Loom-Fixing and Weaving.

A BOOK

For all who are interested in such matters

BY

G. F. IVEY.

GRANITE FALLS, N. C.

1896.
C. P. Roberts, Printer,
SHELBY, N. C.

TS1527
.I9

TS1493
.I9

Granite Falls
N.C.

9-7410

PREFACE.

The writer of this work when learning to fix looms tried in vain to find some book which would help him over the many difficulties he daily encountered. He found many that dealt with weaving from a theoretrical stand point, but none that would describe the troubles minutely and suggest the remedies with sufficient clearness for a beginner to understand.

In after years he found there was still a demand for such a book, and to fill this demand this work has been undertaken.

The subject matter has been condensed as much as possible, so that a large amount of reading will not be necessary in order to obtain a few points, at the same time nothing has been omitted that, in the opinion of the writer, would assist the reader in more fully understanding the subject.

In the preparation of this work I have had the help of many friends but am especially indebted to Mr. J. W. Manly, of the Henrietta Mills, for valuable assistance.

G. F. IVEY.

Granite Falls, N. C., May, 1896.

CONTENTS.

CHAPTER I.

HISTORY OF WEAVING. WEAVING IN EGYPT AND INDIA. PROGRESS OF THE ART IN ENGLAND AND THE UNITED STATES. STATISTICS OF LOOMS AND SPINDLES AT THE PRESENT TIME.

The history of cotton weaving dates back almost as far as the human race. In Egypt mummies wrapped in cloth have been found, that were entombed over 2000 years before the Christian era. In India also, the industry has been carried on for many hundred years. Although the methods used were extremely crude, the results were such as would reflect credit on a much more advanced state of civilization. In fact in one of the tombs of the Pyramids cloth has been found having 150 threads to the inch, while in India trapestries were made having the most elaborate designs, outlined in colors that are still brilliant after hundreds of years. The famous Gossimer webs of that country were so light that it is said it took them five seconds to fall as many feet.

Except in matters of detail the methods of weaving are practically the same to-day. The hand loom was used universally until 1771, and in some of the mountain counties of East Tennessee they may still be seen in active operation. It was not until the beginning of the present century that the power loom came to be successfully used, and a quarter of a century later the number of hand weavers largely exceeded those using the power loom. For a long time a weaver attended only one loom, the only advantage over the hand loom being that it could be operated with much less labor. There was no stop motion for the filling, and as only a small quantity of yarn could be put in the shuttle at one time, constant watching was necessary.

As early as 1678 there was figured and described in a French journal a machine "For making linen cloth without the aid of a workman," the invention of a French naval officer. In 1814 the first mill was built in America for both spinning and weaving. This was located at Waltham, Mass., and was closely followed by others at Fall River and other points. From this small beginning the industry has grown until at the present time (1896) there are in the United States 1098 cotton mills containing 15,079,649 spindles and 364,759 looms, distributed as follows:

	SPINDLES.	LOOMS.
New England States...	11,152,761.	256,036.
Middle A. States........	1,675,870.	36,175.
Southern States	2,047,860.	68,758.
Western States	203,158.	3,790.

In New England Fall River seems to be the center of the industry, while Philadelphia is the center of the Middle Atlantic and Charlotte of the Southern States.

As the management, class of goods manufactured, etc., of the Southern Mills are less likely to be known to those interested, in another chapter is given a list of all Southern Mills having one hundred looms or over, with the number of looms, make of looms, class of goods manufactured and name of overseer.

CHAPTER II.

COTTON. PREPARATORY PROCESS. SLASHING. SIZING, RECEIPTS FOR MAKING SIZE.

Although this book is intended principally for loom-fixers and those interested in weaving, it may be advantageous to have at least a bird's-eye view of the material and the different processes for preparing it for the loom.

Cotton is the fruit of the shrub MALVACEÆ genus GOSSYPIUM. It grows almost anywhere in the Torrid or Temperate Zones but for practical purposes its cultivation is limited to that area included between the 37 degree North latitude and the 30 degree South latitude. With the exception of a few thousand bales raised in Russia, the world's supply comes from the United States, Egypt, India and Brazil. Of the whole amount consumed the United States furnishes about 80%.

On account of its fine, silky nature and long staple, a considerable amount of Egyptian cotton is imported into the United States for fine work. With this exception only native cotton is used.

The quality of cotton judged by the length of staple, color and freedom from foreign matter, depends on the soil, weather and manner of handling. American cotton is classed as follows, the first named being the best.

Middling Fair.
Strict Good Middling.
Good Middling.
Tinges.
Stains.

In preparing the raw material for the loom, it is subjected to the following processes.

Opening.—The cotton is taken from the bales (as many as the space will allow) and thoroughly mixed in order to blend the various qualities and allow the atmosphere to have free access. It is then put through the openers or breakers where the matted particles are torn apart, and the seed, sand and parts of bolls are to a great extent removed.

Pickers.—The pickers more thoroughly separate the fibers and remove the impurities. The cotton is delivered in the form of a lap or roll, each yard having the same number of ounces. It then goes through a similar machine known as a finishing picker or lapper.

Carding.—In this process the dust and short fibers are removed, and the longer fibers straightened out and laid approximately parallel. From the cards the cotton is delivered in the form of a loose rope called sliver. In what is known as the American process the sliver from five or more cards is run through a railway head and any inequalties which may exist are evened up. In the English process the sliver is taken direct from the cards to the next machine.

Drawing.—In this process, repeated once for medium and twice for fine numbers, from three to eight ends are run into one, thereby reducing unevenness, straightening the fibers and laying them parallel.

Slubbing.—The slubber reduces the sliver in size and winds it on bobbins, a certain amount of twist being put in to hold it together. It is now known as roaving. For very fine work, the roaving is passed through three other machines similar to the slubber, known as intermediates, speeders and jack-frames. For numbers under 20's only the slubbers and speeders are used.

Spinning.—For fine numbers this is done on mules, but for numbers under 50's the spinning frame is generally used. In this process the roaving is drawn out to about ten times its former length and wound on small bobbins, enough twist being put in to make it strong and durable. If the yarn is for filling, it goes direct to the loom, but if for warp it goes to the next process.

Spooling.—Although this is the simplest, it is one of the most expensive processes in the mill. The yarn as it comes from the spinning-frame is wound from a dozen or more bobbins on a spool, making a continuous length of several thousand yards.

Warping or Beaming.—From several hundred spools, placed in a V shaped creel, the yarn is wound on a large beam known as a section beam.

Slashing.—From these beams the yarn is passed through the slasher and after being drawn through the harness and reeds is ready for the loom.

As the overseer of weaving often superintends the slashing also, a few words concerning the process may not be amiss.

In the old hand loom the warp was either sized while in the form of hanks and dried in the sun, or was sized when on the loom and dried with hot irons or with a fan. With the latter method the weaver could weave only a few yards at a time, having to stop to size more warp. Later on when the power loom was invented, a better method was necessary, and what is known as the dressing machine was used. In principle this was the same as the modern slasher, except that the warp was dried by hot air instead of by contact with a hot surface. The process was slow but the quality of work equaled if not surpassed that done on the modern machine.

In comparatively recent years the slasher has been invented. This consists essentially of four parts, viz: A creel to hold the section beam, a trough to hold the sizing materials, two cylinders for drying the warp, and a headstock for winding it on beams for looms. The beams are placed in two rows in order to economise space. If one contains a smaller number of threads than the other, it is best to place it farthest back, as ends overlapping are apt to cause trouble. The size box, sometimes called the saw box is of copper and contains a steam pipe to keep the contents at a boiling heat. The cylinders are also of copper and are kebt at a constant temperature by means of steam at from five to fifteen pounds pressure. The corser the yarn the greater will have to be the pressure as more heat will be required to dry the large threads. The head-stock has lease rods to separate each thread from the other, an adjustable comb to guide them on the beam, and an apparatus for driving the beam. This is driven from the main shaft, the motion being communicated by friction in such a manner that the speed at which the warp is wound does not increase as the diameter of the beam becomes larger.

SIZING MATERIALS.—Almost every manufacturer has a certain receipt for making size which he thinks better than any other, and is so zealous in guarding it, that any thing like a uniformity of materials or methods is unknown. In general terms, howerer, sizing materials are divided into five classes according to their properties.

1. Something to fill up the space between the fibers of the yarn and smoothly hold down the ends of any which may project from the surface of the thread. If this were not done the continual chafing by the harness and reed would soon cause the thread to break. For this purpose starch is almost altogether used in this country. Flour is sometimes used, but is not so good on account of its liability to mildew.

2. Some substance having deliquescent properties i. e. the property of absorbing moisture from the atmosphere. Cotton in its natural state has about 7% of moisture. As the warp passes over the hot cylinders of the slasher, this is all driven out. Were it not for the glazed surface of the the thread it would again absorb this amount from the atmosphere. By using something to attract the moisture this hard coat is softened some-

what, and the whole thread is penetrated. There are many chemicals which do this, but experiments have shown that Chloride of Magnesium gives the best results. When the northern or western winds are blowing the atmosphere is very dry, and of itself could not furnish sufficient moisture. To make up the deficiency the floor is frequently sprinkled and if appliances are at hand live steam is let into the room. Although this produces the desired effect, it is unhealthy and in some places is prohibited by law. In recent years an apparatus has been devised which moistens the air without raising the temperature, and most modern mills are provided with it. Chloride of Magnesium should be used cautiously where the cloth it to be calendered as the heat decomposes it and the goods are injured.

3. Some substance that will soften the yarn and make it pliable. Both flour and starch make the warp brittle and unsuitable for weaving. For a softening agent tallow has been found best for medium or heavy goods. Beef tallow is better than mutton and should be free from grit or other impurities. If the quantity used is excessive it is likely to form mildew. For light weight goods paraffine is used. This is a mineral substance and is therefore free from the disadvantage attached to the use of tallow.

Its cost, however, is somewhat greater.

4. Antiseptics, i. e., something that will prevent mildew. This is very important, for if the goods are damaged and it can be shown that it was on account of the sizing the manufacturer is responsible for the loss. A few years ago a consignment of print goods valued at over $200,000 was almost ruined by mildew, although in this case the size was applied after the goods were printed. Chloride of sodium, alum, chloride of zinc and other substances have been used, but for general purposes the latter has been found to give the best results.

5. Weight giving materials. The custom of sizing warps so as to make them weigh more is very little used in this country and is generally considered dishonest. In England, however, the custom is very general, especially on goods intended for export. Sometimes as much as 150 per cent. is added to the goods in this way, but from 20 to 75 per cent. is the more common practice. If enough size is used to make the warp weave well, about 7 per cent is added to its weight, most of this being beat off during the process of weaving. If more weight is desired China Clay, a substance mined in England, is added with enough flour or starch to make it adhere to the yarn.

In addition to what has been mentioned

spirits of turpentine is sometimes added to keep the liquid from foaming, and blueing to eliminate a certain yellowish tint which is often present.

For several years there have been placed on the market combinations of sizing materials embracing all the essential ingredients except the most bulky, and known as "sizing compounds." Manufacturers have found it cheaper to buy these than to buy the ingredients and mix them themselves.

Below is given several receipts for sizing which have been found to give good results.

1. For medium yarns with but little weight added.

Starch,	40	pounds.
Sizing compound,	4	"
Tallow,	6	"
Water,	120	gallons.

Mix all together and boil about half an hour or until no starch is seen in suspension. This will add from 2 to 5 per cent. to the finished goods owing largely to the condition of the atmosphere in which it is woven.

2. For sheeting and drills without using sizing compound.*

Corn starch,	43	pounds.
Tallow,	5	"
Zinc,	$\frac{1}{2}$	"
Water,	70	gallons.

* This receipt was kindly furnished by Mr. Z. T. McKinney, Supt. Trion Mills, Trion, Ga.

Boil hard until it thickens. Then boil slowly one hour and thin down to 110 gallons. Keep boiling gently in size box while being used.

3. For adding 10% in weight.

Starch,	100 pounds.
Tallow,	10 "
Water,	100 gallons.

For additional weight add more starch and tallow with a little chloride of zinc.

4. For print cloth or such as are not calendered.

Starch,	50 pounds.
Tallow,	5 "
Chlo. Magnesium	5 "
Water,	100 gallons.

