact in nearly all carbonizing dusters, is such that only three crushing points are obtained, as the rolls are arranged in pairs. A better arrangement is to have three bottom rolls and two top rolls, the latter resting between the bottom rolls, so that four crushing points are obtained, although there is one less roll on which the pressure has to be regulated. If this arrangement is used, however, the springs for applying the pressure should be somewhat stronger, as the pressure is divided over two points instead of being concentrated at one. In most carbonizing dusters, the width of the crush rolls is too narrow. A better method is to have wider crush rolls, so that the stock can be fed thin and a better crushing obtained whereby none of the burrs will pass to the duster without being crushed. After passing the crush rolls, the stock can be

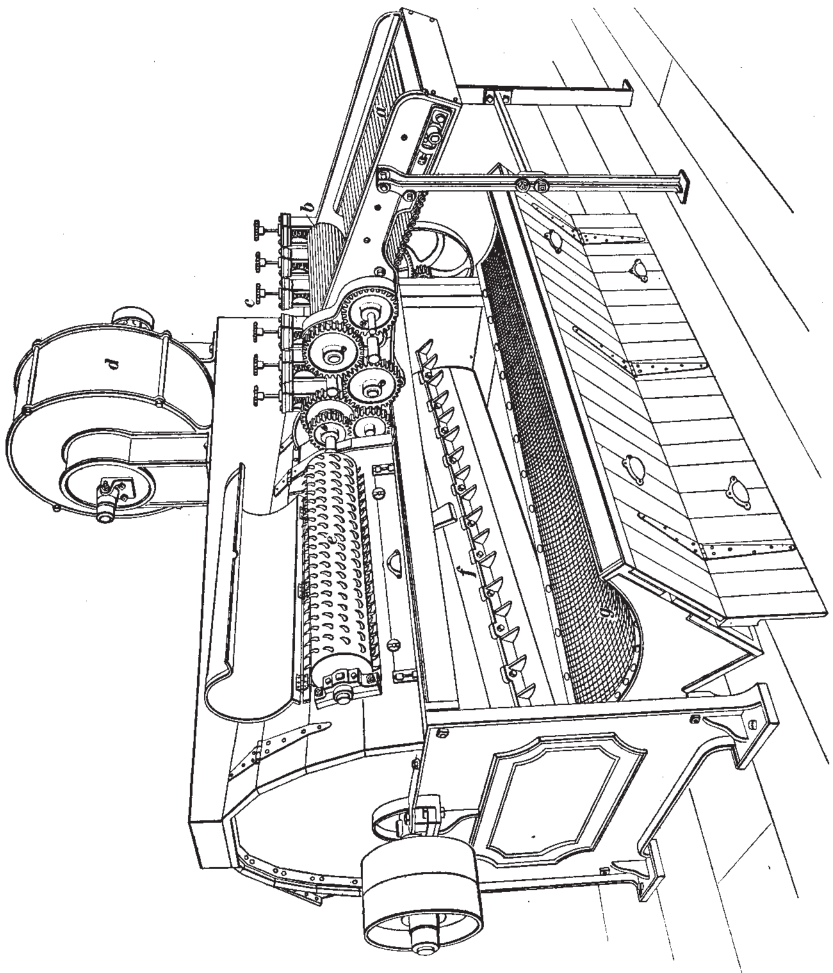

Fig. 1

directed to a narrow apron feeding the duster. Sets of crush rolls can be obtained entirely separate from a duster. The machine illustrated is built with a worker *e*, which greatly assists in opening out the stock. In operation, the worker rotates slowly backwards, its teeth engaging with the wool that is carried around by the main cylinder *f*. The worker is protected by a sheet-iron bonnet, which is shown raised from the worker. The fan *d* is on the top of the machine; and, since the space under the screen, which is beneath the main cylinder, is air-tight, the air drawn by the fans enters at each end of the main cylinder around the main bearings of the same, through apertures provided for that purpose. Beneath the fan there is a screen that retains the stock, being so made that it may be drawn out for cleaning. The air that passes through the upper portion of the machine sucks away light dust, etc. from the wool, while the heavy particles of dirt fall by gravity through the screen *g* under the cylinder. The screen is made in two sections, one of which may be withdrawn from the front of the machine, as shown in Fig. 1, and the other from the rear. The draw that removes the screen is also provided with a door for access in cleaning out the refuse without removing the draw itself. A good position for the fan of a duster is below the screen, or grate, since if placed in this position, the current of air produced not only removes the dust from the stock, but also aids the fall of the heavier particles. When the fan is on the top of the machine, the current of air, being upwards, tends to hinder the fall of matter through the grate. The cylinder *f* is provided with heavy iron teeth for beating the wool. The machine, being provided with tight and loose driving pulleys, does not require a countershaft for driving. The duster illustrated in Fig. 1 occupies floor space 9 feet by 7 feet and requires a $3\frac{1}{2}$-inch or 4-inch belt to drive it, about 4 horsepower being necessary.

