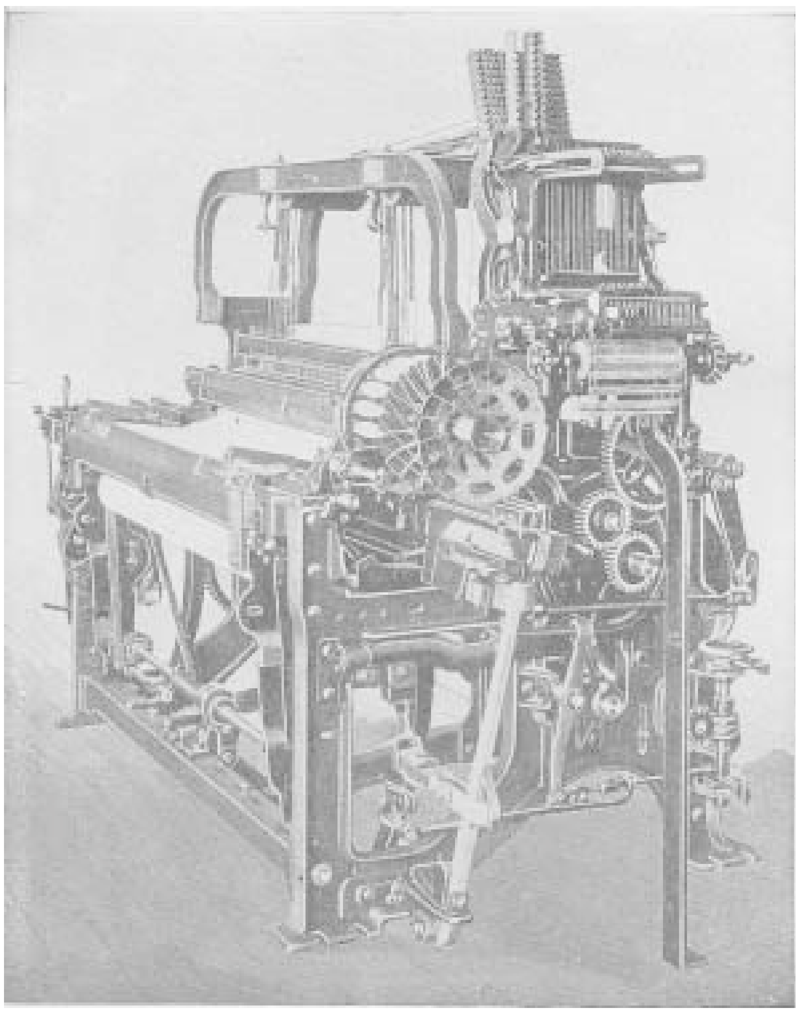
THE ADVANCE
OF THE
NORTHROP LOOM

PREFACE.

This book cannot serve as a detailed catalogue by which the purchaser can always note the exact nature of the devices we shall continue to sell, but rather as a general compendium on Northrop loom weaving, which may have more than a present value for all interested in the art. We can hardly expect to publish a book of this size at short intervals, and we have therefore tried to fill it with information that can apply for some time ahead, trusting to brief circulars to outline improvements on special points, which will appear whenever necessary.



D MODEL L ITH DOBBY.

FORMER LITERATURE ON THE NORTHROP LOOM.

1895.

Circular—"*The Advent of the Northrop Loom*," issued April, 1895. Printed references.

Essay, "*The Present Development of the Northrop Loom*," delivered at the meeting of the N. E. Cotton Manufacturers' Association at Atlanta, Ga., Oct. 24, 1895. Printed in Vol. 59 of the Transactions.

1896.

Papers on "*The Northrop Loom*," by F. M. Messenger, John H. Hines, H. D. Wheat, and discussion by Wm. F. Draper, Arthur H. Lowe, George F. Whittam and W. J. Kent, April 29, 1896, printed in Vol. 60 of the Transactions of the N. E. Cotton Manufacturers' Association.

Chapter in "*Facts and Figures*" on the Northrop Loom, published by George Draper & Sons in the spring of 1896.

Speech of Hon. Wm. C. Lovering, published in the Scientific American of May 2, 1896, and other papers, containing pertinent reference to the loom.

Pamphlet—"*The Looms of the South*," by F. B. deBerard, issued March, 1896, containing detail of savings from use of the Northrop Loom in Southern mills.

Speech of Hon. Charles Warren Lippitt, published in the Manufacturers' Record of June 19; and papers generally throughout the country, giving the history of the Northrop loom development as illustrative of the educational influence of manufacturing.

1897.

Pamphlet—"*Instructions for Running Northrop Looms*," issued by George Draper & Sons, January, 1897.

Pamphlet—"*Instructions Pour la Conduite de Metiers Northrop*," issued by the Draper Company, 1897.

Circular—"*Our Common Loom*," issued by the Draper Company, June, 1897.

1898.

Circular—"*Our Connection with the Art of Weaving*," issued by the Draper Company, April, 1898.

Circular—"*Take-up Mechanism*," issued by the Draper Company, 1898.

Article—"*Industrial Investigations*," by Jacob Schoenhof, in The Forum, for October, 1898. Referred to the great savings of the "Automatic loom," as affecting differences in cost of production.

1899.

Pamphlet—"*Instructions for Running Northrop Looms*." (Revised Edition.) issued by the Draper Company, January, 1899.

Pamphlet—"*Machinery and Labor Displacement*," by George Gunton, issued by the Gunton Institute, containing pertinent reference to the Northrop Loom as a labor-saving invention.

The present circular contains practically all the information that is applicable to date, so that our former issues would have no present interest.

Collected evidence.

Also NORTHROP LOOM HISTORY, Vol. I. 1889-1892— 574 pages.
NORTHROP LOOM HISTORY, Vol. II. 1893-1896—1097 pages.
NORTHROP LOOM HISTORY, Vol. III. 1897-1900—(In press.)

These books are for use by the Draper Company and its counsel during litigation. They contain the history of the experiments and development of the loom, and associated matters of interest. Their contents are naturally private, and not intended for general circulation, although the public is therefore deprived of an acquaintance with a unique mechanical romance. It is believed that no other volumes of like size were ever prepared for such a purpose. In order to select the necessary references, the compiler had to individually peruse over half a million letters, as one only of the many tasks involved. The first two volumes were completed before there was even an indication of an actual law-suit in which their contents could be of service.

THE PRESENT STANDING OF OUR LOOM.

JANUARY 1, 1900.

Former assertions.

In April, 1895, we issued our first circular on the Northrop loom. The assertions contained therein were based on our experience in testing looms experimentally in two different mills, and by the running of a weaving room of 80 looms at Hopedale, open to the inspection of hundreds of practical mill men. In the fall of the same year we made another public statement at the Cotton Manufacturers' meeting in Atlanta, several mills having started and shown favorable results during the intervening time. Other statements were made at the spring meeting of the Cotton Manufacturers' Association in 1896, and we issued our book, "FACTS AND FIGURES FOR COTTON MANUFACTURERS," a few months later. In November, 1897, another elaborate loom circular was presented, and since that time the changes in construction have been such that we did not find a safe stopping place in which to speak of our present loom as a completed product. Now that we have reached a point where the magnitude of our success is such that we might be content were we never to build another loom, we can consistently relate further history.

Conservative statements.

We are gratified in looking back to find that even in the earlier enthusiasm of preliminary anticipation we were conservative in our expectations. We were confident that the Northrop loom would enable a weaver to produce a doubled product, and the average to-day is nearly a *tripled* product. Some of those who questioned the practicability of our innovations at the start have since become our strongest supporters. The few who still endeavor to decry the value of our devices carry little weight and make few converts. The fact that there are several hundred thousand common looms still running is no proof that the merits of the Northrop improvements are not generally appreciated. We are replacing the old style as fast as an increased plant can turn new looms out.

Reasons for delay.

The expense of equipping an entire section of a mill with new machinery is in itself serious enough to interfere with introduction where surplus has not been accumulated, and where stockholders are not inclined to pay assessments or take new stock. Many mills also have a comparatively new equipment in weaving machinery, and it certainly takes a high degree of courage to admit that high-priced mechanism is really worth no more than ordinary junk. Certain mills are also running on classes of goods on which the Northrop loom has not been tried, and they do not care to be the pioneers, especially as their immediate competitors are on the same basis as themselves.

Forces of competition.

All these arguments have been met in the past and will be met in the same way in the future. A labor saving machine increases sales in an ever increasing proportion, as each one strengthens a competition that hastens the survival of the fittest. Even the class of over-shrewd mill managers who wait expectantly for competing inventions to reduce prices, tire in the end and usually fall into line at a time when the scale of possible profit is considerably reduced. Even to-day there are many mills which have already paid for their Northrop looms by the savings made, and those who waited are thus forced to spread their profit over higher capitalization.

"Taking the Northrop loom as a basis (which is already a wonderful success), let us look into a possible weave-room of the future, running on plain two-harness work, such as print cloth or sheeting, if you will. On a single floor there are a thousand looms run by fifty weavers, whose only duty will be to mend broken warp threads and start the looms." —[*Hon. Wm. C. Lovering*.

"There has been expended in experiments, in investigation and for patents, some $300,000. The result is a reduction of one-half in the cost of weaving cotton cloth. The cost of weaving constitutes one-half the cost of labor required to produce cotton cloth. Consequently the saving secured by the loom is approximately one-quarter of the labor of producing the cloth. Experts have estimated that in 1895, $80,000,000 was paid for labor in the cotton manufacture in the United States. Assume that the improved loom had been thoroughly introduced, the saving secured thereby would have been approximately $20,000,000. The interest on the national debt of the United States in 1892, the last year of Republican control, was $22,893,000. The possible saving of the new loom, therefore, would be about seven-eighths of this interest."—[*Hon. Charles Warren Lippitt, ex-Governor of Rhode Island*.

HISTORY.

For the benefit of those not acquainted with our former literature we will hastily review the facts connected with our entrance into this field.

Early invention.

Inventors have endeavored to perfect the art of weaving from time immemorial. Dr. Cartwright foresaw the need of a warp stop-motion back in 1786; other inventors started in the line of filling changing devices as early as 1840.

Our start.

The firm of George Draper & Sons in the year 1888 decided that inasmuch as they had fairly covered their former field of spinning improvements, that in selecting new chances for profitable introduction of cotton machinery inventions it was wise to spend effort in the line that promised the greatest chances for saving. The loom-room with its highly paid force, receiving about one-half the labor expenditure for the usual mill, was evidently the proper field, especially as in no other was there so much physical labor expended per pound of product.

It needed no contemplation to decide that automatic devices for changing filling would necessarily greatly reduce the weaver's labor, and our firm appropriated a certain definite sum, and set an inventor at work on the problem just before the start of 1889.

Sources of conception.

From that period to the present day, the entire inventive talent connected with the Hopedale industry, and much from other sources as well, has been drawn on more or less to perfect the various mechanisms involved in the complete loom. Mr. James H. Northrop, whose name appears on many of the fundamental patents, was continuously engaged in this labor from the Spring of 1889 to the end of 1897. The list of the other Hopedale inventors whose patents are largely utilized includes Gen. William F. Draper and George Otis Draper, under whose charge the entire experimental work has been carried on, Charles F. Roper, Edward S. Stimpson, and many others.

Time and expense.

It took five years of experiment and trial before it was even thought advisable to start building for the trade, and the investment at stake before a single loom was paid for has formerly been carefully figured at over, rather than under, one million dollars.

Mr. Richard Marsden, editor of the Textile Mercury, in his book "COTTON WEAVING," published in 1895, referring to Dr. Cartwright's

Warp-stop development.

original loom, on page 68 states: "*The Doctor was also in this instance in advance of the time; this part of his self-imposed task, even to-day so far as commercial success is concerned, remaining an unsolved problem, as applied to the warp in the loom. It has been solved, but not yet with a sufficient simplicity and economy to obtain the wide adoption of any of the methods yet invented.*" Again, on page 88, referring to warp-stop inventions of other parties, states: "*These, however, need not be described, as neither of the principles embodied in their plans have come into use. In fact, no satisfactory and commercially successful method of stopping the loom on the breakage of a warp thread, has up to the time of this present writing been invented, though electricity, amongst other agents, has been tried.*"

These statements are quoted as simple evidence of the well-known fact that warp stop-motions were an absolute failure so far as tested in ordinary classes of weaving up to the time of our attacking the problem.

Common loom lethargy.

In one of our earlier published references to the art of weaving, we made a statement to the effect that no radical change in any vital feature of the common loom can be shown as the result of the experiments of the last fifty years. This aroused a certain amount of criticism, but in order to emphasize the truth of this remark we wish to call attention to the illustrations of the loom manufactured by Richard Roberts in 1830, which also appears in Marsden's "COTTON WEAVING." This dates back sixty-five years from the time of our statement, yet it shows the use of practically all the mechanical principles employed in the present cotton loom. The general design of the framework shows the relative positions of all of the parts to be practically identical with those of to-day, while the friction let-off, cam shedding motion, swinging lay, protector and take-up, could all nearly be duplicated from present looms. It could almost be guaranteed that this loom, with a slight change in certain weights and proportions, could be made to weave and produce ordinary cloth in as great production as the present trade loom, being deficient only in certain conveniences and adjustments which do not materially affect either speed or production. In fact, there are common print looms in mills to-day that were made over thirty years ago, and yet which run in competition with new looms in spite of their worn condition.

OUR CONNECTION WITH THE LOOM INDUSTRY.

Although never known as loom builders previous to 1894, we believe our influence in perfecting the machine has been universally felt, in the same way that our influence on ring spinning has advanced that line of industry more than have the efforts of the actual builders of spinning frames.

Former loom improvements.

The first self-acting loom temple was an invention of our ancestor, Ira Draper, and it was admitted that the introduction of that device doubled the capacity of the operatives at that time. We introduced all the earlier automatic let-off motions, such as the Bartlett, Shepard, Cottrell, Draper, etc., which fathered every device of the kind now known. We introduced the first parallel shuttle motions, including the Stearns, adopted by nearly every American loom builder; also the first practical shuttle guards, the loose frog, and other minor devices.

Present loom improvements.

Since entering the field as builders of complete looms we have influenced the industry by the introduction of the first practical filling changer and warp stop-motion, and have also reformed the former plain loom details by building the first one-hand loom, making the high roll take-up practicable, using the first metal take-up roller on American looms, building the first American cast iron lays, etc., etc.

"The Northrop-Draper loom has had many tests and made many records. We will now chronicle one that, in romance, surpasses the loom of this make at Tucapau mills, Wellford, S. C., which ran nearly 24 hours without stopping a second:

——Young coupie engaged——against wishes father——hurried consultation——wedding party gathered in the dynamo-room——returned——the bride finding all her Northrop looms running along as merrily as ever."—[*Textile Excelsior*.

"GOOD WEAVING WORK.—A correspondent at Spartanburg, S. C., writes us that they have weavers at Spartan Mill No. 2 running 30 Draper looms. One is a woman, and she has taken off in February up to the night of the 13th, 326 cuts, 51 yds. to cut, which is 50 35-100 yds. per loom; speed of loom 180, 64 x 64 goods, which makes 97 86-100 of production. How is that for running Northrop Draper looms?"—[*Textile Excelsior, Feb. 18, 1899.*

THE INNOVATIONS.

What are known as Northrop loom improvements come under two heads, those of filling-changing mechanisms and warp-stopping devices. The filling-changer increases production per operative, the warp-stopping device does not; and yet the combination of the two, results in utilizing labor to double the advantage which would be obtained by the sum of the two used separately.

Common loom labor analyzed.

With the common loom, when the filling in the shuttle is exhausted, the loom is automatically stopped, thereby losing a certain amount of product. The weaver then goes through the following operations: Releases the shipper-brake, pushes the lay back, withdraws the shuttle from the box or shed, puts in the reserve shuttle, operates the shipper handle to start the loom, rubs the cloth below the breast beam to prevent making a thin place if light goods are being woven, takes up the empty shuttle again, pulls the shuttle-spindle out at an angle, removes the exhausted bobbin—or in the case of cop filling, the cop tube—replaces with a new supply of filling, pulls off a sufficient length of filling from the filling carrier, snaps the shuttle-spindle back into place, holds the filling over the eye entrance with the finger, sucks the filling through the hole, and inserts the shuttle in its receptacle, where it remains until needed.