Mix the starch, tallow and water and then add the manganese chloride which has been previously dissolved by steam.

5. For medium counts up to 50's. This also gives good results for prints.

Starch,	110 pounds.
Sizing compound,	14 "
Tallow,	40 "
Water,	240 gallons.

This will size nearly 5,000 pounds of warp. As there are 164 pounds of solid matter, were it not for the yarn stretching in the slasher, weight would be added to the extent of 4%. Taking this into consideration, and also the amount knocked off in the loom, practically no weight is added.

CHAPTER III.

The Plain Loom. The Shedding Motion. Beating Up. Picking Motions.

It is the intention of the writer to discuss weaving and loom-fixing only as applied to the plain loom. To attempt to describe the various mechanisms and weaves of the fancy loom would require a book much larger than this one is intended to be.

The loom in itself is a simple machine, but to obtain from it the best results requires a harmony of arrangement and a delicacy of touch which it takes years of experience to acquire. In addition to the frame it consists essentially of three parts, viz: An arrangement for raising each alternate thread, a mechanism for passing the shuttle containing the filling through the divided threads, and a motion to beat up the filling in a regular order. With these three motions an inch or more of cloth could be woven, but to make the weaving continuous, there are arrangements for pulling the cloth forward as it is woven, letting off the warp, keeping the cloth distended to a uniform width, stopping the loom when the filling breaks or is exhausted and stopping it when the shuttle is trapped between the reed and fell of cloth. These latter motions are called secondary or auxiliary motions.

Shedding.—On the plain loom shedding is accomplished by means of cams placed on the cam–shaft which revolves half as fast as the main or crank-shaft. These cams are of a peculiar shape as they must cause the harness to open quickly, but remain open long enough for the shuttle to pass through. Both cams are of the same shape but differ somewhat in size, the one connected with back harness being from an eighth to a quarter of an inch the larger. The cams communicate the motion to the harness by depressing treadles connected with the harness by means of jack-straps below and harness straps above, the latter passing over rollers attached to the arch. The roller or ball for the back harness is one-quarter of an inch larger in diameter than the other, as the back harness being farther away must be raised higher in order that the warp threads make the same angle where the shuttle passes through. If the angle formed by the front harness is the greater, the cloth will not look well, the better looking side being underneath.

Picking Motions.—There are several kinds of picking motions used each having certain advantages. On English looms what is known as over-pick or Blacksburn-pick is used. In this the picker-stick is over the lay and at right angles to the direction in which they are placed in American looms. As the motion of the picker is parallel to the race-board, the trouble which often come from this cause are done away with.

In very wide looms such as are used for weaving sail-cloth, what is known as the "positive" shuttle motion is used. In this a strap passing between the race-board and warp carries the shuttle on supports so shaped and polished that the warp threads pass between them and the shuttle, the strap of course reversing its motion at each change of the harness. On very narrow work such as ribbon, tape and suspenders, another form of positive motion is used. It consists of a gear on each side of the warp which engages with a rack on the under side of the shuttle. The shuttle is long enough so that at no time is it disengaged from both the gears, which of course reverse their motion as the shedding takes place.

What is known as the "Lowell motion" is used by several loom makers. In this the pick-lever is of wood and is placed directly over the cam. It is connected with the picker-stick by means of a long strap passing under a roller. This motion has the advantage of being very simple and gives a light, easy pick.

The motion most frequently used on American looms is what is known as the "Stearns motion." It is also called the "cone" pick on accnunt of shape of the roller on the pick lever. Aside from the cam, it consists of a lever having two arms at right angle to each other. The shorter one carries a roller and it directly over the cam, while the larger one communicates the motion to the picker-stick by means of two straps and a connecting link of wood. This motion is capable of quick and easy adjustment and is popular among those using it.

The "bat-wing" motion is also frequently used. It is similar to the Stearns except in the shape of the cam and position of the lever. It is not very well liked on account of its many parts, but is best for wide looms as a great deal of power can be had from it.

There are various combinations of these motions having different names, but as all embody essentially the same principles it is unnecessary to mention them in detail.

In selecting a loom, other things being equal, preference should be given to the one having the smallest pick-cams and gears on account of the momentum caused by large ones. If a loom never got out of fix there would be no objection to a large cam. In fact they would be preferable as a large cam, properly set, give a smoother pick, but when a loom slams off, the lay and crank-shaft come to a sudden stop, while the cam-shaft has a tendency to go on, often breaking the teeth, boxes and other parts.

Beating Up.—When the shuttle passes through the shed it leaves a single thread in a diagonal line at varying distances from the cloth. This is beat up by the reed, the motion being derived from the cranks on the crank shaft. The throw of the cranks varies from four to seven inches, being greatest for wide looms. It is very evident, that in a wide loom the shuttle has farther to go, and therefore requires more time in which to do it. To a certain extent this is gained by changing the time of the harness, but the best possible advantage gained in this way would not be sufficient for a very wide loom. It is customary therefore for loom-makers to vary the throw of the crank in proportion to the width of the loom. It is desirable however to have the throw as small as possible so that the threads are not subjected to so much chafing as would be the case with more space in which the reed could damage them. Manufacturers having any trouble on account of the shuttle not having sufficient time to go through the warp can often remedy it by using a smaller shuttle. For a forty-inch loom the width of the shuttle should be about one-third the throw of the lay. For broader looms a little less and for narrower ones a little more.

It is very evident that as the motion of the lay changes at each revolution of the crank-shaft it must stop a short time at the end of each stroke. If the center of the crank-shaft were level with the pin connecting the crank-arm with the lay, the pause would be of exactly the same duration at each end of the stroke, but as the shaft is several inches lower, the lay will stop longer at the back center than at the front, thus allowing more time for the shuttle to pass through.

For ordinary work the reed is firmly secured to the lay, but for goods where the cost of the material is great, such as silk, the reed is so arranged that if the shuttle should stop before reaching the opposite box, the reed springs back as soon as the shuttle strikes it and no harm is done. The ordinary protector sometimes fails to act and to guard against such accidents and also to protect the loom from the jar caused by suddenly stopping it, this device has been invented.

CHAPTER IV.

Setting and Starting Up New Looms. Setting the Motions.

When looms are shipped knocked down, the frames and sometimes the gears and pulleys are bolted together in crates—as many in a crate as can be conveniently handled. All the smaller parts—rolls, temples, rockers, etc., are boxed up, usually a hundred of each kind together.

The plan by which the looms are to be placed is generally prepared by the engineer, but if not it is well enough to observe a few general points. The heavier looms, or if all are for the same weight of goods, the wider ones should be placed on the line of the main shaft and as near the source of power as possible. If they are not, the torsion on the shaft will cause a vibration which of course is to be avoided as much as possible. The looms should not be crowded. With looms thirty-six inches wide there should be four in a set—two facing each other—and room to get around each set. With narrow looms six may be placed together. In weaving any kind of goods the weaver often has occasion to get to the back of the loom and when they are so close together that he has to go up the alley three or four looms farther than is necessary, much valuable time is lost. What is gained in floor space is more than lost in production.

In order to have two lines of looms run from the same shaft, every other loom must be set over six or eight inches in order that the delivery belts may not be together. Sometimes the crank-shaft is made longer on one of the looms. When this is done they can be set in a straight line across the room as well as length ways. This adds a great deal to the appearance of the room but is a bad plan except for very light looms, as the addition length puts a great deal of strain on the shaft. Some mill men run the line of looms next the wall from a full length shaft while others prefer a counter-shaft for every two looms. In either case the hangers should be as near the wall as possible so as to avoid falling oil. The best constructed hangers often give trouble from this cause, but if there is no loom directly underneath damage is not so likely to result.

After arranging the plan by which the

looms are to be placed, the next thing to do is to drop a plumb from the center of the main shaft at each end of the room. From the points where the plumb touches the floor measure out as far as the looms are to be and run a line from these two points. If a permanent line is desired, take a straight edge and scratch a line on the floor. The ends of the looms are then placed in position with their feet just touching the mark. The breast-beam, back-beam and girths are then firmly bolted on. The frame is now ready for leveling, which is usually done from the breast and back-beam. The cam-shaft is then put in followed by the crank-shaft. On some looms it is most convenient to put on the pick levers before putting in the lay, but if not, the lay should next be put in and after being connected with the cranks it makes no material difference in what order the other motions are put on. Care should be taken that all bolts are tight. They are so apt to work loose that on a new loom they should be tightened as tight as they will stand.

The shuttle boxes need more attention than they usually receive. When they leave the shop they are supposed to be ground and filed smooth. The writer served an apprenticeship in a shop where looms are made and saw enough to convince him that it will not pay to trust to luck in this matter. Every box should be examined and any rough places carefully filed. It is a good plan to file the front side a little beveled so that the top will touch the shuttle a little before the bottom. This will prevent the filling being cut. The swell springs should be bent so as to have the greatest curviture in the center, gradually reducing toward the ends. Where the shuttle boxes are very long, for several reasons it is best to have the greatest curviture as near the mouth of the box as possible. It will not only cause the dagger to act quicker, saving power, but will commence to check the shuttle sooner and thus prevent the filling being knocked off.

On ordinary looms, however, the spring should be bent uniformly from the center, for if the loom slams off and there is no brake or it fails to act, the shaft may run backwards enough to throw the reed against the shuttle the end of which may be in the selvage, If the spring is bent so that the bulge is nearer the back of the box, the loom will run all right, but when the warp is off and the fixer examines the dagger, he finds the top of it beveled off as if by a file. This is because the pressure of the shuttle against the swell is relieved at the very beginning of the stroke and the dagger flies up and strikes the knock-off lever before the lay has time to get out of the way.

Whenever it is practicable the loom belts should be crossed. Not only does this give more surface of contact with the pulleys, but the belts are kept clean. Where they are not crossed they should be cleaned with a piece of cloth at least once a week and some good dressing applied. Card-clothing should never be put on a belt and is not necessary where they are kept clean. All belts should be put on with the smooth side to the pulley. Not only is the friction greater but the belt lasts much longer. In a weave-room belts should not be laced. In the first place it takes too long and in the second place it gives too much trouble. The larger ones should be cemented and the smaller ones fastened with hooks. They are cheap, durable and easily and quickly put on. Care should be taken not to hammer out the curve that is in them as it aids materially in holding them to the leather. In putting on a new belt the fixer usually puts it on any way it comes most convenient. The lap, where the different sections are cemented together should run with the pulley. If it runs against it is very apt to give trouble and need repairing. If the laps start up, about the quickest and best way to fix it is to tack it down with tacks that are just long enough to go through and clinch.

When a loom has been run a long time the bore in the loose pulley wears larger, at the same time making the shaft smaller. This allows the face of the loose pulley to drop below the face of the tight one, and when the belt is shifted its edge strikes the edge of the pulley, greatly damaging the belt. The best way to remedy this is to have a bushing put in the pulley, bored the right size. Wire is sometimes wrapped around the shaft to increase its diameter but is not as good a method.

SETTING THE MOTIONS.

Shedding Motion.—This consists of the cams, treadles, harness and straps for connecting the same. The proper adjustment is of great importance, for on it, to a great extent, depends the appearance of the cloth. If, when the harness were level, the eyes would be on a level with the whip-roll and breast beam, each shade of the warp would be of equal tension, and when the filling was beat up every two warp threads would be separate from the next two by a distance easily appreciable to the eye. It is desirable then to have the harness depressed so that at each pick the top shade may be slack. When this is the case the reed, when beating forward will take up the slack and spread it over the face of the cloth. To accomplish this the whip-roller is raised several inches higher than the race-board, and a strip of wood about an inch thick is put on the breast beam. The exact adjustment depends on the class of goods woven. When the goods are coarse or the filling beat up very close, there is no space between the threads anyway and no necessity for raising the whip-roll or breast beam. An exception to this rule is also to be noted when weaving colored work or drills. In the former case the colors show up more brightly, and in the latter the twill is made more prominent.

It is not desirable to have the warp line out of level more than is absolutely necessary, as the yarn is submitted to a greater strain and will break more easily. It may be said in this connection, that anything which tends to improve the appearance of the cloth by spreading the warp threads will put additional strain on the yarn. It is the business then of every good weaver to find the exact limit beyond which it would be unwise to go.