16. Operation of Duster.—In operation, the stock is fed either by hand or by means of a self-feed on the feed-apron *a*, which carries the wool to the iron crush rolls, which successively operate on the stock and reduce to powder the previously carbonized vegetable matter that is contained in the wool. The wool is now delivered to the action of the main cylinder, which revolves upwards at a speed of about

400 revolutions per minute, although sometimes a speed of 450 revolutions is used when stock with a short fiber is to be treated. A longer fiber will require the slower speed, in order to prevent damage to the stock by breaking the fibers. The action of this cylinder, combined with that of the worker *e*, which operates in conjunction with it, is to shake, or beat, out all the dust and pulverized vegetable matter from the wool, the heavier particles of which fall through the screen *g* into a compartment under the cylinder whence the refuse can be periodically removed. The lighter foreign matter and dust are removed by the current of air generated by the fan through the upper part of the machine and conveyed outside of the mill through a suitable pipe. The wool travels from the small end of the cone-shaped cylinder toward the large end, and is finally thrown out through a square orifice at the end of the cylinder in the rear of the duster.

SARGENT'S LOW FEED

17. In connection with the Sargent multiplex burr picker, illustrated in *Burr Picking*, a self-feed attachment is shown. This self-feed is one that is in common use and is adapted not only to burr pickers but to mixing pickers and to carbonizing and other dusters, to which it is often applied. The object of this machine is to feed the stock evenly and uniformly to the duster or picker, and supplant the more laborious method of hand feeding. The principle on which the machine operates is that of a traveling lifting apron filled with spikes that lift the stock from the hopper and deposit it on the feed-apron of the machine to be fed. The apron is made of hardwood slats attached to endless belts, and is supplied with sharp spikes from 1 inch to $1\frac{1}{2}$ inches in length that engage with the stock in the feed-box; the wool is thus carried to a revolving comb that combs off all excess of wool and evens the feed.

The comb in this machine is a cylindrical revolving one, and is fitted with two rows of teeth, which are withdrawn from the surface of the comb after coming in contact with the stock on the spiked apron; this is accomplished by means of an eccentric, which works in a wide-slotted arm to which the teeth of the comb are attached through suitable connections; by this means the stock is prevented from winding around the comb. There is a traveling apron in the bottom of the hopper for the purpose of keeping the stock constantly pressed against the lifting apron. A *beater*, or *stripper*, is provided for stripping the stock from the lifting apron and depositing it on the feed-apron of the duster or other machine to be fed. The speed of the beater should be about 235 revolutions per minute, and the machine is driven from this shaft. The speed of the lifting apron may be changed by means of cone pulleys and change gears. The floor space occupied by the machine, when attached to another machine, is 4 feet 6 inches in length.

18. Operation.—In operation, the wool or other stock is placed in a large, commodious hopper, or feed-box, from which it is extracted by the lifting apron. The wool is kept in constant contact with the lifting apron by means of the traveling apron in the bottom of the hopper. As the stock is elevated to the revolving comb, large bunches of wool are knocked back into the hopper, and the amount of stock fed is thus made uniform and the apron evenly loaded. The stock is then stripped from the lifting apron by the beater, and falls on the feed-apron of the duster or burr picker. The feed requires about 1 horsepower for driving purposes.

CARBONIZING

EXAMINATION QUESTIONS

(1) (*a*) What is understood by the term carbonizing, or extraction? (*b*) What can be said of the relative advantages of mechanical and chemical burr extraction?

(2) Why are alkalies unsuitable for carbonizing?

(3) What are the two principal agents employed for carbonizing wool?

(4) Explain, fully, the sulphuric-acid process of carbonizing, stating the strength of the acid solution, etc.

(5) What is meant by the term neutralizing when used in connection with the carbonizing process?

(6) What form of wooden soaking tubs gives the best service?

(7) Explain the aluminum-chloride process of carbonization, and explain some of its advantages and disadvantages.

(8) Discuss the drying of carbonized stock.

(9) What is meant by dry extracting, and why is the process unsuitable for carbonizing wool?

(10) What can be said about the method of preparing the sulphuric-acid solution for carbonizing?

(11) Why is a galvanized apron in the dryer necessary for drying stock carbonized with sulphuric acid?

(12) What can be said in regard to poling the stock while in the soaking tubs?

(13) Do wools gain in weight if stored after carbonization? Explain.

(14) Describe the operation of a carbonizing duster on the stock, stating the proper speed for the cylinder.

(15) What is the best arrangement of crushing rolls in a duster?