Time saved by Northrop attachments.

In comparison with this series of operations, the weaver on a Northrop loom does not have to come to the loom every time a new supply of filling is necessary, thereby taking extra steps, but at infrequent intervals can take bobbins from a convenient filling box, pull off a sufficient length of filling, apply the bobbin to the hopper notches and wind the thread on the hopper-stud with a simultaneous movement. By allowing the hopper to get reasonably empty, several consecutive bobbins may be inserted at one time. To illustrate the rapidity with which this is done, we have often timed a weaver filling an empty hopper with 15 bobbins in one minute.

Coming to the other attachments, when a warp thread breaks on a common loom the machine continues running. The broken thread not being operated by its heddle is not raised for the shuttle to pass under, and it thereby falls below the cloth, leaving an open space which is more or less visible to the eye, according to the character of the cloth woven.

Before dropping, however, this broken end, extending from the cloth in the direction of the warp, can very easily get tangled around adjacent warp threads, making a pick-out and spoiling several inches of cloth. The weaver must then stop the loom, loosen up the cloth from the cloth-roll, pull the temples back and remove all the filling threads that have been laid during the length of cloth woven since the tangle commenced. In many mills it is made obligatory for the weaver to stop her other looms during this operation. After the pick-out the warp-beam must be turned back, the tension of the cloth adjusted and the loom set in motion again.

Necessity for warp stop-motion.

When we first applied filling changing devices, we found that the weaver, although greatly relieved of manual labor, was even more uneasy on account of possible overshots, having more looms to look after. We saw it would be absolutely necessary to furnish a protection in the way of an accurate warp stop-motion, so that there should be no mental anxiety or necessity for alert observation. In a large class of weaving, warp breaks are so common that the cloth buyer expects the defects; the manufacturer, therefore, does not always insist that the weaver shall immediately repair a warp break. In order to economize time, therefore, the weaver often lets a broken thread run until the loom is stopped to replenish the filling. It would, therefore, limit the production of such looms to apply warp stop-motions. This is one of the reasons why they have not been developed up to the time we commenced the introduction of the filling changer. Since our introduction of the latter device, certain inventors have expected to introduce warp stop-motion for plain weaving; but up to the present time, the number thus sold does not run into large figures. A warp stop-motion on a plain loom simply saves in mental anxiety.

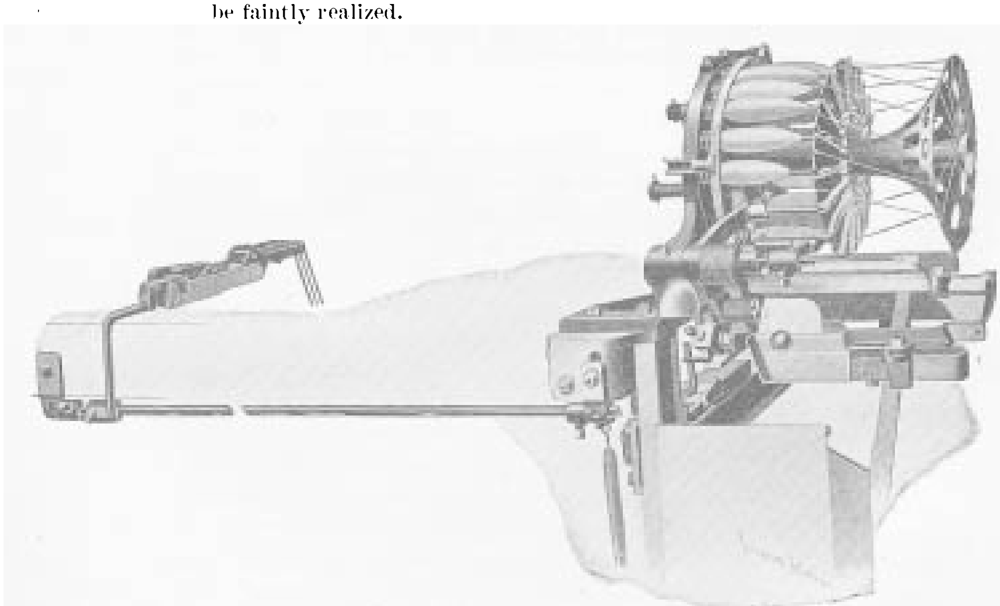
A paradox.

The facts, therefore, present this curious anomaly: A good weaver on plain, narrow looms has a capacity of 8 looms; on the same looms with warp stop-motion has also a capacity of 8 looms; on looms with the Northrop filling changer alone, has a capacity of from 12 to 14 looms; on looms with the Northrop filling changer and warp stop-motion, has a capacity of 24 looms.

THE FILLING-CHANGER.

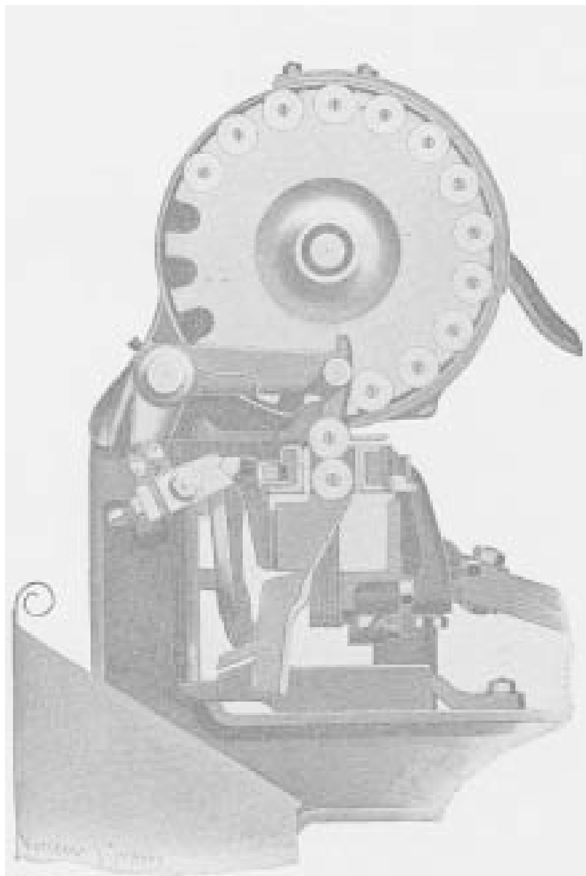
Automatic filling supply.

Referring briefly to the operation of this mechanism, which must be fairly well understood by this time, it might properly be stated at the start that we ourselves are still puzzled by the successful operation of the devices employed. It certainly does not seem to be mechanically feasible to insert a supply of filling in a flying shuttle, which expels an empty carrier at the same time and guides the new thread past several detaining projections into an angled passageway. Were this feat accomplished with the shuttle and lay at rest, it would be sufficiently surprising; but when we consider that the new filling-carrier is inserted instantaneously with the shuttle barely across the lay, and with the lay itself moving in a direction at right angles to that of the shuttle, the difficulty of the problem may be faintly realized.



DETAIL OF CONNECTION

Between the filling fork which detects the absence of filling and the Northrop hopper or magazine which supplies fresh filling. Cop hopper shown in this instance.



CROSS-SECTION OF A COP-HOPPER WITH TRANSFER TAKING PLACE.

The entering cop skewer has just started the pressure that expels the one in the shuttle. It has still to move some distance. The expelled skewer is not empty in this instance, as it illustrates a case in which the filling thread broke while weaving.

Mechanical operation.

In the Northrop loom the filling carrier takes the form of either the usual bobbin or cop skewer, with the difference that each has large metallic rings applied at the head end which serve to engage notches in a forked spring which is secured to the shuttle body. The bobbin or skewer is held in a circular hopper by suitable pockets, the carrier having a rotary movement to bring them successively into proper operating position. The end of the filling is extended from the carrier and wound around a stud. When the ordinary filling-fork detects absence of filling at the opposite end of the loom, a rod is turned, which puts a transferring device into operative engagement with the advancing lay: at the same time a protector finger reaches forward to ascertain whether the shuttle is in proper position to receive a fresh supply. If everything is all right, the transferrer—shaped something like a hammer—presses a fresh supply into the open top of the shuttle, pushing the spent carrier out through the open bottom of the shuttle, down into a receptacle. If the shuttle did not reach home, or should it rebound too much, the shuttle-position detector will not allow the operation. As the lay turns back, the shuttle is thrown across the loom and the thread unwinds from the carrier, entering a slotted passage-way in the shuttle-eye. The lay then beats the filling up and operates a cutter attached to the temple, which severs the end of filling which extends from the cloth to the stud before mentioned. When the shuttle is thrown back, the filling thread is led into the side eye from its new position in the cloth, and the ordinary operation of weaving continues. Should the shuttle fail to thread—or "misthread" as we term it—or should there be no filling supply transferred for any reason, the loom will stop through a device actuated by repeated failure of the filling fork.

It is therefore evident that a filling changer includes four distinct and separate mechanisms. It might be pertinent here to dwell on this fact enough to call the attention of ambitious inventors to the probable necessity of evading four distinct lines of patents before competition is possible.

"We have 48 of these looms in one mill, all operated by three weavers; they are producing about 96 per cent. of continuous running; it is our opinion that each of these weavers could easily attend 20 of these looms on this class of goods."—[*F. M. Messenger, Agent Grosvenor Dale Mfg. Co.*

THE WARP STOP-MOTIONS.

Stopping for warp faults.

We have a wide range of devices to accomplish the purpose of stopping the loom on the breaking of a warp thread, each having its legitimate field and neither including all the possible advantages.

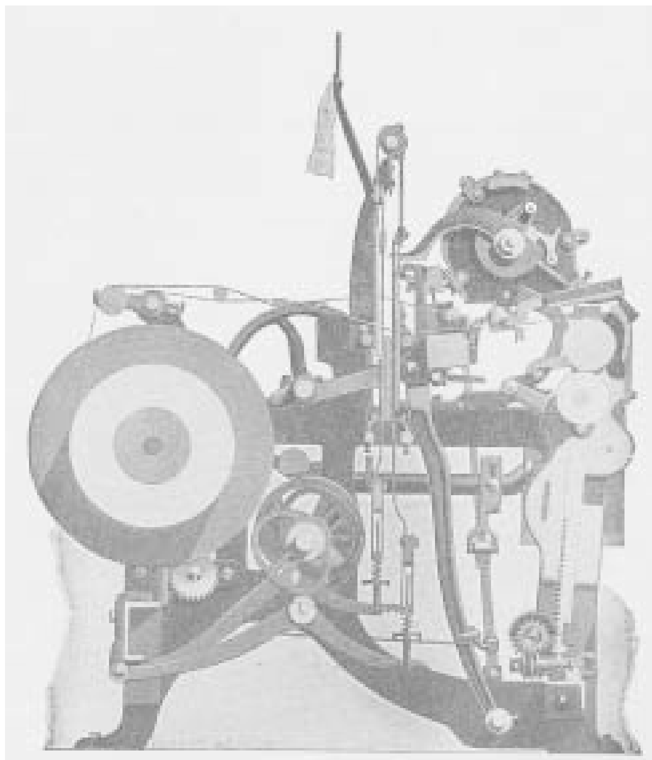
We started by limiting ourselves to the weaving of two-harness goods, but have now shipped thousands of looms to weave with three, four and five harnesses, and hundreds of looms to weave with dobby heads. We have warp stop-motions that can be applied irrespective of the number or manipulations of the harnesses or their heddles.

Steel heddles.

Our steel harness stop-motion uses the heddles themselves as detectors, thereby simplifying the loom and adding nothing to the cost of drawing-in. Wherever the goods are suitable, we recommend this pattern, because of the ultimate saving in cost; for these heddles will wear indefinitely, and as they automatically space themselves the mill does not have to store away thousands of frames only suitable for certain weaves. This free lateral movement also allows the weaver readier access to repair broken warp. We have as yet only adapted the steel harness to two-harness work, although we expect to enlarge its field.

As we have found it absolutely necessary to leave the lower ends of the heddles free, we find they are not adapted to weaving goods where they may have a chance to sway abnormally. Figuring the repairs and replacement of the usual cotton harness at a dollar per year, to say nothing of the loss in interest and the extra stock carried, it will be seen that an indestructible, self-spacing heddle has great advantages. No other builder of loom attachments has ever introduced a successful heddle stop-motion.

In the earlier use of our steel harness it was claimed that our steel heddles broke more warp than the twine heddle. This may have been true at the time, yet the advantages were more than enough to compensate. After exhaustive tests, however, we are now convinced that our present construction of steel harness using double bars for each shade to divide the threads and allow greater freedom, will actually break less warp than any harness known. On a series of looms with print warp and similar conditions apart from the style of harness used, we found that the average breakage of



CROSS-SECTION OF E MODEL STEEL HARNESS LOOM.

(Shuttle positioning device is different from that in perspective view of E model, and hopper is for cops instead of bobbin. Pulleys are at the left hand on this loom.)

This cut gives a good detail of the cloth winding device on our high roll take-up. Also shows hand adjustment of harness jacks.

The detail of the warp-stopping connection cannot be shown in this cut, as the devices used are not on this half of the loom which appears in the cut.

warp for months averaged 11 breaks for the steel harness, and 14 breaks for the twine harness. We have had warps in past years that averaged better for twine harness, but we see no reason why the steel harness should not continue its relative proportion under such circumstances.

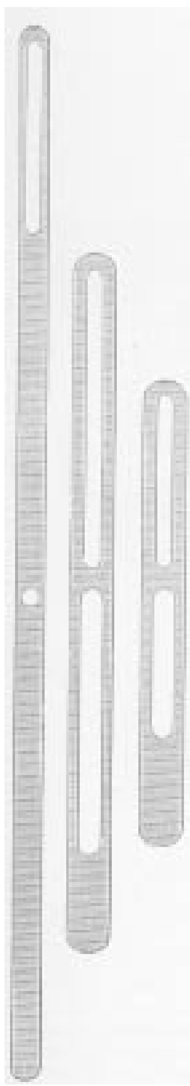
Drop wires.

Our next class includes a drop-wire device, applied between the heddles and the lease rods, each detector serving for two or more threads. This has been widely used on looms having more than two harnesses, and also to a great extent on two-harness goods in competition with the steel harness. We are the only builders of a warp stop-motion of this nature, where one detector governs more than one thread.

Our third class of stop-motions includes the use of a detector for every thread. The advantage of the idea is that it may be applied irrespective of shedding conditions. The disadvantages include a greater expense for drawing-in and a greater number of drop-wires is necessary.

Limits of competition.

The only competition which has sprung up since we first introduced warp stop-motions, has come from this class of devices. As we had naturally covered the vital points with our patents, this competition has been limited in certain important mechanical ways. As usually applied, such drop wires are in a position back of the lease rods, where the breakage of a thread does not immediately lessen its tension at the drop-wire, so that it does not act quickly, and may not serve for the in-

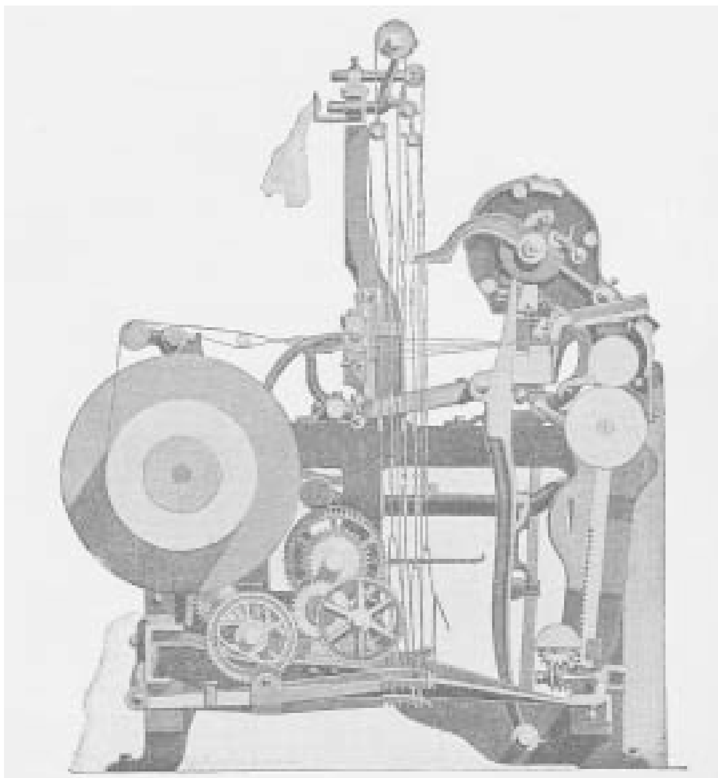


1 2 3

Cut No. 1 shows our regular steel heddle.