The harness cam should be set so that the harness are level when the crank is just a little forward of the bottom center. If all the cams were made exactly alike, it would make no difference which box the shuttle were in, but through the carelessness of machinists the holes are often not in the right place and to have some uniformity it is customary to have the shuttle in the box nearest the pulley. There is an idea among some weavers that the treadle to be depressed should be the one nearest the side from which the loom is about to pick. This idea probably originated with the hand loom where such an arrangement would be a convenience to the weaver, but in the power loom it is a matter of no consequence. Care should be taken that the back harness be depressed by the larger cam, and the cams should be put in all the looms uniformly so that whether it be a right or left hand loom, the large cam is always to the left of the fixer when he is at the back of the loom.

The front harness should be set so that the threads are as near the race board as possible without touching it, and the back harness a trifle higher. If the threads are too low, they will be chafed by the race board and if too high by the shuttle. The harness should open the same width, or, in other words, the shade should be as wide when the front harness is raised as when the back is. To accomplish this, besides observing the points previously mentioned, be careful to have both the harness balls of the same diameter, to have the harness straps the same thickness and the motion of the balls equally divided between the front and back straps.

The Lease Rods.—These play a more important part in the shedding motion than is generally supposed. As their name indicates their primary object is to keep the lease, i. e., keep the threads for the different harness separate. This is necessary partly to keep them from being tangled, but for the most part in order to find the proper place for one when broken. If a loom is started up without the rods being in their place every fixer knows what will happen—the threads will become tangled, obstruct the shed and the shuttle will be thrown out. In order to maintain the relative position of the threads the ones through the front harness are put under the back rod, and those through the back harness under the front rod. A moments notice will show that if both rods were in the same place, the shade of the harness would vary only as they are a slight distance apart. As both cannot be in the same place the difference is made up by having one thinner than the other. This equalizes the size of the sheds, and taken in connection with the different size of the cams, balls, etc, the harness can be set so that both sheds are of almost exactly the same width.

If the rods are made of wood the threads soon cut groves which are apt to catch a passing knot and break the thread. They are sometimes covered with tin, but when the tin wears off the sheet iron underneath discolors the warp. It is best to have them covered with black enamel as it is so hard as to resist the action of the threads, and so smooth as to make practically no friction.

The Harness.—Too much stress can not be laid on the importance of having good harness. No one thing bothers a weaver more or takes more time than frequently repairing harness. In a mill of any size the cost of harness is a considerable item, and the superintendent noticing this will very often have the overseer to patch up the old ones rather than buy new ones. Not only does this take a great deal of time but the chances are that a great many of the eyes will break in the loom causing loss of time and cloth.

Two harness are all that are necessary for plain weaving, but a great many manufacturers prefer using four, the eyes being spaced only half as close together. Most of the threads that break in the loom are broken by chafing against spooler knots, and if the eyes are not crowded it is obvious that there would be less trouble. All weavers agree that the four harness system is the better if it were not for the additional cost. New harness should be thoroughly greased with tallow before using.

Picking Motion.—This consists essentially of a cam, pick-lever and picker-stick with straps for connections. Its proper adjustment is of the utmost importance, for without it, it is impossible to obtain satisfactory results. The cam should be set so that the shuttle will begin to leave the shuttle box when the crank lacks just a little of being at the top center. The loom is then said to be picking soon. The exact position of the cam varies under different conditions. For a fast loom, i. e., one making 175 or more picks per minute the cam should be set so as to pick earlier than for a loom making only 150. If the shuttle box is short or if the goods woven is fully as wide as the reed space, the cam must be set a little later as the shuttle starts so close to the cloth, not giving the harness time to open the shed. In this case the shuttle must receive a stronger blow in order to get it through the shed in time.

For a new loom the cam should be set at such a distance from the bearing of the shaft that its outer edge will be just flush with the outer edge of the pick-ball. As the cam and ball wear, the cam must be placed nearer the bearing in order to obtain the same amount of power.

The pick-lever should be set as close to the cam as possible. There is usually a flange or some prominent mark on the loom frame with which the back bearing should come even. When the loom is running the tendency is to knock the bearing up, thereby preventing the cam from exerting its full power. For this reason the bolts holding the bearing should be large and well tightened.

The best picker-sticks are made from straight-grain, second-growth hickory and, if properly made and adjusted should last at least a year. The lug-straps (the straps connecting the lever with the picker-stick) should be so adjusted that when the loom picks the picker does not come within two inches of the bumper. In other words lengthen the strap as much as possible and still have the loom to run. The strength of the blow necessary to throw the shuttle from one box to another, is known as the power, and the rule of all rules among loom fixers is to use as little as possible. Too much power means broken picker-sticks, worn out straps, battered pickers and three times the trouble and attention that would otherwise be necessary. Besides this the extra jar and vibration will tend to loosen the bolts and screws in every part of the loom. How to make a loom run without too much power is what takes so long to learn. As every loom fixer knows, it takes about as long to learn this trade as any other. The exact position of the cams, pick-levers, swells, etc., can only be determined by long experience. A large part of the secret is having the protection right and keeping it right. A great many fixers will put the dagger in the center of the slot in the knock-off lever, thinking it may work a little either way and still be all right. If the lever is pulled forward to the position it occupies when the loom is running the dagger will strike it nearly an eighth of an inch HIGHER than when the lever is pushed full back. This is owing to the fact that the dagger, being fixed to the lay, describes the arc of a circle, the radius of which is equal to the length of the sword, and shows that a very little margin when the looms is stopped, becomes sufficient when it is running. Besides this the fingers on the protecting rod and more especially the plates on which they press wear rappidly, letting the dagger up a little. If it was originally set in the center of the slot, it soon gets entirely over it and the result is a smash.

Pickers.—For plain weaving the pickers are usually made of leather, well tanned and cemented. When putting one on a loom place it against the picker-stick at the extreme end of the lay and bring the shuttle against it with sufficient force to make a small puncture in the leather. With this as a center cut a conical hole in the picker the shape of the shuttle point. After putting on the loop with sufficient packing to make it tight, drive it on the picker-stick until the center of the hole is exactly level with the point of the shuttle, then bring the picker forward against the bumper and if the hole is still level or a little higher than the shuttle point it is all right, but under no circumstances should it be lower. If it is too low it can be made higher by inserting a small leather wedge between the rocker or shoe and the parallel tongue. If it is too high a wedge similarly placed, but on the under side, will bring it to a proper level. On some looms a set screw with a check-nut is on the rocker by means of which the picker can be adjusted.

It is desirable that the hole in the picker be exactly level with the shuttle as it leaves the box, but for fear of having it too low, it is customary to have it a little high—say from one-sixteenth to one-eighth of an inch. In theory the shuttle should make its own hole in the picker, when it is certain to be in the right place, but in practice it is almost sure to rebound unless the shuttle boxes are made tighter, which is objectionable for several reasons. The shuttle also has a tendency to knock the picker up, which for obvious reasons should be avoided.

Filling Stop Motion.—This consists of a cam on the cam shaft, a rack on the lay between the reed and shuttle box, a filling-fork mounted on a slide, a lever for pushing the shipper handle from the retaining notch, and a jointed lever for communicating the motion of the cam to the filling fork. When the shuttle is in the home box (the one nearer the pulley) the cam should be set so that the lever just begins to rise when the crank is on the front center. The hook on the fork should then clear the snake-head by one-tenth of an inch.

If the fork is adapted for the work it has to do, it is not necessary for the prongs to project beyond the rack, but just get through. If the fork is too heavy the prongs must be further forward. When this is done however it draws off too much slack, and is liable to kink the filling or have it catch on the fork. The fork should either present a square front to the filling or be slightly concave. If it is rounding the filling sometimes goes over it and the loom stops. If the prongs are too short the filling occasionally gets under it with the same result

Take Up Motion.—In this motion there is an excentric either on the cam or crank shaft which by means of a lever operates a ratchet gear which in turn is connected with the sand roller by a train of gears. There is also a device connected with the filling-fork, by means of which the loom fails to take up for several picks after the filling gives out.

When the shuttle is in the box farthest from the pulley, the excentric should be set so that the lever begins to go forward (toward the excentric) just a little before the crank reaches the front center. The loom will take-up when it is in other positions but will often take up one tooth in the gear when it is not desirable, for instance, when the weaver is getting the loom ready for changing the shuttles or drawing in a brokan thread. The stud holding the catch should be placed about in the center of the slot. Some take-up levers may be a trifle longer than others, and to suit varying lengths, the stud may be moved backward or forward.

Let Off Motion.—There are several kinds af let-off motions, all however, being classed under two heads: the friction and the automatic. The former usually consists of a rope or strap passed around a drum on the beam head. One end of it is fastened to a lever to which a weight is attached. By this means a constant strain is kept on the warp which lets off uniformerly whether the diameter be great or small. The motion is rather out of date and is not liked very well as damp weather effects the rope unfavorably.

Among the automatic motions the Bartlet

is the one most frequently used. Although rather complicated, if properly adjusted it gives very good results. When the harness are level, the spring rod connected with the whip roller by a clutch lever, and the upright lever connecting the spring rod with the lower rods should be as nearly perpendicular as possible. The collar on the round rod should be half way between the ends of the two rods, and the front lever straight out from the ratchet gear. Care should be taken that the two short shafts are exactly at right angles to each other and the worm exactly in the centre of the worm gear. When the friction strap is off every part must work perfectly free.

In any let-off the parts should be so arranged that the weavers cannot alter the tension. If they can do it they very often will, as by so doing, they can weave more and have less trouble on account of broken threads.

Temples.—Within the last few years what is known as the ring temple has been put on the market and is giving very good results, but it is safe to assume that the Dutcher temple will be used for many years to come. In setting temples it is of great importance to have them tight on the breast-beam. When it is of iron there is no trouble but when it is of wood a place must be chiseled out an eighth of an inch deep, just tbe width of the base and an inch or more longer. With two screws in the slot the temple will be held perfectly firm, at the same time the length of the mortice allowing for a slight difference in the width of the cloth. The trough should be as near the race-board as possible without touching it. The heel should then be set so that the lay touches it when the reed is about one-eighth of an inch from the trough. There need not be more than a quarter of an inch vibration. More than this not only wears the temple unnecessarily but the cloth begins to leave the burr before it can get back to hold it. This will cause a rough selvage which spoils the appearance of the cloth.

Further Details.—In a new mill the looms, or at least a part of them are ready to run before the warps are ready, for the reason that with new machinery it will take a week or more for the cotton to get from the picker room to the weave room. During this time it is well to have the looms running bare or "limbering up" as it is expressed. This may last a week if necessary, during which time the loom should be frequently oiled and the bolts tightened. When a warp is ready, if all the motions have been properly adjusted, there should be very little trouble in weaving it. The greatest difficulty will be with the shuttles. Before putting them in the loom they should be carefully matched both as to size and weight. Every fixer has noticed that a loom will sometimes run all right with one shnttle, while with the other it gives no end of trouble. This is usually owing to a difference in size, but often to a difference in weight, as of course more power is required to throw a heavy shuttle than a light one. Where the swells are of iron it is a good plan to scrape the shelac off the sides of the shuttles as it not only causes them to rebound but combines with minute quantities of iron and forms a kind of gum which is liable to discolor the filling. For the first day, or perhaps longer, the shuttle boxes will have to be very tight and more check on the picker-stick than would otherwise be neeessary. One great trouble about new looms is that the overseer or fixer is so anxious to see them running and making cloth that not enough time is taken to properly adjust everything. It will have to be done at one time or another and it is much better to do it when there is nothing in the way. As is said before all nuts and screws should be as tight as possible. In any new machinery and especially if there is any wood work, the bolts are more liable to work lose than in machines that have been run some time.

CHAPTER V.

Troubles A Loom-Fixer Encounters.

Loom Slaming Off.—In the vast majority of cases when a fixer is called on to fix a loom the trouble is slaming or banging off, i. e., the shuttle fails to reach the opposite box in time, the protector acts, and the loom suddenly stops. The most frequent cause is either the picker being worn out or a lug strap being broken or stretched. If anything is broken or a bolt out of place a mere novice should see it at once and it is unnecessary to say anything concerning it. By a little watching, with the hand on the knock-off lever or frog one can readily tell which end of the loom is causing the trouble, and govern themselves accordingly. The pick-cam may have sliped or, if the loom has been running some time, the wear of the gearing will have the same effect, i. e., will cause the loom to pick late. If the pick is all right, next examine the dagger and protecting rod and be sure they are working properly. Sometimes the rocker-shaft box becomes loose, causing the lay to move up or down as the loom picks, and will almost invariably cause it to slam off. Some of the screws in the shuttle-box may be loose. This would make the box larger, and by nutralizing the binding effect of the swells cause the shuttle to rebound after striking the picker. As the picker connot then get a full stroke, the shuttle fails to get in the opposite box in time and the loom slams.

In damp weather the same effect is brought about by a different cause. The damp air causes a kind of gum to form on the shuttles and shuttle boxes and by increasing the friction prevents the shuttle entering the box far enough. If the shuttles are wiped with oily waste and afterwards with clean waste the trouble is often evercome. If this does not remedy it, sand-papering the shuttles will have a good effect. They are often scraped with a knife, but this is a bad practice, as it tends to make the shuttles of unequal sizes. The check on the picker-stick may not be sufficient to deaden the momentum of the shuttle, and it will rebound. Again it may be too much and prevent the shuttle entering freely.

As the parallel block is worn the check is increased, while the power is diminished. Loom-fixers keeping this in mind can often save themselves much trouble. Sometimes the heel-spring is wound so tight, that so much power is absorbed in overcoming it that not enough is left to throw the shuttle.

The constant picking of the loom will gradually knock the pick-lever boxes up from their true position. A very little displacement will cause a large loss of power. As is stated elsewhere the boxes should be even with the flange or feather on the loom frame.

When a loom picks, by watching closely, the lug strap may often be seen to jump up an inch or more on the picker stick. As the power is greater the lower the strap works on the stick, it is desirable to keep it where it is put. Several devices have been invented for this purpose but as yet nothing satisfactory has been done. About the best way is to loosen the bolt on the short strap and incline the strap upward. This has the desired effect but shortens the life of the strap. If it could be worked perfectly straight there is no doubt that it would last twice as long.

Occasionally the key in one of the gears becomes loose, and the lost motion is communicated to the pick-lever and causes trouble. Generally when the key becomes loose it comes out and the trouble is readily located, but sometimes it stays in place, especially where tin has been used to pack it, and a careful examination is necessary to discover the difficulty. The key may also be loose in the driving pulley, but when this is the case it can usually be detected by an uneven, jerking motion in the running of the loom.

The belt very often causes a loom to run badly. A slack belt will not exert sufficient power and a tight one, if too tight, will make friction in the crank-shaft and cause more trouble than a slack one. If the belts are kept clean and a good dressing applied every Saturday afternoon, it will help matters wonderfully. The shipper sometimes fails to keep the whole width of the belt on the tight pulley, and of course does not give satisfactory results.

As a loom runs, the gears gradually wear out, especially where the pick comes. As the teeth become thin the motions act later with reference to the crank, and from time to time have to be moved up. This wear is most excessive where the gear is small in diameter. Where large gears are used there are more teeth in contact at one time and consequently less wear. Before the teeth become thin enough to be in danger of breaking, the pick should be changed. This is done by loosening the box of the crank-shaft, raising the shaft until the gears are out of pitch, and then turning the lower one four or five teeth. Of course the pick-cams, harness cams, etc., will have to be moved in proportion. If the top gear has to be changed it must be removed from the shaft and turned to another key-way of which there are usually three already cut. When the gear is completely worn out and is replaced by a new one, the edges of both should come in the same line. Beside looking much better, it will cause them to wear longer. Very often the new gear has a larger bore than the old one, and when the key is driven in it throws one edge farther over than the other and causes the gear to "run out" as a machinist would say. This can be avoided by using a bushing of tin.

There is a collar on the end of the cam-shaft which should be kept tight. Nothing wears out a gear faster than to run with a quarter inch or more end play in the shaft.

Throwing Out the Shuttle.—The picker may be too low, either at the beginning or end of the stroke. The harness may be too low or not timed exactly right. The wire brackets holding the lease rods in place may be bent. The rocker-shaft boxes may be loose letting the lay down too low. The bottom of the shuttle may be worn in a curve, or the temple may be too high off the race-board. Very often one shuttle will be thrown out while there is no trouble with the other. This may often be caused by the points not being the same height from the base. The base may be square but one end wearing a little more than the other will throw that point too low. The shuttle box being too loose will cause the shuttle to be thrown out especially where the loom is a fast one. Where the race-board is iron, the screws holding it to the lay sometimes work out, allowing the board to bulge up.

It is the custom in most mills to have the weavers thoroughly clean the loom when the warp runs out. Occasionally in their zeal to do it well they take off the harness rod and when they put it back, get it on backward. The shuttle will be thrown out at every pick and the average fixer who has never seen anything of the kind, will work several hours before he discovers the trouble.

Thin Places When the Loom is Started.—This is often caused by bad spinning. When the filling runs out there is sometimes a thread left long enough to lift the fork several times before the loom stops. Sometimes the prongs of the fork become bent and strike the rack, lifting the fork after the filling is exhausted. Again the fork may appear all right when the loom is stopped, but the bearings of the roker-shaft having become worn the lay goes down a little. When the loom picks it rises again and the points of the prongs catch on the bottom of the slot which is cut in the lay. The finger on the breast beam rod may be too far from the fork slide. This will prevent the slack motion from working properly. The sliding dog may not be free to slide far enough. This motion can be set so as to let off three notches every time the loom stops. This is enough for all ordinary cases, and in fact for fine cloth is too much.

Thin Places When the Loom is Running. —This is a trouble which will worry a fixer about as much as anything he encounters. While he is watching it the loom may run all right, and he can see nothing the matter, but if he leaves, it is not long before he is called back. The case is further aggravated when the loom runs all right for several hours, makes a thin place, and runs several hours more. The trouble is sometimes caused by the filling being cut at the off box with a sufficient end to catch as the shuttle goes back, lifting the fork and keeping the loom running. If this is not the cause it is nearly always a set screw being loose. It may be in one of the gears or worm on the let-off motion, or in the piece which connects the lower rod with the upright lever. If all the set-screws are well tightened, the parts oiled and the take up gears cleaned out, there is not likely to be any further trouble.

Knocking Off Filling.—This trouble is very often caused in the spinning room, where the filling is either not wound on the bobbins sufficiently tight or the taper is too short. Where this is not the case something is the matter with the loom. The shuttle is driven with such force against the picker that when its momentum is suddenly checked the filling will leave the bobbin on the same principal that the passengers are thrown forward when a train is suddenly stopped.

To economize floor space manufacturers sometimes order looms with short shuttle boxes. This is poor economy, as such looms are much more likely to knock the filling off than those with longer boxes. It will take but a short time for the waste bill to counterbalance any saving in space. If a loom is fitted with shuttles of the right hand, the bobbin will always point from the pulley end of the loom, and it is in the opposite box that the filling is knocked off. To remedy the trouble the shuttle must be stopped as gently as possible. This is done, 1st, by springs connected with the swells and 2nd by the check on the picker-stick. If it can be avoided the shuttle-boxes should not be tightened, but if it is necessary the spring on the protecting rod should be used rather than the swell spring. Under ordinary conditions if the picker-stick is three inches from the end of the box when the shuttle strikes it will be sufficient, but for some inexplicable reason some looms require more power to run them than others, and a four and even five inch check is necessary. Sometimes the check is increased by tightening the heel-spring and sometimes by loosening it, owing largely to the condition of the parallel-block and the length of the picker-stick below the rocker. On the Whitin loom the best results are obtained by having the point of the stick a trifle lower than the parallel tongue. As a last resort the heel strap can be put between the tongue and the picker-stick. Tightening the spring will then almost invariably give all the check desired. The only objection to this is that the picker-sticks are worn out or at least cut off at the bottom sooner than they otherwise would be. Springs of various shapes are sometimes placed on the under side of the lay to check the picker, but they usually damage the stick and cause more trouble than they are worth.

A short or stiff loop-strap will sometimes prevent the picker-stick having as much check as it otherwise would and a longer one can be used to advantage. Sometimes the plate on the swell of the off shuttle-box has worn more than the other and is not pressed as tightly against it. When this is the case the swell does not bind the shuttle as quickly and part of its checking effect is lost. A new plate may remedy the trouble, but if not, the fingers on the protecting rod will have to be moved.

Cutting Filling.—This is a trouble that does not occur very often, but when it does, it is sometimes hard to stop. A bruised place on one of the steel rolls of a spinning frame some times causes it. Every time the back traverse brings the yarn to the place it is cut, not enough perhaps to cause the end to go down, but enough to break it in weaving. A splinter in the thread tube (of new shuttles) or a bruised place in the shuttle box will often cause it. The shuttle may be so worn that the grove is not deep enough or the picker may throw the shuttle in a zigzag motion, catching the filling between the shuttle and mouth of the box. Often the temple is set too far forward, and when the loom is at front center, the filling is caught between it and the reed. There may not be sufficient check, and the shuttle rebounding forms a kink which is caught between the swell spring and shuttle. Where filling-forks having square prongs are used, the sharp corners will occasionally catch the filling in tbe rack and cut it. Sometimes the rivet in the shuttle will work out and cut the filling by catching it against the swell spring.

Filling Fork Catching the Filling—This trouble can usually be traced either to the shuttle or the fork. When the shuttle strikes the picker and rebounds the loom does not always slam off. If the power from that end is sufficiently great the loom will run even though the shuttle rebound two inches or more. When this is the case it can readily be seen that the filling will loop or kink, and as the space between the reed and shutle-box is the only place where the kink can form, it forms there and the fork catches it as the shuttle goes back. Sometimes the fork is so set that the prongs project from an eighth to a quarter of an inch beyond the rack. Of course it carries the filling with it and when the motion of the lay reverses, a kink is formed which is caught by the ever ready fork. If the prongs are too high, or if one is longer or farther forward than the others, trouble is likely to result.

Selvage Breaking Out.—A bad picker, rough shuttle or the harness or temple being improperly set usually cause this trouble, but more obscure causes are the ones that bother the fixer. In the process of sizing, a heavily weighted roll is used to press the warp tightly on the loom beams. All beams are not exactly of the same length, consequently the roll does not always fit. When the beam is longer than the roll the warp piles up on the selvage and that part of the beam being of a greater diameter than the rest, the yarn is of course strained, and more likely to break in weaving.

As several selvage threads can be left out without affecting the appearance of the cloth, the weavers sometimes throw them back until they become long enough to draw in without tying. When they are drawn in they are often so crossed and tangled that all the size is worn off before they get past the lease rods, and the chafing of the harness and reed break them. The harness may be so timed or the pick so set that the shuttle rubs against the selvage threads not only rubbing off the size, but taking out the twist causing the threads to break readily.

In what is known as a well balance cloth, the filling is a trifle finer than the warp, but in certain kinds of goods the filling is the coarser. When this is the case a very little tension in the shuttle will make the cloth narrower than the reed and as the reed beats against it in trying to make the cloth as wide as it is, the selvage is cut out as if by a knife. If the warp were stronger than the filling, the filling would be cut making what is known as button holes.

Through the carelessness of the slasher-tenders a warp sometimes has very little or no size on it, and the fixer is at his wits end to know how to weave it. Lowering the whip-roller will help matters, and if the principle trouble is at or near the selvage the pick motion should be set a little later so as to have the shed fully open when the shuttle enters it.

Filling Fork Coming Off.—A piece of wire driven in the breast beam and bent over the slide will prevent this but it is not mechanical. In this as in everything else there is a cause for every effect, and in this case the cause is the snake-heads being too high. If it is lowered so that the fork is level when resting on it, there will be no more trouble.

CHAPTER VI.

Defects in Cotton Cloth and how to Remedy Them.

ROLLY CLOTH. BUTTON-HOLES AND BAD PLACES IN THE SELVAGE. KINK IN THE FILLING. REEDY CLOTH. ROUGH SELVAGE. VARYING WIDTHS. COCKLY CLOTH. BLACK OIL.