Cut No. 2 shows the detector used to control more than one thread.

Cut No. 3 shows the single thread detector. The lower slot can also be made as a hole, in fact we have adopted the use of a hole in preference since the cut was made.



CROSS SECTION OF D MODEL LOOM.

Hung up with five cotton harnesses, lay in forward position. The warp stop-motion is of the style where one detector serves for several threads.

"In reference to loom fixers, we had no trouble whatever in taking fixers from the Whitin and other make of looms, and in a very short time have them running successfully the Northrop loom. Our looms (at the Tucapau Mill) are placed in two rooms, 160 each; we have four fixers running 80 looms each. If the looms were so arranged that we could put them on 100 looms each, we would do so; in fact, the men tell us that they have less fixing to do on the Northrop loom than on the ordinary one; the Northrop running with one shuttle calls for less adjustment of picking straps, etc."—[*H. D. Wheat, Agent of the Gaffney Co.*

tended purpose of preventing a mis-pick or cloth defect. We overcome this special trouble by making **our Detectors do the leasing,** thereby doing away with the rods. This idea is of course well protected.

Detector lease.

Several unexpected advantages have resulted from this radical change, it having been found that the warp breakage is materially lessened. Another advantage granted by our patents protects us in the use of serrated engaging devices, to prevent twisting and bending the thin, flat stock of which drop wire detectors are usually manufactured. Competitors are forced to contact with a twisting strain, and to prevent damage must make the action so delicate that the parts are necessarily less efficient and less easily kept in order. As we have before stated, the mere competition of warp stop-motions is of little moment, for without a filling changer the warp stop-motion itself is practically impotent, except in the limited field of drop box looms which is already largely covered.

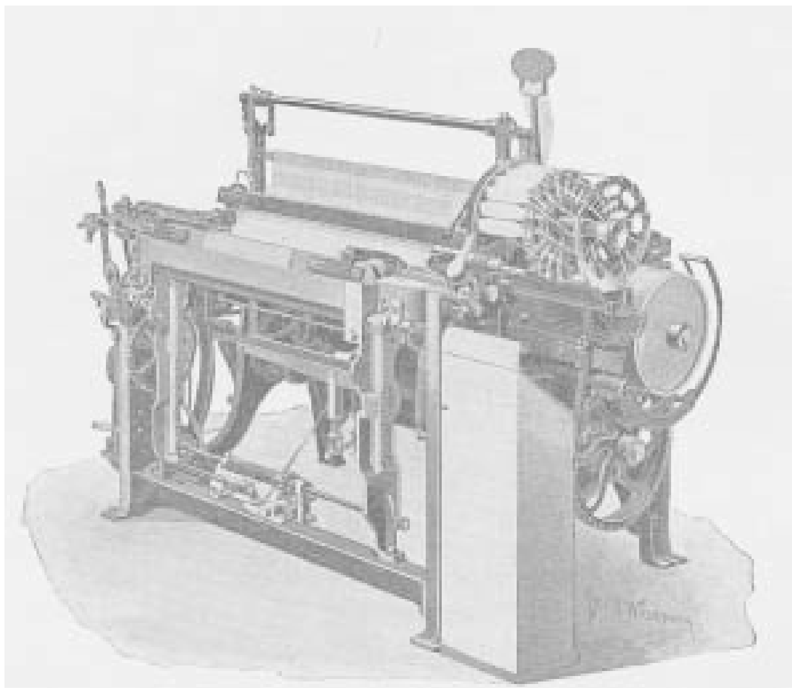
Serrated vibrator.

WARP BREAKAGE.

In our experiments to lessen warp breakage, which have been very elaborate, we found that the use of devices to govern the tension of the warp in such a manner as to allow it to yield under its greatest strain, are very desirable, when the style of the goods woven will allow their use. The simplest device that we know of is our Durkin thin place preventer, which was originally designed to prevent thin or thick places in the cloth, but which is even more valuable on account of lessening warp breakage. With our earlier patterns there was some difficulty in adjusting the tension of the spring to the goods woven, but recently we have adopted a system of adjustable stops on the preventer which govern its action independent of the spring. We recommend this device on all light goods. For heavier goods we use a cam-controlled whip roll, which holds the yarn at the beat and reduces the strain when the harnesses are open.

Tension adjusting devices.

"The manufacturers are perfectly willing to try any new device that may come out in the way of new machinery; and no better example of that can be given than the fact that the automatic loom has found its home in the South almost exclusively, and the advantages of the automatic loom are, by the Southern manufacturers, deemed to be very much in its favor, as against the ordinary running loom. Several manufacturers said, in fact, that it was not hard to secure 97 1-2 per cent. of the full possible production of the loom."—*Mr. Mercer, N. Y. Journal of Commerce.*



E MODEL LOOM WITH FEELER.

Large can is used to enable the dropping bobbin to drag out the length of filling cut by the extra thread cutter.

"Now, by no possibility can the strain which the North could be subjected to by the South be so great as the strain the Northern mill has to sustain from Northern mill, and the Southern mill from Southern mill; for the same causes may be found in operation in the South that produce the differences in the North. The differences of this pronounced type are created by the introduction of the so-called "automatic" loom. When, by this change, 50 per cent. in the weaving-cost can be saved, it is obvious that it will not take long to convince mill-owners that it is profitable to discard the loom which was satisfactory until very recently, and to adopt the new loom by which an expert weaver can turn out from two to three times as much cloth in a week."—[*Jacob Schoenhof.*

PERFECT CLOTH.

When invention attempts to duplicate hand labor, it usually starts with work that is almost automatic with the operatives, and then attempts to invade the field where judgment is thought necessary. Our loom was first adapted to the plainer kinds of weaving, where certain defects are passed over by the buyer. For instance, in the weaving of two-harness goods on common looms, there is no attention paid to the fault of two threads in one shade opening; it is also not important that the weaver should insert the new filling precisely at the point where the last end of yarn was woven off. The original Northrop loom was no better in these respects, for the filling-fork, which governs the insertion of fresh filling, does not detect the absence of filling in time to supply the new thread immediately. When we came to cloth woven with more than two harnesses, we were confronted by a demand that the pick must be matched. We were inclined to accept this decision as final, and kept our inventors busy for years on the problem. Meanwhile, certain of our customers started Northrop looms on goods weaving with more than two harnesses, at their own risk. It was immediately noticed that on three-harness goods Northrop loom cloth would even average better than the same cloth made on common looms, for the delay in action from the filling fork to the hopper was sufficient to insert the fresh filling in the proper sheds at least two-thirds of the time: while the common-loom weaver, who is rarely made to pay any attention to matching the pick, naturally inserts the new filling in the shed left open by the loom when stopped, which is rarely the proper one. It must be understood that it causes no apparent fault in the usual cloth if a full pick is put into the same shed with the broken pick.

Imperfections in cloth.

Coming to four and five-harness goods, and the necessity in certain cases on two and three-harness goods, of making **absolutely perfect** cloth, we saw it was inevitable that the fresh filling should be supplied just before the old filling expired. It was evident that the possible methods of accomplishing this result included a preliminary spinning of an exact length of yarn, or the detection of the change in volume in the shuttle at the proper instant. After trial in both directions we found it more feasible to use the latter idea, and after the usual process of evolution, through at least a dozen distinct stages, we have produced what we call

Possible cure.

Our feeler device.

a "Feeler" mechanism, actually determining its action by touching the yarn in the shuttle to know when it has woven off to the proper extent.

Auxiliary thread-cutter.

After this was accomplished, it was found that the harder problem was yet unsolved. The bobbin or cop-tube, containing the few yards of unexpended filling which was ejected from the shuttle, still left a thread running from the spent bobbin receptacle up through the shuttle-eye to the cloth. It was evident that this must be severed in order that the shuttle should not drag this end back into the cloth, together with the fresh end from the new supply. The original thread cutter, which severs the filling thread extending from the cloth to the hopper-stud, could not accomplish the purpose, as it could not be made to contact with the second thread at the proper time. An entirely new device was therefore necessary, and the proper mechanism has finally been devised. The attaining of perfect cloth is not possible without some sacrifice. It must be figured whether the gain is worth the additional expense for extra mechanism, care of extra parts and the added expense of waste left on the ejected filling carrier. Where it is not absolutely necessary on four and five harness goods that every pick should be accurately matched, we can apply a

Fork retarder.

simple device to the cam follower hook with which the filling fork engages, to delay the action of the hopper for two additional picks; and as in the regular operation of our filling changer there is a natural delay of from one to three picks, the extra two vacant picks will prolong the shed so as to show no serious change in the pattern. This simple idea has been found to be perfectly practical, the goods woven after its adoption having been judged equal or better to those from common looms in the same mill.

"Of course, if the weaver refuses to mind more than eight looms, then there is not a saving but a loss by introducing them, because they cost very much more than the old ones. If the laborers persist in this, they, of course, will succeed in doing one of two things, either stop the improvement and therefore prevent the development of the only method New England has of successfully competing with the South, thus permanently forcing New England into the position of a defeated industry, or else—what is even worse—force the introduction of an inferior population that will work for less wages and use the new looms too."—[*George Gunton.*

SHUTTLE-CHANGING DEVICES.

It might be well to refer briefly to a separate class of filling changers on which a great amount of inventive energy has been expended. When attempting to devise a method of supplying filling automatically to looms, it naturally seems simpler to replace the shuttle itself than to attempt replacing of the filling within the shuttle. We ourselves labored for months in this line, and while we produced a device that was mechanically operative, we learned certain inherent defects.

Shuttle replacement.

The primary object of a filling changer is to save labor. On reflection, it is evident that the only labor saved by a shuttle changer is that expended at the common loom by starting up the stopped loom, and also, possibly in reducing the amount of steps taken. The labor of emptying the shuttle, replacing its supply and threading it, is still necessary. There are also certain associate evils, as the use of a large number of shuttles involves trouble in the setting of the pick by the loom-fixer, as it is impossible to get them to wear alike and box uniformly. Of course, at slow speeds and with a small reserve supply, this is not so prominent. Slow speed, however, will not be countenanced by the purchaser, and a small reserve defeats the real utility of an automatic supply.

Difficulties.

Considered as a mechanical problem, it is found that it takes more parts and more ingenuity to make a successful shuttle changing device than to change the filling in the shuttle. It is easier to insert a round object into spring jaws than to remove the confines of a shuttle box and its binder pressure, and replenish the awkwardly shaped shuttles. While our ill-wishers are continually heralding the numerous shuttle changers destined to drive us from the field, we have yet to hear of any continued successful operation of any one section of shuttle-changing looms. While individual looms, or small numbers, have been mechanically run, no figures have yet been made public which prove that a weaver can gain more production or run more looms with shuttle-changers than without. We have certainly heard of weavers running certain numbers of such looms, but such statements are valueless when not accompanied by figures giving the production. **A common loom weaver** might be given twenty looms, providing the owners were willing to accept a small and inferior product from each.

Trial incomplete.

OUR COMMON LOOM.

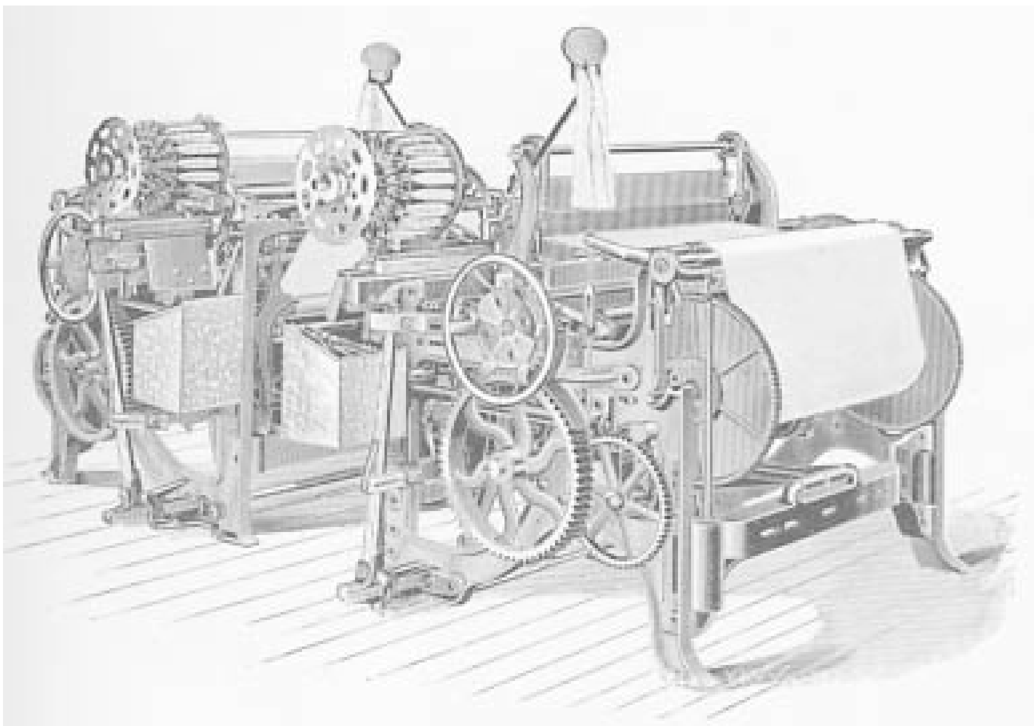
Plain looms.

We have made hundreds of common looms, since starting to introduce weaving machinery, for customers who were not ready to try the automatic attachments, but who foresaw that they might need them and therefore wished to have a loom to which they could be applied. As our royalty profit is ample to cover extras, we have not been forced to cheapen at the expense of utility or scrape a few cents margin by light or inferior construction. Many of the extras which we furnish free are listed at additional figures by other builders.

Our common loom is simply the Northrop loom, minus attachments, with a slight change at the filling-fork. As we sell this higher grade machine at market prices, there is no incentive for us in the present profit between competitor's costs and our selling price. We look, however, to the future somewhat, and realize that we shall some day get our profit in royalty from the inevitable application of the filling-changer and warp stop-motion.

Guarantee.

Under the conditions of construction it is of course absolutely guaranteed that the improvements can be applied at any time required. This cannot be true of looms made by builders who have had no license under which to use our improvements, for they are not acquainted with the technical details that are highly essential for correct operation. Thousands of such looms have been sold, but we can be held responsible in no way for the ultimate disappointment of the purchasers. The changes in their construction usually consist in putting on back binders and making a few minor changes in patterns, copied from looms we built years ago. Those who think they may never wish the Northrop devices can make a good business turn by buying our common loom, for we consider it far superior to any other, and it contains patented improvements which cannot be duplicated. Some of these include our one-hand construction, high-roll take-up, improved Bartlett let-off, patent filling brake, patent beam-lock, patent binder bushings, and other valuable features. In details of construction we furnish extra weight and strength in parts, have new and improved designs, and are always ready to adopt any improvements that can make the loom better in any way.

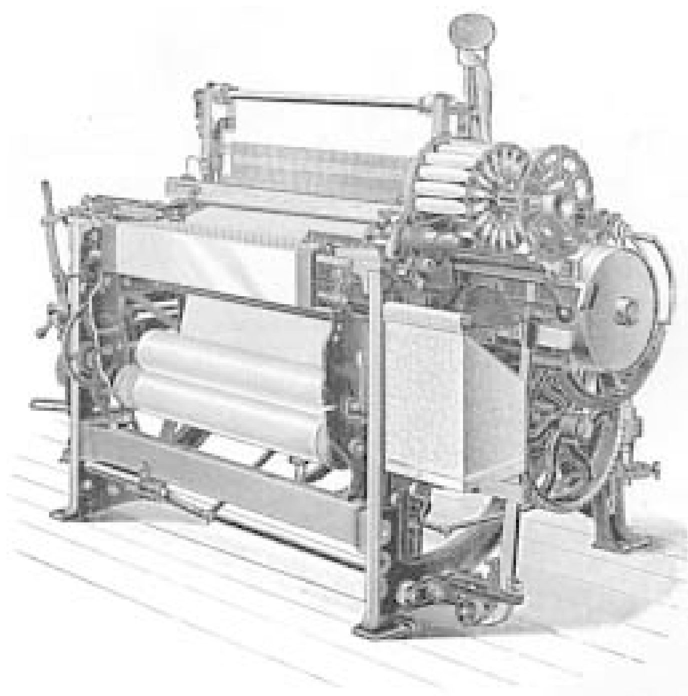


OUR VARIOUS MODELS OF LOOM.

OLD STYLES.

A MODEL (also called 1894 pattern). Now obsolete. This was the original loom sent out on the Queen City, Tucapau, and other early orders. It had shorter lay and shuttle box than we now use, Mason take-up, plain rocker motions, etc.

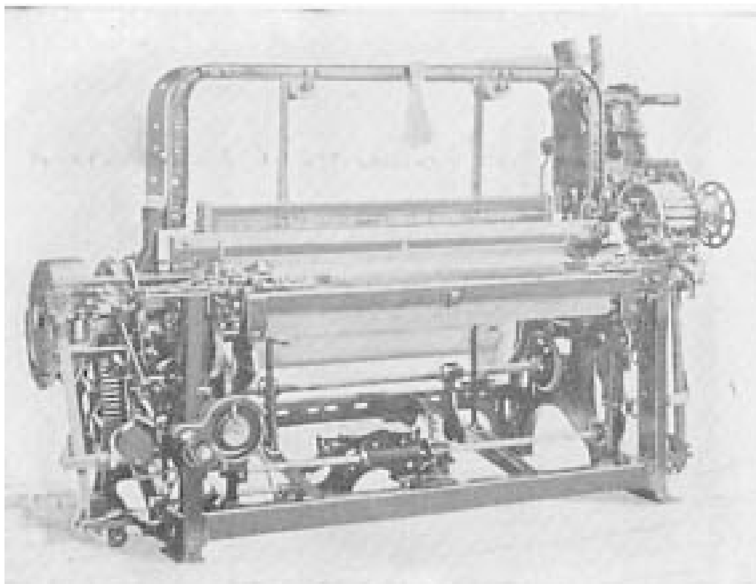
The cut shows two of these A Model looms with steel harness construction, Shepard let-off, and old right and left hoppers.



B MODEL (also called 1895 loom). Also obsolete. This pattern was continually improved and was our standard for prints and other light goods until 1898. It had a wider frame than the A model, longer shuttle boxes, new take-up, Stearns rocker and one hand construction.

C MODEL (also called 1896 loom). Also obsolete. This was our first heavy pattern loom. It was of the one hand construction with heavy design throughout.

The cut shows the B Model, and illustrates, among other details, our take-up construction as used before the high roll was adopted.



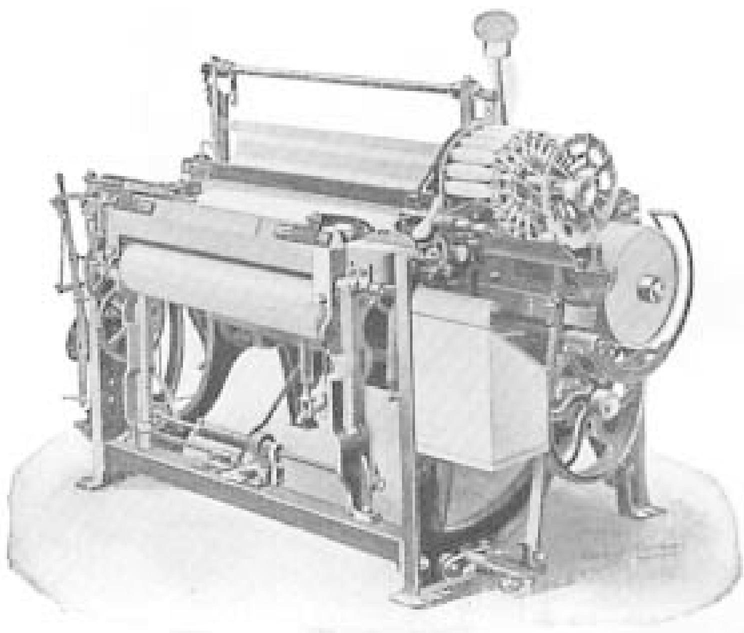
NEW STYLES.

ALL HAVE HIGH ROLL TAKE-UP.

D MODEL.—Heavy standard.

Cut shows dobby head applied. (See also frontispiece.) The take-up on this special style of D Loom is of the worm gear variety.

"In New England to-day the price of weaving on the ordinary looms, with the last ten per cent. that has just been given, is nineteen and eight-tenths cents—say twenty cents—per cut, that is, for fifty yards. A new loom has been invented by which the weaver can mind about twice as many, and therefore the price per cut. is reduced about one-half. These are what are called the Draper looms. . . . . In the South they have hardly any other kind of looms; they have the best. I saw one woman minding twenty-four looms. . . . . The price they pay for fifty yards in South Carolina is six and one-quarter cents. The operatives of course, even at this rate, are earning more than they ever earned before. . . . . *George Gunton.*



E MODEL.—Regular pattern for prints and sheetings.

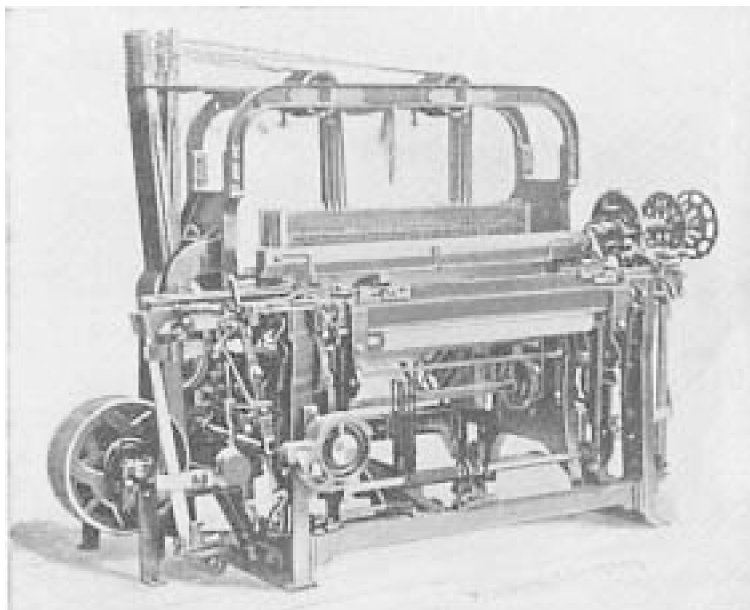
Cut shows a steel harness bobbin filling E Model loom as made in 1898 and 1899. This is the construction on which our largest orders have been taken and on which we are now busy.

F MODEL.—Extra heavy pattern for goods 72 inches and wider. Made with compensating let-off for two beams, triple cranks, compound spring cloth-winder, friction pulley drive.

SPECIAL STYLES.

G MODEL.—Special frame. E model weight with D model depth.

We have no cuts to show these two latter styles.



H MODEL.—Heavy pattern side cam loom.

E, D and H have similar dimensions.

Cut shows H Model with 8 harnesses.

Other models will follow as we continue to meet the varied conditions of an expanding trade.

"In June, this Draper company, in order to fill the orders that were pouring in, for looms, built an addition 270x180 feet, to the iron foundry, and also an addition 150x120 feet (four stories high) to the setting-up shop. These extensions increased the capacity of the plant to such an extent that the working force was increased from July 1st, when it numbered 1,200 hands to over 2,200, the number on the pay roll yesterday.

The company finds its facilities still inadequate, and has outlined means to still increase the capacity of the works, so that three thousand men will be employed."—[*Boston Herald, Dec. 18, 1899.*

NORTHROP LOOM DIMENSIONS.

E, D AND H MODELS.

Size.	Length of Lay for 14½ inch Shuttle. 6¾ inch Bobbin.	Length of Lay for 15⅛ inch Shuttle. 7⅜ inch Bobbin.	Length of Lay for 15¾ inch Shuttle 8 inch Bobbin.	Total Length of Harness Shaft.	Greatest Width of Cloth at Temple.	Proper Width Between Beam Heads.
28 inch.	76 inch.	77¼ inch.	78½ inch.	34 inch.	31 inch.	32 inch.
30 inch.	78 inch.	79¼ inch.	80½ inch.	36 inch.	33 inch.	34 inch.
32 inch.	80 inch.	81¼ inch.	82½ inch.	38 inch.	35 inch.	36 inch.
36 inch.	84 inch.	85¼ inch.	86½ inch.	42 inch.	39 inch.	40 inch.
40 inch.	88 inch.	89¼ inch.	90½ inch.	46 inch.	43 inch.	44 inch.
50 inch.	98 inch.	99¼ inch.	100½ inch.	56 inch.	53 inch.	54 inch.

Depth of Loom from full 18 inch Yarn Beam to 18 inch Cloth Roll:

E Model, 50⅛.

D and H Models, 53¼.

For proper width between Beam Heads we recommend 4 inches more than size of loom. For those desiring extra space we supply Beams 5½ inches wider than size of loom.

F MODEL LOOM DIMENSIONS.

Size.	Length Over All.	Available Space for Harness Shaft.	Greatest Width of Cloth at Temple.	Proper Distance Between Outside Heads of Yarn Beams.
72 inch.	126 inch.	79 inch.	75 inch.	78 inch.
76 inch.	130 inch.	83 inch.	79 inch.	82 inch.
82 inch.	136 inch.	89 inch.	85 inch.	88 inch.
90 inch.	144 inch.	97 inch.	93 inch.	96 inch.
100 inch.	154 inch.	107 inch.	103 inch.	106 inch.

Largest diameter of Cloth Roll, 17 inches.

Largest diameter of Yarn Beam, 16½ inches.

Largest distance between Beam Heads (outside Heads) 6 inches more than size of looms.

Depth of loom from full 16½ inch Yarn Beam to 17 inch Cloth Roll, 54⅝ inches.

Use two Beams in a loom.

LOOM CONSTRUCTION.

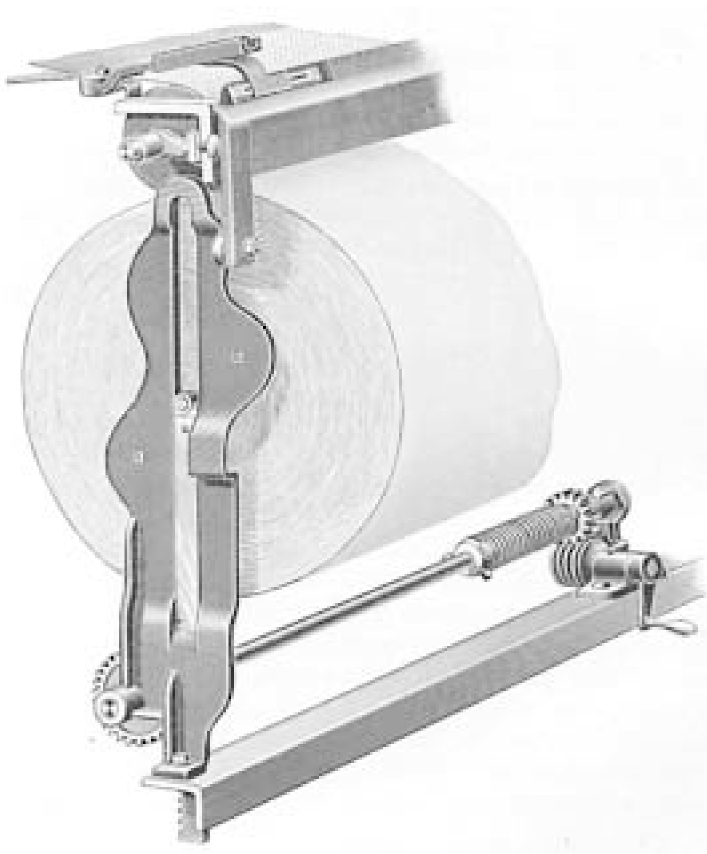
We believe our general improvements in the loom and its parts are of great importance apart from the added novelties. We have endeavored not only to adapt from the best looms of other builders, but also to improve on them whenever possible. With our wide lee-way of profit, we could afford experiments that were denied the builder of common looms. Improvements.

ONE-HAND DESIGN.

We have uniformly adopted the plan of making our looms all of one hand—that is, instead of being in rights and lefts, our shipping mechanism and take-up gears are always at the left of the loom, with the hopper always at the right of the loom. We must of course change our pulleys in order to meet the requirements of the belting, and when the pulleys are on the right hand of the loom the belt is shifted by a simple cross connection. With this system, we not only avoid a great many right and left designs, but we aid the weaver by training him to use the same motions for similar results. It is well known that with the old custom, patterns would vary sufficiently so that there was not uniformity of action, the fixer being required to learn the peculiarities of two different mechanisms. In spite of the simplicity of the idea we are apparently the only loom builders who have thought of this method. We have of course protected the details by patents. One-hand construction.

LET-OFF.

We have improved the original Bartlett let-off in many details giving special care to the adaptation of proper gears to various weaves. While we know our construction is certainly superior to the older forms, we think it possible that some of our present experiments may materialize in a still later form, which will be even better suited to the purpose. We shall, of course, allow our customers to profit by any improvement the minute that we are sure of its success. Let-off.



DETAIL OF THE CLOTH WINDING DEVICE
ON OUR HIGH-ROLL TAKE-UP.

(See also sectional views of looms on pages 16 and 18.)

"In conversation with one of our most prominent manufacturers this week, who has just returned from a trip through the South, he informed us that he took especial pains to visit a mill making print cloths, where it had all Northrop looms, and that he never saw nicer woven goods, and made at a cost which we are not at liberty to state, but it was very low indeed."—[*Boston Journal of Commerce.*

TAKE-UP.

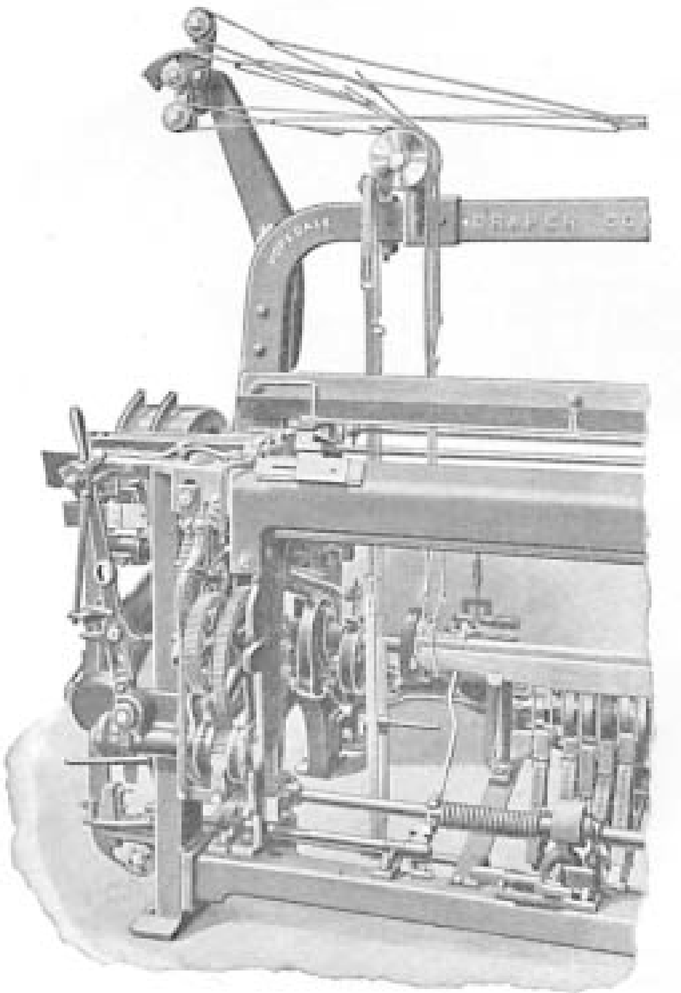
It is often necessary to weave goods having considerable length in one piece, the usual limits being within a diameter of the full roll measurement of 18 inches. It has been the custom formerly to build special looms for this purpose. With our high roll take-up, however, we can weave cloth of any length desired up to the 18-inch roll. Even on goods where long rolls are not necessary, it is often a help to the weaver to be able to take off the cuts when convenient, rather than being forced to watch for any special cut marks.