Rolly Cloth.—This is sometimes known as wavey or uneven cloth. It is usually caused by the friction-strap on the let-off motion becoming oily and slick. The set-screws in some of the gears or worms may be loose, or the bolts holding the let-off frame to the frame of loom may be loose. Some of the working parts may lack oil or be clogged with waste. The spring holding the pawl to the ratchet gear may be broken or worn so as to become weak. A filling box may have been run against the worm shaft bending it so that it binds in its bearings. The upright lever may be so low or so high as to cause the spring rod to bind. The gudgeons on the warp beams may be loose or bent.

When a new warp is put on having a diameter of say eighteen inches there is a leverage of nine inches tending to turn the beam. It sometimes happens that the friction-strap is not sufficient to hold it tight enough to let-off evenly. More friction can be had by putting a piece of leather back of the gudgeon and bolting the locks tight. Loose locks will allow the weight of the beam to rest on the let-off shaft preventing it from working freely. The set screws in the worm or gears may be so short that the head will strike the casting before the point strikes the shaft. The spiral springs may be so choked with waste as to lose their elasticity.

Button-Holes; Bad Places in the Selvage. —Button-holes are caused by there being too much tension in the shuttle. This will make the cloth narrower than the reed, and the reed in trying to distend it will cut the filling.

If the bobbin is neither too low nor too high. The tension is caused by waste on the bobbin or by a lump of it in the thread tube. There are a number of causes for bad places in the selvage. The picker may be too low. The harness or harness cams may not be set right. The harness may be too loose or a few eyes lower than the rest The bottom of the shuttle may be worn in a curve or the temple may be too high off the race board. It may be too high on account of the bearing of the rocker shaft being loose or badly worn. If it is simply worn the temple may be lowered by packing with a piece of paste-board. The spindle in the temple may be rusty preventing the burr from working freely.

Kinks in the Filling.—The loom may be all right and the kinks caused by there being too much twist in the filling. All such should be steamed but if not, a piece of leather may be tacked on the lay at the mouth of the shuttle-box or flannel tacked in the shuttle in front of the thread tube. If the shuttle has an adjustable tube the tension may be regulated to suit the filling.

The filling fork may protrude too far through the rack, taking the filling with it and causing it to kink when the tension is removed. The shuttle rebounding will have the same effect. The writer has known fixers to work on shuttles for several hours when a minutes work on the fork or a few seconds taken in tightening the shuttle box stopped the trouble at once. The rolls in the spinning-frame may be too close together for the length of the staple. When this is the case, however the kinks may be seen id the filling before it is woven.

Reedy Cloth.—This term is sometimes applied to defects caused by defective reeds, but in a general way it is applied to cloth where the warp threads seem to be separated from each other, or in other words where the cloth does not have a good cover. The whip roller or strip on the breast beam may be too low. (see p. 33) The harness being set to open too late will also have a very marked effect. Where the harness have been frequently repaired some of the eyes may be higher or lower than the rest. The reed or pitman straps may be too loose or the lease-rods may be too close to the harness. The nearest one should be at least six or eight inches away. Uneven yarn will of course make the cloth uneven as a loom has not yet been invented that will make good cloth from poor material.

Rough Selvage.—The harness may not be set right. Having the shed too small when the shuttle passes through will cause the shuttle to twist the outside selvage threads, or if the picker is too low, it will throw the shuttle up and twist them when the harness are all right. The twisted threads in themselves would make a bad selvage but when they are twisted tight the twist contracts them and gives the selvage a puckered appearance. The temple may be too far from the fell of cloth when the reed strikes it, or the burr on the temple may not work freely. The diameter of the warp beam may be a little greater at the selvage causing it to let off more (see page 58). The drawing in girls will sometimes skip eyes, and when they come to the selvage, tie in additional ones to make up the loss. These are very often higher or lower than the others and will make bad work in the loom.

Occasionally a loom is found where the hole in the harness cam is not exactly in the right place. This will cause the shedding to be imperfect and often cause a bad selvage. If the cam is loosened on the shaft and turned half around, it will often stop the trouble.

Varying Widths.—When a thread is broken in the warper the attendant does not always catch the broken end promptly but pieces it up one, two or three laps short. This will of course break in the slasher and often 25 or 30 yards run before it is noticed. All these threads are missing both in the reed and harness, and it is no unusual thing to see from two to a dozen loose ends coming up as the warp is woven. Some of these are used when a place comes up where there is no thread to be found. Others are fixed up in a dozen different ways to keep them from tangling the other threads. When a thread is missing and there are no spare ones it is quite customary to take one from the nearest selvage. A great many weavers seem to have an idea that selvage threads are of no special importance and when they break out will sometimes break them off for hours at a time rather than draw them in. All this makes a difference in the width and sorely perplexes the finishers.

Again as the beam becomes smaller the leverage tending to turn it becomes shorter and a greater tension is on the warp. This makes the cloth weave narrow. One shuttle may have more tension in it than another. This in itself would make but little difference, but taken in connection with other things will cause the width to vary. It is a good plan for the fixers to measure the cloth on every loom at least once a day and keep it at a uniform width.

Cockly Cloth.—This is caused by weaving with insufficient tension. The cloth looks raw and rough, and the filling threads seem to be raised on the surface. This is more likely to occur after damp weather. As the moisture contracts the warp, the fixers, in order to keep the cloth at the standard width, let out the tension spring and neglect to take it up again when the atmosphere becomes dry. The weavers will often let out the tension if it is so arranged that they can alter it.

Black Oil.—Oil discolored by being mixed with particles of iron will injure the sale of any cloth, although if it is to be bleached or printed it does not make so much difference. It usually gets on the cloth through the carelessness of the slasher tenders or weavers and most overseers hold them responsible.

Sometimes a half inch or more of the filling will be black about six inches from the selvage. This comes from the shuttle, more especially new ones. The shell-lac or the tannin in the wood combines with minute particles of iron and forms a black compound which blacks the filling, always from the off shuttle box. A little oil put on the shuttle and thoroughly rubbed off with waste will remove the gummy substance and stop the trouble.

Occasianally small black specks are observed scattered along the cloth about midway between the selvages. These come from the treadle stand and can be prevented by covering it with cloth until the surplus oil is absorbed or the warp becomes too small to be reached by the flying particles.

A solution of oxalic acid is often applied to the larger spots, combining with the iron, forming oxalate of iron, which being soluable in water can be washed ont. Unless thoroughiy removed it is liable to damage the cloth by corrosion.

Finishing.—Cloth which has been woven in the best manner and from yarn carefully prepared is often complained of by commission merchants as not being first-class. The truth of the matter is that the best of cloth is often seriously injured in the finishing process. Take the calenders for instance. If the rolls are too hot the cloth will be hard and wirey and feel as if the yarn had been twisted too much. If there is not enough steam on the cloth the effect will be the same. Too much, however. will contract the cloth and give it a slightly puckered appearance. Again there may be too much tension on the back-beam. This will cause the cloth to be stretched too much and spoil its appearance by pulling the filling threads so that they will not cross the warp at right angles. The greatest care should be had throughout the entire process of finishing. If the cloth is tacked it should be done neatly. All loose threads should be pulled off. No little things shows to worse advantage than to open a bale of cloth and find the end a mass of tangled threads. The bales should be put up neatly and branded carefully. A little trouble in this direction will pay well, for, other things being equal, a man will invariably choose goods which are put up with the most care.

CHAPTER VII.

Weavers's Calculations.

To Find the Number of Reed to Use.

Rule.—Subtract four from the number of warp threads per inch and divide the remainder by two.

Example.—There are 60 threads per inch in the warp the goods to be 36 inches wide, what reed is to be used?

$$60-4=56.$$

As there are two threads to the dent, divide by 2 which makes 28 dents per inch. As there are 60 threads per inch and as the goods are to be 36 inches wide there will be

$60\times36=2160$ theads.

In practice, however, goods that are to be 36 inches wide are woven 37 and stretched to 36 in the finishing. We must then take

$60\times37=2220$ threads.

Now as there are two threads to a dent we divide by two which gives 1110 dents and as there are 28 dents per inch we also divide by 28 which gives 39.6 inches as the length of the reed. Now there are say 8 double selvage threads at each end. This would be 16 threads, 8 dents

$$\frac{8}{28}=\frac{2}{7}=.28 \text{ of an inch}$$

shorter, which being subtracted leaves 39.32. To this is usually added a quarter inch guard at each end making a total length of 39.82 inches.

If the sley is finer than 65 subtract 2% in addition to the four and proceed as above.

Example.—There are to be 70 threads per inch, goods to be 40 inchs wide what reed is to be use?

$$70-(4+2\%)=64.6$$

$$64.6\div2=32.3 \text{ dents per inch.}$$

$$70\times41=2870 \text{ threads}$$

$$2870\div2=1435 \text{ dents}$$

$$1435\div32.3=44.42$$

$$44.42+.5=44.92 \text{ inches}$$

long, neglecting selvage.

Numbering Cotton Yarn.—The numbering of cotton yarn is based on the principle that 840 yards of No. 1's weigh one pound, which is divided into 7000 grains and is called a hank. The finer the yarn the greater the number of yards in a pound and the higher it is numbered. For example No. 5's will contain five times 840 yards to a pound and No. 20's twenty times.

TO FIND THE WEIGHT OF A PIECE OF CLOTH, THE NO. OF YARN, WEIGHT AND PICK PER INCH BEING GIVEN.

Example.—Picks per inch 64. Warp threads per inch 64. Width 28 inches. Filling No. 30's. Warp No. 29's. What is the weight of the goods? We first get the number of yards of yarn in a yard of cloth. As the goods are 28 inches wide each thread of filling will be 28 inches long and as there are 64 in an inch and 36 inches in a yard we have

$$28 \times 64 \times 36 = \text{no of yards}$$

of filling. There are 36 inches in each warp thread, 64 to an inch and 28 inches wide.

$$36 \times 64 \times 28 = \text{No. of yards in warp.}$$

In one pound of No. 32's there are 32×840 yards, which reduced to inches gives

$$32 \times 840 \times 36.$$

For the weight of filling we then have

$$\frac{64 \times 28 \times 36}{32 \times 840 \times 36}$$

Working out by cancellation this equals

.0666 of a pound.

For the weight of warp

$$\frac{36 \times 64 \times 28}{29 \times 840 \times 36} = .0735.$$

Adding

$$\begin{array}{r} .0666 \\ .0735 \\ \hline .1401 \end{array}$$

This is the weight of one yard in decimals of a pound.

Adding 6% for contraction in weaving we have .1485 which divided into one gives 6.7 yards to the pound.

There is no fixed rule for contraction in weaving as it is greatest on coarse yarn and fine counts of reed. From 6 to 7 per cent though is about right—the latter figures perhaps being nearer correct.

TO FIND THE AVERAGE NO. OF YARN REQUIRED FOR CLOTH OF ANY DESIRED WIDTH, WEIGHT AND PICK.

Example.—Warp 60 threads to the inch. Pick 56. Width 36 inches. Weight 4 yards to the pound. What is the number of yarn?

We first get the number of yards of yarn in a yard of cloth.

Warp - - - -	$60 \times 36 = 2160$
Filling - - - -	$56 \times 36 = 2016$
Adding	4176
Contraction 7 %	.07
	292.32

Which being added makes

4468.32

As one yard weighs only one quarter of a pound, we must multiply by 4 to get the number of yards in a pound.

$$4468.32 \times 4 = 17873.28$$

Dividing by 840 we get 21.28 average number of yarn. In this calculation we assume that the cloth is woven 36 inches wide and weighs 4 yards to the pound as it comes from the loom. If it woven wider and afterwards stretched, proper allowance must be made for it.

If the number of warp and filling were the same 21.28 would be the correct number, as suming that no weight is added in sizing. To have a well balanced piece of cloth, how ever, it is necessary to have the spaces between the threads of equal distance both in warp and filling. Owing to the fact that there is not so much twist in the filling as there is in the warp, the diameter of the thread is greater and consequently the filling should be a little finer. It should also be finer owing to the fact that the tension on it in weaving is not so great as on the warp giving it a better chance to spread. Taking these things into consideration the filling should be about three or four numbers finer than the warp.

TO FIND THE NUMBER OF YARN IN A GIVEN PIECE OF CLOTH.

Pick out the threads and lay them end to end until there are $11\frac{1}{2}$ yards (one half yard being allowed for the contraction in weaving which does not all stretch out). Weigh these and divide their weight in grains into 100, which is one-seventieth of a pound as twelve yards is one-seventieth of a hank. The result will be the number of the yarn.

Example.—$11\frac{1}{2}$ yards of filling weigh $4\frac{1}{2}$ grains, what is the number of yarn?

$$\frac{100}{4.\cancel{3}\,5} = \cancel{23.8}\ 22.2$$

If the warp has been sized enough to increase its weight it should be first washed in hot water to remove the sizing materials.

TO FIND THE GREATEST POSSIBLE PRODUCTION FOR A LOOM, THE SPEED, NUMBER OF PICKS PER INCH, AND NURBER OF HOURS PER WEEK BEING GIVEN.

Multiply the speed per minute by 60 and the number of hours and divide the product by the number of picks per inch and 36.

Example.—A loom runs 66 hours per week at 175 picks per minute on goods having 64 picks per inch. What is the best possible production?

$$\frac{175\times60\times66}{64\times36} = 300.7$$

yards per week.

It is customary to deduct from 8 to 12 % for necessary stopping for changing the shuttle, repairing the warp, etc. Supposing the above goods to contain 45 yards to the cut. How many cuts should a weaver make per week deducting 8 % ?

$$\begin{array}{r} 300.7 \\ .08 \\ \hline 24.056 \end{array}$$

Subtracting,

$$\begin{array}{r} 300.7 \\ 24 \\ \hline 276.7 \end{array}$$

Dividing,

$$\begin{array}{l} 45)\,276.7\,(6.1 \\ 270 \\ \hline 67 \\ 45 \\ \hline \end{array}$$

Answer, 6.1 cuts per week.

TO FIND THE SPEED OF A LOOM FROM THE MAIN SHAFT.

Multiply the number of revolutions of the shaft per minute by the diameter of the pully on the shaft and divide by the diameter of pully on the loom.

Example.—The shaft makes 300 revolutions per minute. The pully on shaft is 8 inches in diameter and on the loom 15 inches. What is the speed of the loom?

$$\frac{300 \times 8}{15} = 160$$

picks per minute.

An ordinary plain loom without shuttles, belt or straps costs from \$40.00 to \$60.00. \$50.00 being the average. From one-eigth to one-sixth horse power is required to run one. Thus a room containing 600 looms would require 100 horse power if 36 inch looms, and 80 if 30 inch running at the same speed. In either case 20% should be added for shafting.

The size of a loom is reckoned according to the width of goods it will weave. It is possible, however, by using all the reed space to weave goods 37½ inches wide on a 36 inch loom. This extra space is given in order to weave the goods wide and afterward stretch them to the required width.

MANAGEMENT OF A WEAVE ROOM.

The Overseer.—Anyone who is at all familiar with cotton manufacturing will admit that the success of a cotton mill depends on the overseers and to a great extent on the overseer of the weave room. The quality of an overseer depends on his ability to do good work, as large a quantity as circumstances will allow, and at the least possible cost. In the weaving room the finished product is cloth, and it should be the aim of every overseer to get every yard possible subject to the above conditions. It is a mistake, however, to suppose that it takes years and years of hard work to qualify a man for this position. It must must be admitted that for some men it does take that long and some are really never qualified. It depends altogether on the man. It is absurb to suppose that a man well educated, with a taste for reading and study, and not afraid of work, will take as long to advance as one who spent the time in the mill when he should have been at school, and who strives to rise through main strength alone. It is a deplorable fact that so few educated men choose mill life as their business. There are plenty who after leaving school are willing to work in the office, wear a standing collar and direct the movements of others. What we need are educated young men who are not afraid to doff a spinning-frame or run a set of looms. These are the ones who will make intelligent and progressive overseers and superintendents. Education will not take the place of common sense or experience. No man can make a successful overseer who is not able to do anything he requires others to do, but it is not necessary for him to spend a life time acquiring that knowledge. I know of a man who when applying for a position as overseer stated that he had woven eight years, fixed looms six and been second-hand five. He did not make near the success, however, as his successor who had been in a weave room only three years. The difference simply was this: The first man work-with his hands while the second used his brain. He never saw an effect without looking for the cause, and was not satisfied until he found it. He took several texile papers and read them carefully, and when a position was open he was ready for it.

The best overseer is not the one who is always in a hurry, who never has time to do anything thoroughly, who talks the loudest and brags the most. He must have perfect control of his help and have their confidence both in regards a man and a workman. To do this he must understand his help. Humane nature differs as much as inanimate nature. A good overseer will know just how to approach everyone. To one he will be kind and obliging, to another apparantly careless and indifferent, while a third may require the most careful watching.

The Loom Fixer.—The loom-fixer like the overseer must be a man of sound judgment, ability and energy. In almost any mill several grades of loom-fixers will be found. There are some, who possessed of no education and but little common sense, accomplish by hard work what others do with half the labor. They plod along day by day and year by year never getting out of the old channel and never expecting to. In process of time they become good fixers, but never anything more. By seeing a loom act in a certain way a great many times, they learn to recognize the trouble and know how to remedy it, but never think what cause brought about the effect.

Again there are fixers who are intelligent, have good judgment and are good fellows as the term is generally applied, but who have not sufficient energy to run a section of looms. They are always resorting to make-shifts. They will tinker with a battered picker a quarter of an hour rather than go to the bench after a new one. They will put a leather washer under a bolt head, rather than get a bolt of the proper length. These are the men who finding that a jack-strap has stretched until it is too long tie a knot in it to take up the extra length. They move about with such deliberation that the weavers catch the contagion and the production suffers. They are always at leisure and ready to crack a joke with a weaver or the overseer. If they ever get above a section it is owing to influence rather than merit.

To the third class the right man belongs. He is the one who looks for a cause in everything. He does not tear a loom all to pieces just because it does not run to suit him. When a loom has been running all right and suddenly refuses to do good work, the chances are that some one thing is out of order. A good fixer will locate the trouble and remedy it without altering every motion on the loom. He reads the best papers on textile subjects and keeps right up with the times. He knows the names of all the parts of a loom and can change the number of picks per inch without referring to the table of gears. This fixer will become an over seer and perhaps a superintendent, while his associates are cursing their luck and ascribing his success to influence.

General Hints.—A loom should be well oiled. Every weave room should have a man whose business it is to attend to this matter and who is held responsible for it. Most of the parts can be oiled while the loom is running, but the crank-arms, swells, etc., must be oiled at noon, the oiler going to his dinner from 11 to 12 or from 1 to 2. Good oil should be used for it has long been demonstrated that it is not economy to use cheap oil.

A very good plan for a weave room is to have a flag of tin to every set of looms which is to be raised when a loom it out of fix. This flag is fastened to the arch by a staff of hoop iron and is painted so as to attract attention. This is a much better arrangement than having the weaver to hunt up the fixer or to wait for him to pass. Not only does the fixer know how his looms are running, but the overseer can very accurately judge by the number of flags that are up if a fixer is ccmpetent or not.

The looms should be kept as clean as possible. Not only do dirty looms tend to make bad cloth by the lint getting into the shed, but a weaver feels better and can work better with neat and tidy surroundings. For the same reason the weavers should be encouraged to dress neatly. Where there is any choice in the matter engage only those who are neat and clean in their appearance, for they will be much more likely to be neat and careful about their work. In some states it is unlawful to clean looms while they are running, but where it is done it is best to use a long handled brush made of slasher waste. It's use is perfectly safe even in the hands of an inexperienced person, and there are usually several hands about the room who can make them during their spare time. The proper time to fix a loom is when it shows signs of being out of fix, but the best time look it over carefully and tighten the nuts is when the warp is off. The weaver should then clean it thoroughly, and the fixer look it over, see if the pickers are in good order, examine the protection and if any parts are worn out renew them. No other time is so good in which to oil every part thoroughly.

VALUE OF LITTLE THINGS.

Superintendents and managers often wonder why it is that with two mills, situated perhaps in the same town, having similar machinery, and manufacturing the same class of goods, at the end of the year one will pay a better dividend than the other. Of course they know it is in some part of the management, but exactly what they are unable to determine. In looking over the possible causes they are very apt to overlook little details which in the long run make a vast difference. In most mills the ability of a loom fixer is measured by the amount of cloth he is able to get from the looms under his charge within a stated time. This amount is measured, not in yards but in cuts, and the average fixer is always looking for a chance to get a cut, careing little if it be several yards short of the standard number. When a beam is nearly empty it is considered a smart trick to cut off the warp while there are still several yards unwoven. This yarn, costing perhaps 20 cents per pound placed on the beam, is thown in the waste box and sold for 4 cents per pound, a clean loss of 16 cents, neglecting its increased value when woven. In a mill of 800 looms on five yard goods with the warp running three weeks, there would be something over 1100 warps off per month. If two yards are wasted on one-fourth this number, there would be a loss of 660 pounds a year, which if it were woven would be valued at nearly two hundred dollars. This in itself is no great sum, but taken in connection with other things makes a great difference.

When goods having less than 60 picks per inch are woven, the weaver for fear of making a thin place when the filling is changed, raises the take-up lever, letting the ratchet gear back from two to five teeth in addition to what are let off by the slack motion. In most take-up motions each tooth means two picks, and a very little calculation will show that in a large mill several hundred yards of cloth are lost each day. A much better plan to prevent thin places is to have the weavers start up the loom with one hand while with the other under the breast-beam, they hold back the cloth while several picks are being made. Not only is more cloth made by this method, but after a little practice it can be done quicker and the weavers prefer it.

Nearly all mills have some sort of a receptacle in connection with the filling box for saving the clean waste, but all do not insist upon the weavers using them. Swept up with the lint this waste is worth half a cent, properly saved and collected from four to five cents.

Canvas or duck lug-straps have almost superceded the use of leather. When one breaks it is sometimes at the bend but more often where the bolt goes through. Instead of thowing it away it can be cut off and made to do excellent service as a short strap. Every time this is done from five to seven cents are saved. The fixers would generally prefer to throw them away as they are stiff and hard to put on, but once in position they will last a long time.

In any mill and on any loom picker-sticks will break. The good fixer, knowing that it will not do to put them in any sort of a way, takes his time and makes a good job of it. Very often it won't fit and he must take it back to the bench and file it a little or exchange it for another. When he finally gets it in position and starts to tighten the heel bolt, he finds that the threads are stripped or the bolt turns. He must then make another trip to the bench for a hand-vice or another bolt. During all this time not only is the loom stopped, but others which are needing attention are stopped also. Every fixer should be provided with one or more spare rockers with parallel tongue, bolt, etc., and keep a stick fitted up ready for the loom. Only a few minutes will then be necessary to replace a broken stick and at his leisure he can fit up another ready for the next break.

In the United States where the spinning and weaving are usually carried on in the same building, the looms are of necessity placed on the ground floor. Almost invariably a hill or some building shuts off a part of the light from the very place where it is most needed. As this state of affairs can not be very well remedied, the overseer should see that he gets all the light possible. The walls should be frequently white washed and the windows kept clean. A man occasionally employed doing this will save many times his wages in increased production and better cloth. The way the window curtains are put up has a great deal to do with the light. They are often simply tacked to the top of the frame, and when not needed are twisted and folded on a nail or hook. Even when this is done at least 20% of the window surface is still covered and at the top where it is most needed. A much better plan is to have the curtains wide enough for the whole window and stretched across the top on a tight wire. The edges are secured to a cord passing through a screw-eye at each side. When the cord is pulled one way the curtain is drawn across the whole surface of the window and when pulled back is drawn entirely away and can be folded in a narrow space at the side.

When the hours of labor are long, say eleven or twelve hours per day, from 15 to 20 per cent of the work must be done by artificial light, and it is of the greatest importance that it be as abundant as possible. The old rule (made where the hours were short) was to allow one sixteen candle power light to every four looms. At that time the lamps cost eighty cents each, while at the present time much better ones can be had for nineteen cents. It is certainly bad management to economize in this direction. There should be a lamp between every two looms, and the additional expense will be covered in a few months by better cloth and more of it. There are some mills that have a few hundred looms in a dark basement where for half a day or more they have to weave by electric light. The overseers of such mills have all noticed that with the looms running at the same speed, and with the same class of weavers, the production was at least 10% less than from the well lighted sections. I have spoken of this matter among the little things, but it is really of the greatest importance and under no circumstances should be neglected.