Length of cloth roll.

The introduction of our high-roll take-up has been so uniformly successful that we use it on all our looms, irrespective of type or class. The advantages are evident when the conditions are understood. When the take-up is some distance from the fell of the cloth, there is an opportunity for shrinking or wrinkling that cannot exist where the cloth is stretched over the rough surface of the roll, almost immediately after it is formed. The width of the goods is made more uniform, and the picks are more even. While the principle of running the cloth directly on a roll is not new, the difficulties of designing a proper arrangement for winding the cloth underneath the roll have prevented wide adoption—in fact, we are the first American loom-builders to attempt to use the idea. Our rack and worm motion allows the cloth to be removed from the roll at any time, and it is wound hard and even. The coil spring on the gear shaft can be set to regulate the tension as desired and the action of that spring is theoretically perfect for the purpose, as it keeps the pressure practically uniform. Cut motions operated by the weight of the cloth itself must necessarily start with a very light pressure, increasing as the weight increases. The preliminary looseness often allows the cloth to wind over at the edges in an objectionable manner. One of the advantages in construction with our idea is that it enables the breast-beam to come outside of the cloth, to protect it from blemish when the weaver leans over the loom. Another advantage of the high roll is that it helps to take strain off of the temples, thereby preventing a certain amount of warp breakage.

More uniform width.

In striving after cheap construction, we are afraid that American loom builders have made one serious error. We naturally followed the custom at first, but encountered such serious difficulties that we were



DETAIL OF LACEY TOP RIG.

Cut also shows our worm gear take-up with the let-back modification.

glad to find an easy though expensive way out of them. We refer to the practice of making the cloth-roller of wood, which is certain to shrink or swell more or less in use, thereby not only breaking or loosening the filleting, but also varying the picks in the cloth. Looms which are geared for a definite number of picks must vary more or less both ways when using a wooden roller. Of course the general result of yards per pound for the entire product may be uniform in a year's production, but a uniformity made up by averaging known variations in a supposedly standard product is hardly a proper practice. We believe a great many foreign looms are made with metal rollers, and while we have copied their principles we believe our construction to be superior. We use sections of wrought iron pipe, which of course cannot change their diameters, and insert wooden plugs by which to attach the fillet.

Metal rollers.

With certain styles of goods it is necessary for the take-up motion to let back more than usual when the filling changes. Our take-up motion is made adjustable by the removal of a cotter pin so that it can let back from one to four teeth, as desired. In some goods it is better to run the chance of a thick place than to allow the slightest chance for a crack of any kind.

Letting back.

SHEDDING MECHANISM.

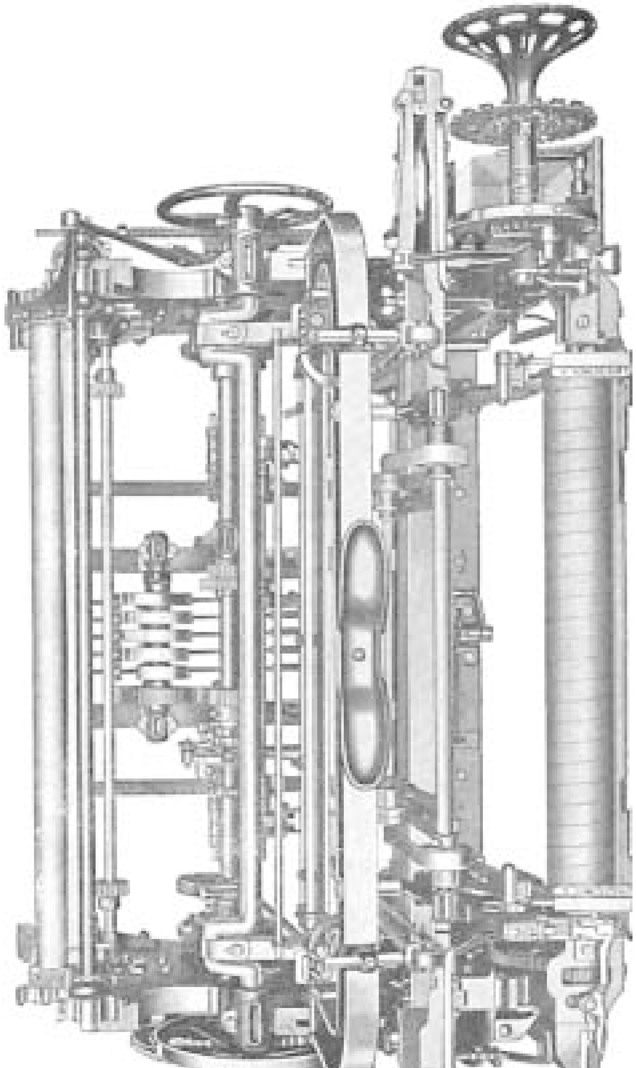
For two harness work, we use the ordinary straps and jacks for two harness cotton harness, and a peculiar strapping, with side guide rods on our steel harness.

For 3, 4, 5 and 6 harness, we recommend our Lacy top rig, which will take either number by slight change in arrangement. This device is simple and durable, is always in place to hang a warp, does not wear out straps like the ordinary devices and is easily adjusted. It is similar to the Crompton & Knowles head, but contains important additional improvements.

Multiple harness motion.

Our cams and cam drive are applied with special reference to ease in making changes. Several points which we have discovered will be found of great convenience to the loom fixer.

We also equip looms with side cams and arrange for Dobbys when desired.



BINDERS.

Our binders are pivoted on an eccentric stud, so that they may be adjusted front and back by loosening the upright bolt and turning the bearing. The pivot is also fitted with a rawhide sleeve that is not subject to excessive wear. This latter device is known as the Raby bushing, and was in use on thousands of looms with great success before we bought the patent. Eccentric adjustment.

BRAKE MECHANISM.

We employ a simple and convenient filling brake, which is actuated whenever the shipper is released. The operative raises a finger to remove it, and on pulling the shipper handle the parts automatically re-set themselves. We have lately perfected the adjustment so that by proper care it is possible to absolutely prevent the slight cracks in thin goods which may be caused when the loom is stopped. Automatic setting.

The cut on the opposite page is the curious effect of a photograph taken from above the loom, with the camera pointed downward. The construction is of the cotton harness type, with cams for five frames.

Quotations from reports made by users of Northrop looms before the N. E. C. M. Association.

"Weavers make more money with less expenditure of labor."
"Weavers are running 16, 20 and 24 looms."
"Average warp thread breaks are 10 per loom per day."
"Less than one per cent. of seconds."
"Looms are run during the noon hour without attendance."
"Help prefer to run these looms."
"Does not require as much skill to run the Northrop loom."
"Quality of cloth is better."
"Less fixing to do."

INSTRUCTIONS FOR ORDERING NORTHROP LOOMS.

Reed. Send for enough specification blanks to fill out one for each size loom.

Send half a dozen pieces of different reeds, to help us fit fliter. Reeds vary so much, one piece is not sufficient. As the contraction on our high roll take-up is considerably less, on certain classes of weaves, than on other looms, it would be well to write us before ordering new reeds. The maximum reed space is 5″ wider than the size of the loom.

Bobbin or Cop. It is necessary to send several sample cops with mule spindle or bobbin and spindle. Bobbins are patented and must be ordered through us. At least 200 to a loom should be provided. When cops are used we send twenty skewers with each loom. These are charged extra.

Let-Off. We furnish Bartlett, Shepard or Friction let-off, or Bartlett and Friction combined. On F model looms we furnish a Compound let-off.

Take-Up. Our "High Roll" construction admits of winding any diameter cloth roll up to 18″. Embodied with this we have three separate styles of Take-up.

Our regular pattern takes up with every pick, and lets back to prevent thin places.

Our Worm Take-up is a positive take up, without the let back feature, and is especially designed for corduroys, velvets and similar fabrics, which require 200 picks per inch and above.

Our worm Take-up with Let-back is designed for those who require a positive take-up, and still desire the let-back feature. (See page 34.)

Harness Motion. We furnish the regular top harness motion or the Lacey compensating motion.

We also adapt our loom to take the Stafford or Crompton Dobby.

Warp Stop Motion. Drop-wires and heddles are extras, and should be ordered in sufficient quantities for extra drawing-in sets. It is well to order about 20 per cent. more drop wires or heddles than the looms figure for this purpose.

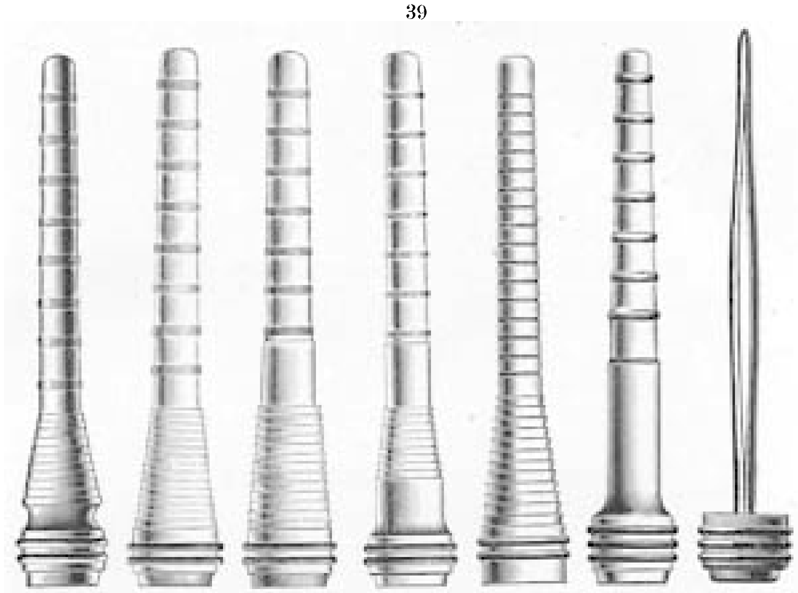
Pulleys. Regular size of pulleys, 12″ diameter, 2 1-4″ face, for 28 loom. 14″ diameter, 2 1-4″ face, for 40″ loom. We strongly recommend this width of face, as wider pulleys are much more troublesome in shifting belts.

Equipment. We furnish looms with filling-changer, warp stop-motion, check stands, shuttle guard, filling-forks, one shuttle, one and one half beams per loom. No leather parts.

Pickers. Pickers must be of short pattern, not projecting above shuttle box.

We furnish sample sets of strapping and pickers, without extra charge.

Write for additional information if necessary.



1 2 3 4 5 6 7

BOBBINS AND COP SKEWERS.

Patterns of bobbin.

No. 1. Represents our early type of bobbin—now discarded.

No. 2. First abandonment of groove at base.

No. 3. Standard pattern with Claus step for ordinary yarn.

No. 4. Special Queen City pattern.

No. 5. Standard for coarse filling. Note also the base made larger than formerly. We expect to fit all our new looms to take this bobbin, as it will have greater strength and be less affected by reaming. Of course, all the other patterns can have this same base. In ordering filling spindles for this new bobbin be careful and specify the large cup.

No. 6. Feeler bobbin for use with feeler or mispick-preventer looms, extra ring on base.

No. 7. Cop skewer for cop looms.

Our bobbins and cop skewers are made in three lengths

Dimensions.

1. 6 3-4 inches long for traverse of 5 1-2 inches.
2. 7 3-8 " " " " " 6 1-8 "
3. 8 " " " " " 6 3-4 "

The exteriors shown in the cuts are used on all three lengths.

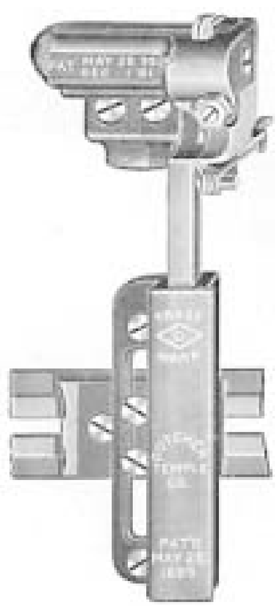
We have many additional contours to suit the whims of customers, but the above are approved by use.

All bobbins and cop skewers must be ordered by us. They are patented articles.

We insist on this simply to protect the successful operation of our looms. We do not take profit enough to pay us for the trouble in handling this part of the business.

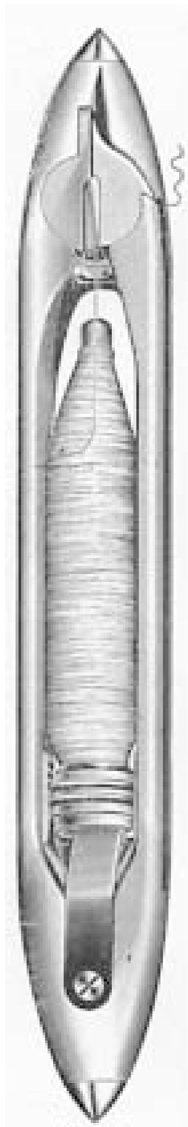
THREAD-CUTTING TEMPLES.

Trimming the fringe.



The device shown in the cut has now been in use over two years without material change, and we consider it reliable and satisfactory as a thread severing device to prevent fringe from the bobbins of yarn supplied by the filling-changer. The jaws will *not* cut the loose ends. common to ordinary weaving, which result from the filling running out at the side of the warp.

"A satisfactory test was observed by the writer at the Tucapau Mills, Wellford, S. C., where, with but three months' experience, weavers cared for an average of 13 looms each; six weeks later an average of 15 looms per weaver had been reached."—[*F. B. deBerard.*



NO. 16.

SHUTTLES.

We make a great variety of shuttles, as we have customers who still prefer some of our earlier varieties.

The cuts show our present standards. The springs are alike in both.

The eye in No. 16 is well known and tried.

The No. 33 eye threads up better with cops and can be used on filling spun with a reverse wind.

These eyes are used in three different lengths of shuttles.

NO. 33.

SHUTTLE NUMBERS.

We only give those which are standard. We have special shuttles for special customers who can order by the number on the bottom. While we now use only left hand shuttles, the same number does for both hands. In ordering for right hand looms, specify as follows:

Directions for ordering.

"One hundred No. 16 Shuttles—Right Hand."

WE MAKE THREE LENGTHS OF SHUTTLES:—

Short——For 6¾ inch bobbin or cop—14½ inches long.
Medium—For 7⅜ inch bobbin or cop—15⅛ inches long.
Long——For 8 inch bobbin or cop—15¾ inches long.

	Numbers to Order By	
For Standard Looms:—		
Short Bobbin Shuttles,	No. 16	No. 26
Medium Bobbin Shuttles,	No. 13	
Long Bobbin Shuttles,	No. 18	No. 40
For Feeler Looms:—		
Short Bobbin Shuttles,	No. 22	No. 43
Long Bobbin Shuttles,	No. 23	No. 42
For Standard Looms:—		
Short Cop Shuttles,		No. 33
Medium Cop Shuttles,		No. 35
Long Cop Shuttles,		No. 38
For Feeler Looms:—		
Short Cop Shuttles,		No. 34
Long Cop Shuttles,		No. 39
	Numbers in this column have eye like No. 16.	Numbers in this column have eye like No. 33.

LOOM SALES.

Introduction.

Our list of loom orders starts on the next page, and furnishes the best evidence of merit that could be conceived.

MAKE-UP TO JANUARY 1, 1900.

Name of Customer.	No. of complete Northrop Looms sold.	No. of Plain Looms.	No. of Warp Stop-motion applied to old Looms.	Total.
Amoskeag Mfg. Co. N. H.	1261		8555	9816
Amory Mfg. Co. N. H.	118		4	122
Ashland Co. R. I.	20			20
Aurora Cotton Mills Ill.	96			96
Abbeville Cotton Mills S. C.	940			940
Acushnet Mills Corp. Mass.	418	2		420
Ateliers de Construc. Ruti Switz.	2			2
Albion Co. R. I.	80		1	81
Atlantic Cotton Mills Mass.	12		1	13
Anderson, J. M. Mex.	1			1
Augusta Factory Ga.	32			32
Aiken Mfg. Co. (Mason) S. C.	13			13
Anderson Cotton Mills S. C.	240			240
Appleton Co. Mass.	32			32
Avon Mills N. C.	1600			1600
American Spinning Co. S. C.	320			320
Bourne Mills Mass.	2000			2000
Boott Cotton Mills Mass.	116			116
Bennett Spinning Co. Mass.	1			1
Bates Mfg. Co. Me.			26	26
Bahnsen, J. H. Mex.	12			12
Berkeley Co. R. I.	128			128
Belton Mills S. C.	700			700
Buffalo Cotton Mills S. C.	1200			1200
Bemis Bros. Bag Co. Tenn.	624			624
Brandon Mill S. C.	320			320
Cocheco Mfg. Co. N. H.	100			100
Continental Mills Me.	1			1
Chicopee Mfg. Co. Mass.	126	1		127
Cawthon Cot. Mill Co. (Mason) Ala.	4			4
Cornthwaite & Rickards Russia.	100			100
Clemson College S. C.	2			2
Columbia Mfg. Co. N. C.	69			69
Crompton & Knowles Mass.	1			1
Chewalla Cotton Mills Ala.	40			40
Canadian Col. Cotton M. Co. Can.		2		2
Crompton Co. R. I.	2			2
Coventry Co. R. I.	1			1

MAKE-UP TO JANUARY 1, 1900.—[Continued.]