In running a weave room or in fact any

room in the mill, in order to obtain the best results, it is absolutely necessary to keep the machinery running. I know an old superintendent, who on giving some rules to his son placed this at the head of the list. I remember that he once had a small boy perched on a step-ladder for nearly half a day pouring water on a hot hanger rather than stop ten minutes to adjust it. Again, I have seen a whole mill stopped in order to tighten a pully which ran only two looms. Of course there is sometimes a method in such madness, as some mill men will stop five minutes in order to make up ten. When this is done the help are sure to notice it and get "even" in some way. It is better to lace a belt at night rather than have a dozen looms standing while it is done in the day time. Without entering into a discussion of the subject the writer has always found it best to draw the line at Sunday work.

Only a few of the many little things which need attention have been mentioned. The wide-awake overseer will always be on a lookout for such things, and in the long run the wisdom of his course will be apparent, for success is the reward of vigilence.

CHAPTER IX.

List of all Southern Mills Having One Hundred Looms or Over, Together with the Number of Looms, Make of Looms, Class of Goods Manufactured and Name of Overseer of Weaving.

ALABAMA.

DWIGHT MF'G CO., Alabama City. 1000 Whitin looms. Sheeting, Shirting and Drills. Chas. Maguire.

ANNISTON MF'G CO., Anniston. 320 Lewiston looms. Sheeting, Shirting and Drills. James T. Powell.

EUFAULA COTTON MILLS, Eufaula. 322 looms, 321 Lowell and 1 Crompton. Sheeting, Shirting and Towels. Chas. F. Faulkner.

DALLAS MF'G CO., Huntsville. 750 looms. 704 Colvin, 32 Whittin and 14 Bridesburg. Brown and Bleached Sheeting and Shirting. Wm. Huiclaliffe.

MONTGOMERY COTTON MILLS, Montgomery. 100 Lowell looms. Osnaburgs. W S Clark.

PRATVILLE COTTON MILLS, Pratville. 140 looms. Osnaburgs. John Burns.

MATTHEWS COTTON MILL CO., Selma. 385 looms, 155 Lowell, 130 Colvin and 100 Whitin. Sheeting, Shirting and Drills. Early Grover.

TALLAHASSEE FALLS MF'G CO., Tallahassee Falls. 389 looms, 200 Whitin, 91 Pool & Hunt, 90 Lowell and 8 Gilbert. Sheeting, Shirting, Drills, Ducks and Osnaburgs. B. F. Barnes.

TUSCALOOSA COTTON MILLS, Tuscaloosa. 222 looms. Plaids. Robt. Wilson.

TUSCALOOSA MF'G CO., Tuscaloosa. 321 looms. 145 Woods, 90 Bridesburg, 84 English and 2 Lowell. Plaids, Domestics, Cottonades, Towels and Drills. R. A. Clark.

ARKANSAS.

MAMMOTH SPRINGS COTTON MILLS, Mammoth Springs. 134 looms, 62 Bridesburg. 56 Wood and 16 Empire. Plaids, Tickings, Towels, etc. I. E. Dunn.

GEORGIA.

ATHENS MF'G CO., Athens. 318 looms, 208 Woods, 90 Bridesburg and 20 of other makes. Checks, Stripes, Kerseys and Cottonades. A. B. Harper.

PRINCTON MF'G CO., Athens. 100 Lowell looms. Osnaburg and Ducks. John J. Lee.

ATLANTA COTTON MILLS, Atlanta. 540 looms. 308 Lewiston and 232 Whitin. Sheeting and Drills. R. T. Williams.

EXPOSITION COTTON MILLS, Atlanta. 1159 looms. 640 Mason, 480 Bridesburg, 38 Woonsocket and 1 Lowell. Sheeting, Shirting and Drills. C. S. Wilkinson.

FULTON BAG AND COTTON MILLS, Atlanta. 450 looms. Sheeting and Bags. T. R. Pierce, Supt.

AUGUSTA FACTORY, Augusta. 824 Lowell looms. Sheeting, Shirting and Drills. Mm. Lanhamn.

ENTERPRISE MF'G CO., Augusta. 928 Lowell looms. Sheeting, Shirting and Drills. S. Wiseman.

ISÆTTA MILLS, Augusta. 150 Thomas looms. Plaids and Stripes. Jas. Brotherton.

JOHN P. KING MF'G CO., Augusta. 1203 looms. 1200 Lowell and 3 Mason. Sheeting, Shirting and Drills. C. M. Harrington.

SIBLEY MF'G CO., Augusta. 2218 looms. 1109 Whitin, 729 Lowell and 380 Crompton. Drills, Sheeting, Ducks, Plaids, Checks, Awnings, Cheviots. John Kuneton.

CLEGG MF'G CO., Columbus. 116 looms. 50 Crompton, 36 Woonsocket, 14 Knowls and 16 Bridesburg. Towels and Bed Spreads. J. T. Bray.

EAGLE AND PHŒNIX MF'G CO., Columbus. 1400 looms. 924 Crompton, 50 Mason, 426 Bridesburg, Woods, Gilbert and Thomas. Ginghams, Plaids, Cottonades, Demins, Cheviots. Towels, Ticking, Sheeting and Shirting. T. W. Tillman.

HAMBURGER COTTON CO., Columbus. 194 looms. 140 Crompton, 18 Lowell and 36 other makes. Plaids, Stripes, Ticking, Towels and Quilts. Chas. W. Jones.

MUSCOGEE MF'G CO., Columbus. 478 looms. 240 Crompton, 218 Bridesburg, 11 Jacard and 11 English. Checks, Demins, Cottonades, Ticking, Towels and Quilts. B. C. Bell.

SWIFT MF'G CO., Columbus. 369 looms. 220 Bridesburg, 114 Crompton, 23 Knowles and 12 Lowell. Plaids, Ticking, Denims, Sheeting and Bed Spreads. Chas. W. Hancox.

CROWN COTTON MILLS, Dalton. 256 looms. 164 Lowell and 92 Colvin. Ducks and Osnaburgs. J. T. Wills.

SWIFT'S COTTON MILLS, Elberton. 172 looms. 170 Whitin and 2 Lowell. Fine Sheeting. Chas. H. Lord.

GRIFFIN MF'G CO., Griffin. 200 Crompton looms. Sheetings, Drills, etc. Charles Wheeler.

KINCADE MF'G CO., Griffin. 216 Crompton Looms. Towels, Kerseys, Cottonades, Ticking, etc. John L. Davidson.

JEWELLS COTTON MILL, Jewells. 121 Lowell looms. Brown Goods. George Ethridge.

UNION COTTON MILLS, LaFayette. 208 Stafford looms. Sheeting, Drills and Towells. Gus F. Roberts.

RACOON MF'G CO., Racoon Mills. 104 looms. 56 Lowell and 48 Bridesburg. Sheeting and Drills. J. V. Allman.

ROME COTTON FACTORY, Rome. 108 looms. 88 Lowell and 20 Whitin. Ducks, Osnaburgs and Sheeting. Enoch Rhoden.

ROSWELL MF'G CO., Roswell. 120 Lowell looms. Brown Sheeting. W. H. Faulkner.

TRION MF'G CO., Trion Factory. 694 looms. 436 Whitin and 258 Lowell. Sheeting and Drills. J. Wheeler Mears.

LANETT COTTON MILLS, West Point. 632 Lowell looms. Sheeting, Drills and Satteens. T. L. Bowers.

WEST POINT MF'G CO., West Point. 224 looms. Duck. T. Young.

KENTUCKY.

HENDERSON COTTON MILLS, Henderson. 865 Lowell looms. Sheeting. Taylor G. Moredock.

LOUISIANA.

LANE COTTON MILLS, New Orleans. 368 looms. 190 Lewiston, 110 Lowell and 68 Whitin. Drills, Ducks and Osnaburgs. Wm. Arlt.

MAGINNIS COTTON MILLS, New Orleans. 1164 looms. 819 Whitin, 289 Crompton and 56 English. Sheeting, Shirting and Drills. John Nutall.

MISSISSIPPI.

TOMBIGBEE MILLS, Columbus. 256 looms. 134 Lowell, 102 Whitin and 20 other makes. Sheeting and Osnaburgs. W. R. Ledbetter.

NATCHEZ COTTON MILLS, Natchez. 336 Lowell looms. Drills. J. C. Hewett.

ROSALIE COTTON MILLS, Natchez. 240 Lowell looms. Fine Sheeting and Drills. Thomas F. Hall.

STONEWALL MF'G CO., Stonewall Station. 492 Lowell looms. Towels, Sheeting, Drills, Ducks and Onasburgs. J. S. Crane.

MISSISSIPPI MILLS, Wesson. 768 looms. 404 Crompton, 114 Bridesburg, 112 Lowell, 78 Thomas and 60 Gilbert. Checks, Plaids and Fancy Goods. John F. Thompson.

NORTH CAROLINA.

ASHEVILLE COTTON MILLS, Asheville. 420 looms. 220 Crompton, and 200 Bridesburg. Plaids, Cottonades, Chevoits, Hickories, Ducks, etc. E. D. McCollum.

AURORA COTTON MILLS, Burlington. 220 looms. Plaids and Checks. (No Overseer.)

BELLMONT COTTON MILLS, Osceola. 126 Wood looms. Plaids, C. L. Hutcheson.

ELMIRA COTTON MILLS, Burlington. 384 looms. 254 Woods and 130 Crompton. Plaids, Stripes, etc. H. C. Fowler.

GLENCOE COTTON MILLS, Burlington. 186 Wood's looms. Stripes, Cheviots, Plaids and Domets. M. M. Marshall.

E. M. HOLT PLAID MILLS, Burlington. 140 looms. 100 Woods and 40 Bridesburg. Ginghams. J. H. Erwin, General Manager.

13

LAKESIDE MILLS, Burlington. 150 looms. Plaids. G. M. Holt.

WINSOR COTTON MILLS, Burlington. 146 looms. 80 Woods and 66 Crompton. Plaids, Stripes and Cottonades. W. H. Councilman.

CHARLOTTE COTTON MILLS, Charlotte. 248 Stafford looms. Plain, White Goods.

HIGHLAND PARK MF'G CO., Charlotte. 410 looms. 240 Knowles and 170 Crompton. Ginghams, Dress Plaids and Heavy Shirting. Kenneth Giles.

PATTERSON MF'G CO., China Grove. 130 Lowell looms. Sheeting. Jno. F. Miller.

CABARRUS COTTON MILLS, Concord. 278 looms. 170 Lowell and 108 Whitin. Brown Sheeting. W. S. Linder.

CANNON MF'G CO., Concord. 260 Lowell looms. Brown Sheeting. T. H. Stiefel.

ODELL MF'G COMPANY, Concord. Mills, Nos. 1, 2 and 3. 335 looms. 256 Bridesburg, 50 Whitin, 22 Woods and seven other makes. Ginghams, Domets, Sheeting and Towells. J. A. Kennett.

Mill No. 4. 966 looms. 906 Whitin and 60 Lowell. Coarse and Fine Sheeting. R. F. Coble.

PEARL COTTON MILLS, Durham. 180

Crompton looms. Wide Sheeting. P. T. Geddens.

DURHAM COTTON MF'G CO., Durham. 340 looms. 200 Bridesburg, 68 Whitin, 60 Crompton and 12 Lowell. Domets, Gingham and Bleaching, W. B. Rayner.

ERWIN COTTON MILLS, Durham. 360 looms. 160 Whitin, 150 Crompton and 50 Lowell. Draperies, Muslins and Fancy Goods. Edward Terryberry.

ALTAMAHAW COTTON MILLS, Elon College. 304 looms. 118 Whitin, 100 Mutual, 52 Crompton and 34 Knowles. Fancy Duck. J. E. Wicker.

OSSIPEE COTTON MILLS, Elon College 202 looms. 140 Woods and 62 Crompton. Cottonades, Plaids, etc. Jas. N. Williamson, Jr.

GASTONIA COTTON MF'G CO., Gastonia. 135 Lowell looms. Fine Sheeting. Geo. A. Gray, Supt.

MODENA COTTON MILLS, Gastonia. 200 Lowell looms. Fine Sheeting. W. T. Storey.

MINEOLA MF'G CO., Gibsonville. 168 looms, 64 Crompton and 104 other makes. Ginghams, Thos. G. Moser.