Name of Customer.	No. of complete Northrop Looms sold.	No. of Plain Looms.	No. of Warp Stop-motion applied to old Looms.	Total.
Columbus Mfg. Co. ... Ga.	320			320
Dyerville Mfg. Co. ... R. I.	12			12
Dunbarton Flax Spin. Co. ... N. Y.	1			1
De Leidsche Katoen Maatschappie ... Holland	12			12
Dwight Mfg. Co. ... Mass.	681	1		682
Dixie Cotton Mills ... Ga.		12		12
Dallas Mfg. Co. ... Ala.	48			48
Edwards Mfg. Co. ... Maine	709			709
Everett Mills ... Mass.	48		563	611
Edmands, A. B. ... Mass.		1		1
Exposition Cotton Mills ... Ga.	136	48		184
Eagle & Phœnix Mfg. Co. ... Ga.	102			102
Erwin Cotton Mills ... N. C.	1			1
Easley Cotton Mills ... S. C.	320			320
Eufaula Cotton Mills ... Ala.	32			32
Fulton Bag & Cotton Mills ... Ga.	352		500	852
Fall River Loom Fixers ... Mass.	2			2
Falls Co. ... Conn.	1			1
Florence Mills ... N. C.	200			200
Farnum, John & Co. ... Penn.	1			1
Farwell Mills ... Me.	12			12
Globe Mills ... R. I.			42	42
Grosvenor Dale Co. ... Conn.	1045	134		1179
Gaffney Mfg. Co. ... S. C.	1401			1401
Granby Cotton Mills ... S. C.	1014			1014
Graniteville Mfg. Co. ... S. C.	1062			1062
Georgia Textile School ... Ga.	1			1
Great Falls Mfg. Co. ... N. H.	630			630
Grendel Mills ... S. C.	288			288
Grinnell Mfg. Co. ... Mass.			2	2
Henrietta Mills ... N. C.	101			101
Hutchinson, Hollingworth & Co. Eng.	1			1
Henderson Cotton Mills ... N. C.	84			84

MAKE-UP TO JANUARY 1, 1900.—[Continued.]

NAME OF CUSTOMER.		No. of complete Northrop Looms sold.	No. of Plain Looms.	No. of Warp Stop-motion applied to old Looms.	Total.
Home Cotton Mills	Mo.	20			20
Hathaway Mfg. Co	Mass.	393			393
Hill Mfg. Co.	Me.	1			1
Jackson Co.	N. H.	37			37
Juanacatlan Mills	Mex.	8			8
King Philip Mills	Mass.	12		2	14
Knowles Loom Works	Mass.	2			2
Lawrence Mfg Co.	Mass.	16			16
Lockhart Mills	S. C.	800			800
Lonsdale Co.	R. I.	1187			1187
Lancaster Mills	Mass.	50		652	702
Lyman Mills	Mass.	24			24
Lewiston Machine Co.	Me.	1			1
Lowell Textile School	Mass.	1			1
La Virgin Mill	Mex.	12			12
Lawrence Loom Fixers	Mass.	1			1
Lower Pacific Mills	Mass.			1	1
Lanett Cotton Mills	Ga.	738			738
Lockwood Co.	Me.	1500			1500
Louise Mills	N. C.	152			152
Lorraine Mfg. Co.	R. I.			2	2
Merrimack Mfg. Co.	Mass.	177		1	178
Massachusetts Cotton M.	Mass.	123	112	6	241
Mass. Mills in Georgia	Ga.		601	6	607
Meridian Cotton Mills	Miss.	148			148
Methuen Co.	Mass.	26			26
Mays Land. Wat. Power Co	N. J.	1			1
Merchants Cotton Co.	Can.	12			12
Montreal Cotton Co.	Can.	162			162
Mechanique Weberei	Switz.	80			80
Mohawk Valley Cotton Mills	N. Y.	1			1
Mississippi Mills	Miss.	49			49
Mira Flores	Mex.	24			24
Maginnis Cottton Mills	La.	50			50
Mass. Inst. of Tech'y	Mass.	2			2
Mills Mfg. Co.	S. C.	484			484

MAKE-UP TO JANUARY 1, 1900.—[Continued.]

Name of Customer.	No. of complete Northrop Looms sold.	No. of Plain Looms.	No. of Warp Stop-motion applied to old Looms.	Total.
Manville Co. .... R. I.	24		1	25
Millville Mfg. Co. .... N. J.	100			100
Newmarket Mfg. Co. .... N. H.	192			192
Naumkeag Steam Cotton Co. .... Mass.	24			24
Nashua Mfg. Co. .... N. H.	18			18
Nockege Mills .... Mass.	1			1
New York Mills .... N. Y.	33	1	3	37
Nightingale Mills .... Conn.	14			14
Northrop Loom Co. of Canada. Can.	264			264
Newberry Cotton Mills .... S. C.	26			26
New Bedford Textile School ..... Mass.	1			1
Nantucket Mills .... N. C.	32			32
Neuse River Mills .... N. C.	150			150
Ossipee Cotton Mills .... N. C.	104			104
Orr Cot Mills .... S. C.	700			700
Olympia Mills .... S. C.	2600			2600
Otis Co. .... Mass.			6	6
Pacific Mills .... Mass.	807			807
Pelzer Mfg. Co. .... S. C.	1001			1001
Putnam Mfg. Co. .... Conn.	252			252
Poe, F. W. Mfg. Co. (Mason) .... S. C.	13			13
Philadelphia Tex. School .... Pa.	1			1
Pemberton Co. .... Mass.	2		60	62
Proximity Mfg. Co. .... N. C.	521			521
Parkhill Mfg. Co. .... Mass.	1		12	13
Potomska Mills Corp. .... Mass.		1		1
Queen City Cotton Co. .... Vt.	1308			1308
Quidnick Mfg. Co. .... R. I.	16			16
Robert, S. & Co. .... Mex.	10			10
Rio Blanco Co. .... Mex.	24			24
Revolution Cotton Mills .... N. C.	376			376
Social Mfg. Co. .... R. I.	290		33	323
Stark Mills .... N. H.	191			191
Steele's Mills .... N. C.	600			600

MAKE-UP TO JANUARY 1, 1900.—[Continued.]

Name of Customer.	No. of complete Northrop Looms sold.	No. of Plain Looms.	No. of Warp Stop-motion applied to old Looms.	Total.
Spartan Mills .... S. C.	1551*			1551
Stonewall Cotton Mills .... Miss.	12			12
Societé Alsacienne de Construction Mech. .... Ger.	16			16
Societé Anonyme du Phœnix Bel.	1			1
Santa Rosa Mills .... Mex.	8			8
Slater, H. N. .... Mass.	250			250
Shetucket Co. .... Conn.	1			1
Tucapau Mills .... S. C.	469			469
Tremont & Suffolk Mills .... Mass.	1976		250	2226
Tarboro Cotton Factory .... N. C.	200			200
Trion Mfg. Co. .... Ga.	656			656
Trainer & Sons, D. Mfg. Co. .... Pa.			1	1
Utica Steam Cotton Mills .... N. Y.	13			13
Utica Cotton Co. .... N. Y.	1			1
Union Cotton Mills .... S. C.	20			20
Victor Mfg. Co. .... S. C.	648			648
Whittenton Mfg. Co. .... Mass.			20	20
Walhalla Cotton Mills .... S. C.	120			120
Wilmington Cotton Mills .... N. C.	60			60
Whitney Mfg. Co. .... S. C.	373			373
Warren Mfg. Co. .... S. C.	801			801
York Mfg. Co. .... Me.			69	69
Total	42,515	916	10,819	54,250

The list of Foreign sales does *not* include looms made by our Foreign licensees, but only those made in our own works and shipped to outside countries.

Note on next page that while the Northern sales, including old looms changed over, are slightly in excess of the Southern, the complete new loom figures are heavily in favor of the south.

RECAPITULATION.

Northern States.	No. of complete Northrop Looms sold.	No. of Plain Looms	No. of Warp Stop motion applied to old looms.	Total
Maine	2224	. . .	95	2319
New Hampshire	2547	. . .	8559	11106
Vermont	1308	. . .	. . .	1308
Massachusetts	7326	118	1576	9020
Rhode Island	1760	. . .	79	1839
Connecticut	1313	134	. . .	1447
New York	49	1	3	53
New Jersey	101	. . .	. . .	101
Pennsylvania	2	. . .	1	3
Illinois	96	. . .	. . .	96
	16726	253	10313	27292
Southern States.				
North Carolina	4250	. . .	. . .	4250
South Carolina	17426	. . .	. . .	17426
Georgia	2337	661	506	3504
Alabama	124	. . .	. . .	124
Mississippi	209	. . .	. . .	209
Louisiana	50	. . .	. . .	50
Tennessee	624	. . .	. . .	624
Missouri	20	. . .	. . .	20
	25040	661	506	26207
*** Foreign Countries.**				
Canada	438	2	. . .	440
England	1	. . .	. . .	1
Germany	16	. . .	. . .	16
Holland	12	. . .	. . .	12
Belgium	1	. . .	. . .	1
Switzerland	82	. . .	. . .	82
Russia	100	. . .	. . .	100
Mexico	99	. . .	. . .	99
Foreign C.	749	2	. . .	751
Northern S.	16726	253	10313	27292
Southern S.	25040	661	506	26207
Totals	42515	916	10819	54250

Delightful reminiscence.

In looking backward over the many perplexing trials which we encountered in our early experimenting, we feel grateful for the conservatism which kept us from attempt at public introduction until we had a developed machine that had actually made a public record, before we approached a possible customer.

Our test of running a weave room of 80 looms continuously for months open to public inspection, was one of the best expenditures of money that we ever made. In waiting for the results of that test we avoided the common habit of "*slopping over*," into which many other early enthusiasts continually fall. The first looms that we made are running yet, and doing more than we ever claimed for them at the time. Even had we gone on the market before our test, we believe our past reputation would have induced a certain amount of confidence; but in view of the experience of the last few years, we warn manufacturers against the claims of those promoters who try to sell what they have had no former experience in making, by referring to tests that are too limited for practical proof.

As a matter of interest we give a few quotations from printed matter relative to certain competing loom inventions, none of which are in the market at the present day, all having failed of introduction when brought to the test of a customer's payment. The names of the various looms referred to are omitted; yet it makes little difference if the reader misappropriates the remarks, as they are probably as true in one application as another:

Curiosities of the imagination.

"It occupies less floor space, is running with the same power, with less wear on the warp, and at less cost, and with production double that of the ordinary loom."

It were well at times to state what a machine will *not* do. If double speed requires double the labor, there is no gain in wage reduction.

"On account of the shuttle being so much wider, he can run the loom at a much higher speed, thus more than doubling the production."

Why not make the shuttle a foot wide and thereby decuple the speed?

"There cannot be two opinions as to the advisability of putting this wonderful invention before the great weaving factories of the United States, and once placed there, at least among the more important ones, it thereafter will take care of itself, besides placing those who are shrewd enough to get in on the ground floor now in comfortable circumstances."

The latter reference shows a possible desire to sell shares rather than looms. It is far easier to print certificates than make automatic machinery.

"It enables one weaver to do the work of ten or fifteen weavers, and allows the loom to be kept in constant motion, thereby practically almost doubling its capacity."

Fifteen weavers on eight common looms each to be replaced by one weaver on one hundred and twenty! Eight weavers in a 1000-loom mill!!

"The stock of the Company, 20,000 shares of which is being sold for working capital, ought to prove as good an investment as the stock of the General Electric Co., Bell Telephone Co., the Standard Oil Co., or that of any other of the great corporations which control the most valuable practical inventions of the age."

Then why part with it?

"The enormous profits that must accrue to the Company will be understood with a moment's consideration. There are about 1,000,000 looms at work in the United States, and there are something like 14,000,000 in Europe. These attachments fit on any old loom, will be made in large quantities, and may be rented like a telephone. If the price be fixed at a monthly rental of even $3.00, it is plainly to be seen that the corporation must in a very short time pay enormous dividends."

15,000,000 looms earning $36 per loom per year for the life of the patent, or say 15 years to be conservative.

15,000,000
36
90,000,000
45,000,000
$540,000,000
15
2,700,000,000
5,400,000,000

$56,700,000,000 possible profits.

Colonel Sellers was but an amateur in exaggeration, after all!

"An idea of its immense preductive capacity may be obtained from the fact that at the time of my visit it was weaving a texture containing 124 threads in a square inch, at the rate of 140 yards in ten hours, and this was not by any means the highest speed at which it might be run."

The public have been anxiously waiting to know the production at "*the highest speed.*"

"It occupies considerably less than the usual area of floor space, is run with less power, less wear on the warp in weaving, and at a less cost, and has a rate of production largely in excess of the ordinary loom."

And yet the public would not buy one loom. The same promoters who wrote the above are now engaged in attempting the sale of attachments for *common* looms, having abandoned their first conception in spite of its claimed advantages. Change of base.

"It is understood that already one large mill in that city has ordered, or is preparing to order, in the next few days, 1500 self-feeding shuttles of the kind to be put on the market by Mr——."

A copy is more or less of an indirect compliment. Of course, we consider any self-feeding shuttles as infringements of our patents.

"Calmly jogging along at the rate of 300 to 350 picks per minute, and incidentally turns out better cloth than the old looms, though it produces from 150 per cent. to 200 per cent. more in the same length of time."

It is well to be calm under all circumstances even in the sea-sickness from vibration at such abnormal speed.

PRICES.

There are certain important facts connected with the exploitation of a new invention which the general public are still far from comprehending. An improved machine is brought to their attention and their first impulse is a protest if an increased cost is demanded. It is easy to get a customer for a machine that costs no more than the old one, even if the seller makes 100 per cent. or more from having reduced the cost of manufacture or increased the product. It is a very different proposition to make the customer pay more for the same productive unit, no matter if he actually makes a much higher profit per dollar invested. Problems of trade.

The introducer of a patented improvement has 17 years protection from the date of his patent in which to be paid for all his expenditures involved in perfecting, protecting and introducing the idea. Taking our loom as an example, we must make a return to pay for years of preliminary labor, for hundreds of useless experiments, for thousands of disused patterns, for special tools, for introductory expense, for litigation and in countless other channels. We have seen an active year of loom business return us nothing but the bare manufacturing profit charged by one of our departments on a mere mechanical attachment. Not that we complain; we are willing to lose for ten preliminary years to gain the legitimate profits of the seven later years, providing we have the confidence of conviction in the value of our devices. It pains our economic instinct, however, to see the vast total of profitless labor and expense devoted by others to competition with us in lines where there is only profit enough for one.

Perturbed emotions.

Our loom costs the customer perhaps three times the price of the common loom adapted to the same product. What matter if it cost ten times as much, provided there were proportionate profits in the investment? The higher we make the price the better the customer is protected; for were they sold too cheap, the immediate universal use would stop all chance of comparative profit. The early purchaser of an improvement buys for the profit allowed by the gain in selling at the price set by the users of the older machines. Just so soon as the improvement becomes so widely used that the price is set to the new standard, the profit lessens, and the owner of the older machines is absolutely compelled to buy the new or go out of business. We are naturally confronted by the problem as to whether it is better to sell fewer machines at a higher profit, or more machines at a lesser profit. In view of the troubles incurred in the introduction of new mechanical devices, we preferred to limit our early output, and now we find that even our present prices are not sufficient to limit our order list to a reasonable figure. We know perfectly well that looms would not be ordered unless they were a profitable investment to the purchaser, and our great rush of orders simply proves that our former assertions as to the value of our improvements were reasonable. It is capable of positive proof that it is better for our present customers to pay an extra $25.00 for this loom, if such payment can delay the universal adoption **one year.** We believe we have delayed it several years and thereby continued the protection of our earlier customers. Needless to say, it is the early customer who demands our first consideration. Those with sufficient courage and confidence to risk largely in the trial of a new idea, demand good treatment. Those who attempt to block advancement as long as possible and then hurriedly fall into line when resistance is useless, will also receive good treatment; for we shall still allow them the privilege of buying at market prices.