BELMONT COTTON MILLS, Graham.

126 Woods looms. Six-yard Plaids. C. L. Hutcheson.

ONEIDA COTTON MILLS, Graham. 383 looms. Plaids. A. L. Bain, Sup't.

GRANITE MF'G CO., Haw River. 436 looms. Plaids and Cheviots. J. Thompson.

THOS. M. HOLT MF'G CO., Haw River. 252 Crompton looms. Ginghams. W. J. Thompson.

HENRIETTA MILLS, Henrietta. 1446 looms. 1422 Whitin and 24 Lowell. Sheeting, Shirting and Percale. J. W. Manly.

EMPIRE PLAID MILLS, High Point. 112 looms. 94 Bridesburg, 12 Lowell and six other makes. Plaids. E. J. Steed.

HOPE MILL MF'G CO., Hope Mills. 336 looms. 171 Bridesburg, 11 Knowles and 254 other makes. Cottonades, Ticking, Domets and Fancy Shirting. Neill T. Brown.

VIRGIN COTTON MILLS, Huntersville. 100 looms. Sheeting. T. Brinkley,

MT. PLEASANT COTTON MILLS, Kimeville. 101 looms. Mutual and Bridesburg. Plaids. D. M. Neese.

DILLING COTTON MILLS, King's Mountain. 553 Stafford looms. Print Cloth. G. G. Boon.

KING'S MOUNTAIN MF'G CO.,

King's Mountain. 150 Stafford looms. Fine Sheeting. C. W. Richardson.

LEAKSVILLE COTTON MILLS, Leaksville. 174 looms. Ginghams. (No Overseer.)

WENNONAH MILLS, Lexington. 377 looms. 166 Lowell and 211 other makes. White and Colored Goods. W. E. Holt, Jr.

McADEN MILLS, McAdenville. 320 Bridesburg looms. Plaids and Colored Goods. Oliver Senior.

MOORESVILLE COTTON MILLS, Mooresville. 106 Whitin Looms. Wide Sheeting.

W. I. HOOPER MF'G CO., Mt. Island. 104 looms. 64 Bridesburg and 40 Knowls. Plaids. (No Overseer.)

CAROLEIGH MILLS, Raleigh. 336 looms. 192 Crompton, 72 Stafford and 72 Whitin. Dress Gingham. John A. Drew.

PILOT COTTON MILLS, Raleigh. 204 looms. 174 Crompton, 20 Lowell and 10 Whitin. Chambrays and Plaids. W. H. Williamson.

COLUMBIA MF'G CO., Ramseur. 260 245 Whitin looms. Sheeting. W. C. York.

NAOMI FALLS MF'G CO., Randleman. 260 looms. 160 Bridesburg and 100 Crompton. Plaids, Cheviots and Ginghams. A. C. Hanner.

PLAIDVILLE MF'G CO., Randleman. 140 looms. Plaids. J. O. Pickard, Sup't.

RANDLEMAN MF'G CO., Randleman. 224 looms. J. O. Pickard, Sup't.

GREAT FALLS MF'G CO., Rockingham. 134 looms. Sheeting. S W. Steel.

PEE DEE MF'G CO., Rockingham. 300 looms. 210 Woods, 70 Knowles and 20 Pettee. Plaids, Hickories and Coat Linings. Geo. Warburton.

ROBERDELL MF'G CO., Rockingham. 300 looms. 60 Bridesburg, 180 Mutual, 50 Knowles and 10 English. Domestics and Ginghams. D. M. Nordan.

ARISTA MILLS, Salem. 180 looms. 102 Whitin and 78 Crompton. Checks, Stripes, Sheeting and Duck. Fred C. Hege.

SALISBURY COTTON MILLS, Salisbury. 503 looms. 301 Whitin, 200 Cromptonand 2 Knowles. Ginghams and Cheviot. J. L. Odell.

STATESVILLE COTTON MILLS, Statesville. 180 Stafford looms. Fine Sheeting. G. D. Ebuank.

VIRGINIA COTTON MILLS, Swepsonville. 150 Crompton looms. Cotton Cloth. D. F. Williams.

WILMINGTON COTTON MILLS, Wilmington. 226 looms. 156 Petee, 46 Knowls and 24 Whitin. Checks and Stripes. R. A. Barnett.

WORTH MF'G CO., Worthville. 198 looms. 176 Lowell, 20 Lewiston, 2 English. Sheeting, Bags and Plaids. W. G. Aldridge.

SOUTH CAROLINA.

ANDERSON COTTON MILLS, Anderson. 600 Whitin looms. Sheeting. W. H. Rodgers.

BATESBURG COTTON MILLS, Batesburg. 100 Mason looms. Sheeting. J. N. Buffington.

BAMBURG COTTON MILLS, Bamburg. 112 looms. Fine Sheeting. S. H. Wentworth.

AIKEN MF'G CO., Bath. 412 Mason looms. Sheeting, Shirting and Drills. J. M. Timmerman.

CHEROKEE FALLS MF'G CO., Blacksburg. 160 Wide Looms. Sheeting.

KERSHAW MF'G CO., Camden. 350 Whitin looms. Sheeting. S. C. Thomas.

CHARLESTON COTTON MILLS, Charleston. 720 looms. 464 Lowell and 256 Whitin. Sheeting, Shirting and Drills. T. S. Bolton.

CATAWBA COTTON MILLS, Chester. 430 Knowles looms. Fancy Gingham. J. C. Bowhing.

CLIFTON MILLS, Clifton. No. 1, 799 looms. Sheeting and Drills. M. E. McGuinn.

No. 2. 877 looms. 629 Whitin and 248 Lowell. Sheeting and Drills. T. J. Bigby.

No. 3. 1200 Lowell looms. (No yet running)

RICHLAND MILLS, Columbia 750 Stafford looms. Fine Sheeting and Drills. L. A. Hughes.

COWPENS MF'G CO., Cowpens. 204 Lowell looms. Fine Sheeting. S. C. Thomas.

DARLINGTON MF'G CO., Darlington. 384 Whitin looms. Drills and Sheeting. A. F. Northcott.

ENOREE MF'G CO., Enoree. 820 Colvin looms. Sheeting and Drills. J. J. Rodgers.

FORT MILLS MF'G CO., Fort Mills. 423 looms. 276 Woods, 75 Crompton and 72 Bridesburg. Gingham, Shirting and Ducks. S. W. Wells.

MILL FORT MF'G CO., Fort Mills. 160 looms. 100 Crompton and 60 Whitin. Sheeting and Shirting. W. C. Burnett.

FAIRMOUNT MF'G CO., Fairmount. 104 Stafford looms. Flour Sacks. Jas. Thomas.

GAFFNEY MF'G CO., Gaffney. 1300 looms. 1000 Northrop and 300 Whitin. Sheeting and Prints.

GRANITEVILLE MF'G CO., Graniteville. 744 looms. 542 English and 202 Lowell. Sheeting, Shirting and Drills. G. G. Berry.

GLENDALE MILLS, Glendale. 518 Lowell looms. Sheeting, Shirting and Drills. J. L. Weathers.

HUGENOT MILLS, Greenville. 230 looms. 90 Woods, 79 Bridesburg, 34 Lowell and 27 Crompton. Plaids, Cottonades, Cheviots, Domets, etc. J. W. Black.

F. W. POE MF'G CO., Greenville, 250 looms. Sheeting. (Not yet started.)

GREENWOOD COTTON MILLS, Greenwood. 360 looms. 180 Whitin and 180 Lowell. Sheeting. J. D. Summey.

SAXE GOTHA MILLS, Irene. 224 Whitin Looms. Fine Sheeting. Jas. W. Thompson.

LANGLEY MF'G CO., Langley. 1284 Lowell looms. Sheeting, Shirting and Drills. John W. Anderson.

LEXINGTON MF'G CO., Lexington. 108 Kilburn and Lincoln looms. Bed Ticking and Drills. L. W. Redd.

LOCKHARDT SHOALS MF'G CO., Lockhardt Shoals. 600 Looms. Fine Sheeting. W. H. Hufurst.

NEWBERRY COTTON MILLS, Newberry. 874 Whiting looms. Sheeting, Shirting and Drills. John Nutall.

COURTENEY MF'G CO., Newberry. 540 Stafford looms. Fine Sheeting and Twills. Fred Holt.

PACOLET MF'G CO., Pacolet. 1946 looms. Whitin, Lowell and Pettee. Fine Sheeting. J. A. Young.

PELZER MF'G CO., Pelzer. Nos. 1. 2 and 3, 1717 Lowell looms. Drills and Plaids. John W. Johnson.

No. 4, 1400 looms. 1000 Northorp and 400 Stafford. Drills and Sheeting. W. C. Coble.

PIEDMONT MF'G CO., Piedmont. 1790 Whitin looms. Sheeting and Drills. W. R. Roberts.

REEDY RIVER MF'G CO., Reedy River Factory. 156 looms. Sheeting and Drills. (No overseer.)

ROCK HILL COTTON FACTORY, Rock Hill. 192 Stafford looms. Sheeting and Drills. W. T. Whitaker.

STANDARD COTTON MILLS, Rock Hill. 486 Crompton looms. Fine Ginghams and Shirting. J. G. Luther.

SPARTAN MILLS, Spartanburg. 1100 looms. Sheeting and Shirting. M. G. Stone, Supt.

UNION MILLS, Union. 350 looms. Sheeting. W. E. Serm.

TUCKAPAU MILLS, Welford. 320 Northrop looms. Print Cloth. G. C. Pruitt.

WHITNEY MF'G CO., Whitney. 310 Whitin looms. Sheeting. H. F. Moody.

TENNESSEE.

COLUMBIA COTTON MILLS, Columbia. 136 looms. 102 Colvin, 24 Lewiston and 10 Lowell. Sheeting, Drills and Seamless Bags. (No overseer.)

GREAT FALLS COTTON MILLS, Great Falls. 132 looms. 122 Mason and 10 Lowell. Sheeting. W. C. Cantrell.

BROOKSIDE MILLS, Knoxville. 626 looms. 450 Stafford and 176 Colvin. Ducks, Sheeting and Drills. J. W. White.

BLUFF CITY COTTON MILLS, Memphis. 252 looms. Sheeting.

PHŒNIX COTTON MILLS, Nashville. 508 looms. 227 Lowell, 202 Woods, 70 Bridesburg and 9 Crompton. Ginghams, Plaids, Demins, Ticking, Towles, Sheeting, Draperies, etc. W. D. McGuinn.

SYLVAN MILLS, Shelbyville,. 104 Lowell Looms. Sheeting. Ed Pickup.

TENNESSEE MF'G CO., Nashville. 400 Lowell looms. Sheeting, Shirting Linings and Drills. P. H. O'Neill.

TRENTON COTTON MILLS, Trenton. 150 looms. 145 Lowell and 5 Knowles. Sheeting and Drills. Geo. Evereth, Supt.

TEXAS.

GALVESTON COTTON AND WOOLEN MILL. Galveston. 590 looms. 578 Whiting and 12 Crompton. Demins, Cheviots, Ticking and Sheeting. John M. Sargent.

VIRGINIA.

RIVERSIDE MILLS, Danville. 2241 looms. 1300 Crompton, 652 Lowell and 289 Lewiston, Plaids, Stripes and Heavy Sheeting. Geo. W. Robertson.

ETTRICK MF'G CO., Ettrick. 262 looms. 150 Empire, 100 Colvin and 12 Lowell. Print Cloth, Fancy Duck, Drills, Sheeting and Shirting. Watt P. Kelly.

LYNCHBURG COTTON MILLS, Lynchburg. 704 looms. Sheetings, Sateens and Prints. O. B. Tilton, Supt.

MARSHAL MF'G CO., Marshal. 230 looms. Sheeting. G. A. Peple, Supt.

MATOOCA MF'G CO., Matooca. 346 looms. 143 English. 84 Lowell and 119 other makes. Sheeting, Drills and Fancy Goods. J. S. Holt.

POCAHONTAS MILLS, Petersburg. 119 looms. 71 Lowell, 8 Bridesburg and 40 English. Sheeting, Drills and Ducks. W. O. Tucker.

BLUE RIDGE MF'G CO., Petersburg. 107 looms. Sheeting and Drills. E. H. Blakenny.