The test of sales.

THE USER'S PROFITS.

Returns from the use of Northrop looms are more or less proportionate to the capability of the purchaser. Starting with the fact, now well proved, that a weaver can produce from two to four times as much product, with less skill and less expenditure of mental and physical energy, there is evidently a chance to save on the basis of wages formerly paid for weaving in the proportion of 50 to 200 per cent. In foreign countries where weavers run but few common looms, it is possible to save at an even higher proportion. Offset against this are the increased cost of loom fixing and repairs, and the interest on the additional investment. We have figures from mills showing that it is certainly possible to save half the former cost of weaving, or one quarter the entire labor cost of the mill. Basis of figuring.

Roughly figured, the profits on the loom, irrespective of interest on investment, should run from $20 a year upward. The higher the scale of common weavers' wages the higher the profit. Taking the print loom, on which such profits should be easily made, it shows 25 per cent. on the $80 of extra cost paid for the attachments and royalty, or a chance to pay this extra cost in four years' time. The profit per loom cannot be figured by the production of the weaver alone, but must be considered in relation to the number of common looms formerly tended. For instance, supposing a weaver to earn at the rate of $400 per year in wages, we should have $100 per loom on a four-loom basis. A change from four to six looms on the same relative wages would show a profit per loom of some $33. Taking the same weaver on another class of goods, where eight looms were run, and the same proportionate change to twelve looms would only show a saving per loom of $16.50; but Northrop loom weavers do *not* change from four to six or from eight to twelve; they have actually changed from four to sixteen, from six to twenty and from eight to thirty-two. With small, cheap help to fill hoppers, they have even run forty. On print numbers, the profit of the Northrop loom may be roughly figured at a cent per pound in the cloth. It has been universally true that the purchaser of looms who approaches the matter timidly, giving his weavers but a few more looms and reducing the price per cut by a too narrow margin, has had more difficulty, both with the looms and the help, than have the bolder manufacturers who reso- Reasons for variations.

lutely cut the price per cut in half and insisted on their weavers running their full capacity.

While it is not our place to instruct customers how to run their mills, there are certain facts which everyone should appreciate. Certain managers are very proud of getting nearly 100 per cent. production off their Northrop looms; such a result, however, is plain evidence that the weaver could easily run *more* looms. It should be the object of the manager to get as much cloth *per weaver* as possible, rather than as much cloth *per loom*, and base his scale of wages accordingly. In other mills it is often noticed that the hoppers on Northrop looms are practically full the greater part of the time; this is another evidence that the weaver could run more looms. Not that it should be expected that the same product per loom will continue. Ninety per cent. of the cloth taken from 20 looms is a much larger total than 95 per cent. off of 16 looms; and 7 cents a cut on the 20 looms will earn the weaver more money than 8 cents on the 16.

Better possibilities

New systems.

Another opportunity is open for profit in perfecting the system of using cheap help to fill the hoppers, or do the cleaning and oiling, letting the weaver repair warp defects and keep a general oversight over the machines.

No labor-saving device attains its full efficiency in the first few years of use, and we hardly think the present records on our loom have attained the maximum. While we only figure to save in the actual price paid for weaving, the better value of the goods has often proved of great importance. Cloth without warp runs sells at higher figures for many purposes, and the reduction in the number of seconds also materially affects the returns. Several buyers already stipulate that certain goods shall be woven on Northrop looms.

Better goods.

The owners of a cotton mill already erected and run during the trial period of the first few years, soon recognize the competition of the new mills that start in with more modern equipment. They find it necessary to economize in some line or other to meet the lower range of prices which the increased product of the new mills invariably forces. In past consideration of this problem the usual plan adopted has been the increase of plant, in the hope of saving in the general running expenses. The history of the cotton industry in this country shows that the majority of mills *have* increased beyond their first capacity for production. An enlarged plant necessarily in-

Past economy.

creases the product, thereby still further increasing the supply of goods to be sold. The ultimate gain is necessarily small, for saving is only possible in certain general expenses by this method, and the entire general expense of a mill is but a small percentage on the total cost of manufacture.

The successful development of our loom gives a mill the chance of making a great saving in its expenses without increasing the labor or responsibility of the management, and by reduction of the number of employees it actually lessens the investment necessary for tenements and the labor used in paying off and supervising. The possible profit from our mill will pay good dividends when a competing mill with common looms is not able to show more than an even balance. Mills have been prompt to take advantage of improved machinery in the past, as they universally use high-speed spindles and are thoroughly committed to the revolving top flat card. Neither of these changes, however, can show more than a fraction of the profit possible with our loom, for the saving in weaving is **more than the entire cost of carding with the picker-room thrown in,** and **more than the entire cost of spinning.** Should we charge twice the price for our looms we could still figure why the consistent manufacturer should use them.

Indirect returns.

Surprising truths.

"How the introduction of this new loom affects the cost of labor may be shown by a comparison of two accounts of the cost of labor in print cloth, one taken by myself from a mill account of older date, but from one of the best mills in New England, and the other from the workings of recent date, received from a mill but a few days ago.

COST OF LABOR IN ONE POUND OF PRINT CLOTH.
(28 inches, 64 x 64, seven yards to the pound.)

ITEMS.	1887. Cents.	1898. Cents.	Differences 1898. Cents.
Carding	0.855	0.7	0.155
Spinning	1.137	1.1	0.037
Preparing for loom	0.697	0.7	—0.003
Weaving	2.8	1.6	1.2
Other labor expenses	0.239	0.25	—0.011
Total labor cost	5.728	4.35	1.378
Difference on account of improved loom			1.2
All other differences			0.178

The items covering all other manufacturing processes are scarcely worth noticing. The difference is almost entirely traceable to the new loom."—[*Jacob Schoenhof*.

Foreign builders.

The Northrop loom has won recognition outside of the United States in spite of the difficulties of foreign introduction. A complete new shop has been built, equipped and run by the Northrop Loom Company of Canada, established at Valleyfield, Province of Quebec, and several hundred looms from its product are in successful operation. The Societe Alsacienne de Constructions Méchaniques, of Mulhouse, Germany and Belfort, France, are building on large orders at both of their establishments. The Ataliers de Construction Ruti, of Ruti, Switzerland, are manufacturing on various foreign orders for Switzerland, Italy, etc.

We have sent looms from our own works to Mexico, Holland, Russia and elsewhere.

There are other countries, notably England, where our loom should have been more highly appreciated. We have had continued orders and requests for rights to build these looms there, but have been waiting to arrange on some basis that would take the responsibility of introduction from our hands, we being fully occupied with the enormous increase in our own immediate business at home.

PATENT INFRINGEMENT.

Keep off the grass.

In order to warn the unsuspecting from infringing our patent rights we call attention to some of the devices used on our looms, which we consider are fully covered by our patents or applications for patents:

The FILLING CHANGER and all its detailed parts.

The various WARP STOP-MOTIONS and their various elements; also certain processess of their manufacture.

The THREAD CUTTING DEVICES.

The SHUTTLES, with their peculiar spring and eye formation.

The BOBBINS and COP SKEWERS with their projecting rings.

The FEELER DEVICE.

The HIGH-ROLL TAKE-UP.

The ONE-HAND METHOD of loom construction.

The peculiar FILLING BRAKE.

The BEAM LOCK.

The LEATHER BINDER BUSHING.

The FILLING FORK.

The ECCENTRIC CRANK-ARM ADJUSTMENTS.

The PICKER CHECK.

The METHOD OF FORGING used on our loom cranks.

The Lacey TOP RIG.

The LET-OFF improvements.

The Eaton PICK-FINDER.

The SIGNAL and INDICATOR and many others.

Reserved ammunition.

We also have patents covering devices which we do not use, but which might tend to compete with our adopted constructions. For instance, we own several shuttle-changing patents, which have proved a serious stumbling block for outside competitors. In fact, we have never seen attempts at automatic looms in which we could not find good grounds for suit should we deem them of sufficient importance. Florid articles in the press and enthusiastic claims by promoters do not disturb our equanimity, so long as orders are not taken from us, or our business otherwise interfered with. There will be time enough to defend our rights when attack is worthy of retaliation.

In our circular of November, 1897, we had a word to say to possible competitors which still seems pertinent, and we find no need of changing its language. We therefore give a reprint, as a few unfortunate experimenters failed to note its truth on first appearance.

"There are doubtless many bright men who will in the next few years give time and toil in the endeavor to evade the claims of our patents while producing similar mechanism. In view of the many other fields for inventive skill we ask—Is it worth the while? We are undoubtedly the first in the field and legitimately entitled to a fair reward for the expenditure of money, loss of time and consumption of brain energy. Our success is no vagary of chance or lucky stroke of fortune. Every step in advance has been gained after constant thought and experiment, with ten failures for every success. The patent office has recognized the novelty of our devices by broad basic claims. We have searched the records here and abroad, and have proof that we are pioneers in our line. We shall defend our rights in the courts with the obstinacy of conviction, if such methods are necessary. Only recently we have prepared, at great expense, an exhaustive printed record of the experiments, with dates and corroborative testimony indexed and arranged for reference in case of necessity. We have no wish for chance to show our strength. A lawsuit involves a waste of energy for one side at least, and an expense for both. We appreciate these facts after thirty years of continuous litigation."

The following list gives definite illustration of the scope of our loom patents (not including temples) and the inventors who have developed them. It does not, however, include a large number under which we have rights to use and sue.

	Shuttle Changers.	Filling Changers.	Warp Stop-motions.	Shuttles.	Bobbin and Cop Skewers.	Thread Cutters.	Mispick Preventers.	Parts of Harness Mechanism.	Parts of Lay.	Let-off and Take-ups.	Miscellaneous.	Inventions covered by patents.	Actual number of patents granted each inventor.
Northrop, J. H.	2	17	21	9	2	7	6	6	6	5	5	86	76
Draper, G. O.		2	11	3	1		2	6	1		1	27	23
Draper, W. F.		4	5	4		3	1		2	1	1	21	20
Roper, C. F.			5		1			3	2			11	9
Brooks, J. C.	3		1	1			4				1	10	7
Smith, O.			9					1				10	10
Littlefield, C. A.	1	2	2		1		2					8	8
Eaton, W. G.			1			1	4			1		7	6
Stimpson, E. S.				2		3						5	5
Day, C. M.		2	1		1							4	4
Davenport, E. W.				1		1	1			1		4	2
Durkin, D.						1				1	2	4	4
Bigelow, M. J.			1								2	3	3
Claus, A.					1	1			1			3	3
Draper, G. A.								1	2			3	3
Mooney, T.									3			3	3
Beardsall, A. W.							2					2	2
Allen, W. E.			2									2	2
Cunniff, J. V.				1	1							2	1
Cunniff, E.				1	1							2	1
Edwards, J. C.			2									2	2
Keeley, J. W.				1				1				2	2
Mason, E. P.		1				1						2	2
Mommers, R. J.			2									2	2
Northrop, Jonas		1	1									2	2
Nutting, C. E.				1				1				2	2
Piper, O.			1	1								2	2
Raby, Z.									2			2	2
Railton, J.				1				1				2	2
Shuttleworth, A. C.			2									2	2
Armstead, M. J.								1				1	1
Aube, A.				1								1	1
Bailey, S. C.											1	1	1
Baldwin, L. C.					1							1	1
Brunette, L.						1						1	1
Burton, J. L.		1										1	1

LIST OF PATENTS AND INVENTORS—[Continued.]

	Shuttle Changers.	Filling Changers.	Warp Stop-motions.	Shuttles.	Bobbin and Cop Skewers.	Thread Cutters.	Mispick Preventers.	Parts of Harness Mechanism.	Parts of Lay.	Let-off and Take-ups.	Miscellaneous.	Inventions covered by patents.	Actual number of patents granted each inventor.
Clement, A. W.		1										1	1
Conn, J.											1	1	1
Cumnock, W. W.									1			1	1
Cutler, W. E.								1				1	1
Draper, E. S.											1	1	1
Fitts, W. B.		1										1	1
Hinchliffe, W.									1			1	1
Horne, A. P.						1						1	1
Joy, C. L.						1						1	1
Knapp, C. H.									1			1	1
Lacey, F.								1				1	1
Lacey, W.											1	1	1
Ludlam, J. S.						1						1	1
McKay, J. L.											1	1	1
O'Connell, P. J.				1								1	1
Owen, H. W.				1								1	1
Piron, V.			1									1	1
Reilley, P.		1										1	1
Remington, H. A.										1		1	1
Rhoades, A. E.	1											1	1
Rigby, R.									1			1	1
Robinson, E. A.			1									1	1
Ryon, E. H.	1											1	1
Smith, E.			1									1	1
Spear, W. T.									1			1	1
Stimpson, W. I.						1						1	1
Storrs, H. A.								1				1	1
Sullivan, J.									1			1	1
Syme, D. B.											1	1	1
Vickerman, J.			1									1	1
Walker, S.											1	1	1
Wilmot, L										1		1	1
	8	33	71	29	10	23	22	24	25	11	19	275	250
Totals after deducting those patented by more than one inventor	8	31	67	27	9	17	22	21	22	9	19	252	23

Actual number of patents 227

QUOTATIONS FROM OUR ADVERTISEMENTS OF THE LAST FIVE YEARS.

1895.

"We believe that certain improvements we are soon to introduce will divide the cost of weaving by two on all plain goods.

We have a complete weave room of eighty looms running on print cloth, which is open to the inspection of interested manufacturers."

"It is a grave question whether we should invite more (loom) orders under the circumstances. A success may prove embarrassing when it comes so suddenly."

"Textile Workers should be interested in all inventions that make their labor easier, cleaner or healthier.

What is more unclean or unhealthy than the now necessary process of sucking filling through a shuttle eye?

We are introducing a loom which automatically threads the shuttle without labor on the part of the weaver. This loom also prevents damage to the cloth, caused by broken warp threads."

"Many persons are disappointed in the Northrop Loom because it does not produce finished goods at one end from a bale of cotton fed into a hopper at the other side."

"We believe a purchase of common looms a grave error at the present day."

1896.

"A mill that orders common looms at the present time deliberately handicaps its future prospects."

"We now recommend this (Northrop) loom and stake our reputation on its success."

"The majority believe in progress. They favor inventions that relieve human labor by transferring operations from fingers to levers and cams. The Northrop Loom is of this class."

"We do not have to reply on assertion. Thousands of (Northrop) looms are in actual use testifying to their own merit."

"We have had additional orders already from six of the first ten mills supplied."

"Consign your common looms to the scrap heap where they belong, and equip with machines that will earn a profit."

1897.

"The Northrop Loom is now an Unquestioned Success on all plain cotton fabrics. . . . We have never had a more positive conviction. This Loom must be adopted."

"When mills like the Pacific and Tremont & Suffolk throw out common looms for New Northrop Looms, the question of success is solved.

Before the year is over the Amoskeag Mfg. Co. will have nearly 10,000 looms changed to take our motions."

"Weavers on all common looms choke their lungs with cotton fibre. When the filling is colored the effect is more or less poisonous, and in either case the health is undermined."

"It is commercial suicide to buy a common loom in the face of facts easily known and proved."

"Why not return to hand looms and get a cheap equipment, also giving more laborers employment?"

1898.

"What would you think of a loom that requires but half the labor, weaves more perfect cloth and will run over time without need for attention?

Would you buy it at a price that makes it the cheapest machine ever put in your mill, or would you wait, and doubt, and doubt and wait, until the competition of the enterprising forced you into line at the rear of the procession?"

"Adverse criticism has often killed a good idea in its infancy while its strength was not equal to the struggle. We escaped the fate which many prophesied."

"The only hope for our cotton mills in these critical times, lies in the prompt adoption of improved machinery. . . . . It may be urged that if all mills put in new machinery they will simply be back at the old competitive level—very true—but they WILL NOT ALL DO IT. Therein lies the chance for profit for those who have the necessary courage, capital, or happy combination of both."

"The doubters and the skeptics are not yet silenced—they never will be. Some of them still think it a great mistake for mills to use high speed spindles, filling frames and revolving flat cards. We have no time to waste on their conviction, as their species must yield to the natural law—the survival of the fittest."

1899.

"The mills that refuse their opportunities will find their future utility serving as picturesque ruins in the landscape."

"If old mills stand in timid dread on the brink of indecision the new mills will crowd them over the edge."

"You can feel assured that merit is recognized when the copyist appears—but you don't want a copy."

Owing to overwhelming orders our advertising department turned to other channels about this time, the loom business having grown beyond all expectations.

"Let us then renew the assurances of our distinguished consideration, while we devote our energies to filling the orders with which we have been favored."

"The cloth is as near perfect as can be. Weavers run, or attend, from 16 to 28 Northrop looms, and do not work any harder than I have seen them do on 8 common looms, and pretty near all the weavers here are what would be called new weavers; that is, having only from two to three years experience; and, in fact, the majority of them learned here."—[*Contributor to Wade's Fibre aud Fabric.*

INSTRUCTIONS FOR RUNNING NORTHROP LOOMS.

The experience that we have already had is by no means sufficient to settle all points of discussion absolutely. We have ourselves changed gauges at times and adopted new methods of dealing with the difficulties. There is nothing so new or intricate about our devices as to cause a panic among fixers. The fact that thousands are running should quell the temporary alarm with which many of them view the introduction. Incapacity always dreads change. Ability is glad of the chance to increase its scope.

No cause for alarm.

HOPPER (OR BATTERY) ADJUSTMENT.

In setting the battery, first see that the filling-fork works in the grate properly. Then place the *filling-motion finger* against the *filling-fork slide*, and the lever on the *starting-rod* at the battery side of the loom, to which the *starting-rod spring* is connected, can then be set so as to cause the *shuttle-feeler* to clear the shuttle when the lay comes forward. Then turn the loom and allow the filling-fork to engage with the *filling-motion hook*, which will cause the *starting-rod* to turn and bring the *shuttle-feeler* across the mouth of the shuttle box. The end of the *shuttle-feeler* should come very close to the back box-plate when the lay is all the way forward.

Shuttle feeler.

The position of the shuttle-feeler should be 3 15-16 inches from the hopper surface against which the butt of the bobbin is pressed to the inner face of the feeler. On cop looms it should be 3 13-16 inches. To see if it works properly, pull the shuttle far enough out of the box so that the feeler will strike it; this should cause the *latch-finger* to clear the *bunter* as the lay comes forward and the *shuttle-feeler* contacts with the tip of the shuttle. To see if the transferrer acts properly bring the lay forward with the shuttle in proper position, until the *bunter* contacts with the *latch-finger*, and as the *transferrer* inserts the fresh bobbin or cop, note

Transferrer.

how far it is pressed into the shuttle. Should it go too far down, the *latch-finger* must be set further back, by means of an adjusting screw at the rear. Should the bobbin or cop not go down far enough, the *latch-finger* must be set nearer the *bunter*. In setting the *transferrer* it should be regulated so that it will contact very lightly with the bobbin or cop which has been placed in the shuttle. when the *transferrer* is at the end of its downward stroke.

Transferrer fork.

The wrought iron part of the *transferrer* called the *transferrer-fork*, which helps to press the bobbin or cop into the shuttle, should be directly over the center of the shuttle opening, and if it is out of this position may be bent into place.

When the *shuttle-feeler* is in proper position and clears the shuttle tip, and the *latch finger* contacts properly with the *bunter*, bring the lay slowly forward by hand, and see that the *transferrer* places the bobbin or cop exactly in the center of the shuttle. If the shuttle should come too far forward or too far back, the proper position may be secured by turning the eccentric pin in the lay sword upon which the pitman works. If the pitman is too badly worn to allow of this adjustment, it should be replaced by a new one.

Pitman.

Picker wear.

If by reason of a badly worn picker the bobbin or cop is placed in the shuttle when it is too far into the shuttle-box, an additional piece of leather should be put on the lay-end to compensate for the wear on the picker.

Unless in case of breakage, some of the foregoing adjustments will remedy any trouble experienced with the proper working; but as a rule very little trouble is had with the battery and it requires scarcely any adjustment.

Gauging.

Our hoppers are guaged to set 1 5-8 inches above the lay at the left end, with the disc 2 inches above the lay. If the lay wears in its bearings sufficiently to fall away from these measurements materially the bearing should be set up.

Hopper spring.

The rotation of the hopper disc should always bring a bobbin into proper position. If not kept properly oiled there may be trouble in this direction. On the other hand, the hopper spring is often set too strong, so as to bring the bobbin into place with a violent shock, in case there is a gap, often resulting in actually breaking the wood. Weavers should not allow these gaps to occur often, and it is perfectly easy for them to turn the hopper back and fill it properly without leaving these spaces.

SHUTTLES.

The Northrop shuttle differs from other shuttles in that it is self-threading, and does not have a spindle to hold the bobbin in place.

Shuttle eye. The eye of the latest Northrop shuttle is so constructed that it will thread from bobbins or cops wound either right or left hand, and with fine or coarse filling. The end of the filling is held by the stud on the hopper, and as the bobbin or cop is transferred to the shuttle and the shuttle picked to the other side of the loom, the motion of the shuttle draws the thread into the slot and under the horn; as it is picked back again the thread moves down into the eye in the side of the shuttle, and the operation of threading is completed.

Our shuttle eye is designed to prevent the filling from throwing forward and escaping from the slot or horn, and this occurs very rarely. It is imbedded in the wood and finished smoothly, so that there is no chance for its catching either the filling or warp threads.

Spring. In the end of the shuttle opposite the eye is the shuttle-spring. This spring has notches in each side, into which the rings on the bobbins or cops are forced by the transferrer, holding the bobbin or cop in place.

To prevent breakage, in case the shuttle should go too far into the box to receive the bobbin or cop properly, a piece of steel inclined at one end has been inserted over the back part of the shuttle spring. As the bobbin is driven into the shuttle it strikes this inclined slide and is pushed ahead into the notches in the spring.

Incline.

Cop shelf. A different shuttle is provided for cops than for bobbins, a cop shuttle having a shelf under the tip of the cop-skewer.

If the horn of the shuttle-eye should get jammed, closing the entrance, it can be opened by a knife-blade or other tool similar to that; but care should be taken not to open it too wide.

Clogging. In case the shuttle-eye should become clogged with cotton or lint, it should be cleaned out. This is one of the causes for the filling breaking, though such trouble is rare.

A small piece of flannel is placed at the throat of the shuttle, for a friction, which can be easily renewed at any time. In this connection, when using coarse filling it may be found necessary to prevent it from unwinding too freely. In such cases we find that bunches of slasher-waste or bristles inserted through holes in the side of the shuttle are effective in preventing the trouble. These must be put in by the loom-fixers, as on account of the difference in conditions it is impossible for us to send them out made in this way. Friction.

If the shuttle-spring or slide get loose they should be tightened up by means of the screws. Care should be taken on this point, as shuttles should not be run with loose springs. Loose springs.

In case of the filling cutting, it may be found that the wood near the shuttle-eye has become rough, which may be remedied by smoothing with fine sand paper or emery cloth. Any small slivers or sharp edges should also be removed by the same means.

If warp threads should be broken out by the shuttle, it may be due to the shuttle tips being blunt or rough, in which case the trouble may be remedied by polishing and smoothing them with emery cloth.

SHUTTLE BREAKAGE.

Outside of the usual splintering and slivering, generally caused by unfit wood, the actual breakage of shuttles on Northrop Looms is probably due to the following causes:

The shuttle may get pinched between the temple and the reed in case the protector fails to act. This is evidence that the fixer is not following up his work, for the protector should be carefully watched. Accidents.

Another trouble is caused by the shuttle being pinched by the binder when the protector dagger engages the frog, for the engagement actually brings more pressure on the binder at this time. We have remedied this feature by a new design of frog on our later looms. Protector pressure.

Our shuttles are necessarily somewhat weakened by the necessity of allowing space for the spent bobbin to be expelled. The opening of the springs may possibly cause the shuttles to split, if the rings on the bobbin do not at once slip into the notches, but get wedged between the grooves. We now grind the ends of these springs so as to limit the chances of their engaging the sides of the wood. Thin sides.

Bobbin catching.

Another cause is the catching of the bobbins, due to the hopper action being defective for some reason or other. In spite of all these chances our shuttles wear very well, considering, and as we furnish all the shuttles used on our looms, we know absolutely what the amount of wear actually must be, and should assume that the average life of our shuttles was over rather than under six months. We believe that certain improvements recently adopted will increase this life on the looms we shall build for the future. Of course it must be remembered that our loom runs one shuttle continuously and should therefore wear a shuttle out in half the time taken by a common loom which uses two shuttles alternately.

Average life.

SHUTTLE WOOD.

Poor stock.

Shuttle wood is liable to curious variations, both from natural and artificial causes. Sometimes the stock is too severely kiln-dried, taking all the life out of the wood so that it breaks like sealing wax. Sometimes shuttles are put through processes (some of which we have tried) in which the wood is treated to a boiling solution of wax or oil. This is liable to injure the stock, although it may improve the surface smoothness.

Hot processes.

SHUTTLE DESIGN.

The shape of the shuttle blanks, the distribution of their weight, and the position of the points, all have a material effect on the direction of motion. Some shuttles made for front binder looms have a longer back, so that the pressure of the binder in its last contact shall not change the direction. We make our blanks, of the smaller pattern, with the back side as long as possible and raise it to conform with the slant of the upper shed.

Variations in shape.

Balance.

Shuttles should balance as nearly as possible on the line bisecting the length, and their points should also be on a line which will pass through the center of gravity.

Conditions of motion.

The problem of a shuttle's flight is one involving so many elements that it is safer to experiment than to theorize. A shuttle in operation continuously varies in weight from the diminishing of its yarn, and it is pulled from its normal position by the side-drag of the yarn, whose tension also varies in proportion to the amount of filling on the carrier from which it is unwound.

MISTHREADING.

We use this term to illustrate the failure of the shuttle to thread itself properly when the new filling is inserted and the shuttle first thrown across the lay. The thread being held by a stud on the hopper, the motion of the shuttle is supposed to draw it under the horn of the shuttle, so that on its return it will slide down into the eye. Normally, this action must always take place. There are, however, unfavorable conditions which will prevent proper threading. If the shuttle is picked too hard it is very possible that the shock when received in the opposite box will cause the filling to throw forward in such manner as to escape from the horn. In this event it will break when the shuttle is thrown back. It is also possible that a hard pick will throw the shuttle with such a jerk that the thread will be broken and snapped before it has a chance to thread up. This does not usually happen unless the filling is weak or slack twisted. Of course the shuttle-eye may sometimes get jammed so as to close the slot. It may also get choked by a bunch of lint in such manner that the thread cannot enter. The thread will then raise the fork all right, but break on the return passage of the shuttle. When this happens the shuttle will continue changing filling, making a curious looking defect in the cloth, as it will lay threads going from the hopper and lay none on the return. In two-shade goods this places several threads in one shed. The usual misthreading detector on the fork will not stop the loom in this instance, as on the first throw of the shuttle, the thread will pull off over the top of the shuttle on its first passage and raise the fork.

Errors in threading.

Hard pick.

Closed entrance.

Misthread stop-motion.

A large number of our earlier looms are fitted so as to stop on one misthread, later looms allowing two misthreads before a stop. It has been possible, however, for the weaver or the fixer to intentionally disarrange this device to prevent stopping of the loom, so that any accident like closing the shuttle entrance or exhausting the hopper would make a bad thin place in the cloth. Such a fault is inexcusable, and if detected in the cloth room by the appearance of the goods, should instantly be remedied.

When the loom stops otherwise than from warp breakage or from the detector, it is not necessarily a sign of a misthread, as the shuttle-positioning device may be responsible. This latter mechanism is designed to prevent transferring a bobbin should the shuttle be out of position. It is evident that if the hopper is thus prevented from action, the filling fork will operate as if a misthread had taken place, for the shuttle will be returned without laying yarn, and thus not raise the fork. If the filling has been exhausted, this action will be evidenced by the presence of an empty bobbin in the shuttle, though such an empty bobbin is not the only evidence of such action, as the filling might have broken before exhaustion.

Shuttle positioner effect.

As the thread attached to the hopper stud must necessarily lie above the shuttle, it is evident that in order to thread the shuttle properly the bobbin should lie as near in line with the direction of this thread as possible. For this reason the shuttle springs are canted slightly, raising the point of the bobbin above the horizontal line. Some customers have noticed this point and thought it was an error in construction. Of course there is a limit, as it will not do to allow the yarn on a full bobbin to project above the top of the shuttle, so as to contact with the warp threads.

Raised bobbin point.

Men in the mills, having inventive capacity, often attempt to improve on our shuttle eye, claiming they have made sample shuttles which will be better than ours in practice. While we by no means assume that our eye is perfect, it is well to consider the various factors which are combined in the present device. An eye for the Northrop shuttle must be constructed to thread easily with fine or coarse filling, should be adapted to thread from cops or bobbins wound from left to right as well as from right to left, should be so shaped as to prevent the filling from throwing ahead and getting out of the slot, must provide for the easy passage of bunches, must give a proper friction, should be so shaped as not to necessitate weakening the wood materially, and should have sufficient weight to properly balance the metal parts at the other end. For easy manufacture it should be adapted to easy moulding and machine work. It must also be inserted into the wood so as to leave no chance for the thread to catch whether it be warp or filling.

Attempts at improvement.

We have shuttles in our collection that possibly are better than our present form in several of these various particulars, but the total efficiency must of course remain the end in view.

Failure to thread the shuttle is not evidence of imperfect design of apparatus, but rather of imperfect adjustment of other parts of the loom. As far back as 1894 we made tests on looms which would transfer over 1000 bobbins without a misthread. Since then we have improved our shuttle so that it will accommodate more varying conditions. We believe the set of the pick has more to do with this than anything else, and recommend a light, easy pick with moderate pressure in the shuttle box.

Former records.

We learned years ago that the amount of misthreading was somewhat affected by the amount of moisture in the weave room. Yarn is strengthened by moisture, and strong yarn will naturally break less under strain, whether it is filling or warp. We noticed this more when our shuttles were less perfect than now.

Moisture.

BREAKING OF FILLING.

Every break of the filling causes extra labor, as the weaver must put a bobbin in the hopper twice, or even oftener, in order to have its supply fully woven off. Normally there should be no difficulty with well spun yarns. If the pick is hard, however, the jerk may not only break the filling, but cause it to throw out of the shuttle and catch on other adjacent parts, and thereby make breakage. The interior design of the shuttle has more or less of an effect on this result, for if the yarn may not wind off freely it may wrap around the point of the bobbin or cop skewer and break while weaving. With our earlier shuttle we expected a break on No. 36 filling of at least one in ten in the shuttle, whereas we do not now expect more than one in twenty or thirty. It is easy to note the amounts of such breaks by casually glancing at the hoppers throughout the weave room, the presence of partly filled bobbins being direct evidence of filling breakage.

Breaks of yarn in the shuttle.

The filling sometimes catches on the picker and breaks, if there is any rough place or crack to detain it. Of course the filling is not in contact with the picker or picker-stick normally, but when the shuttle stops in the box the yarn is often thrown ahead out of the shuttle by the reaction. When the shuttle is next thrown through the warp it takes up this amount

Filling catching.

of slack. The thread can, of course, catch on any other part of the shuttle box in the same way, if there is a crack, projection or corner to detain it.

Cop breakage. With cop filling there is often breakage while running in the shuttle, due to the filling catching in the slot of the cop skewer. This is sometimes remedied by forcing a small piece of leather into the slot, though care in manufacture should obviate the trouble in advance by smoothing its edges. The greatest difficulty with this yarn, of course, comes from split cops which occur from shock in the shuttle-box or poor design of spindle or skewer.

BOBBINS.

Material. We are advised by competent authority that the best material for filling bobbins is silver birch, or under another name, second growth yellow birch. Of course if everyone demanded this material it is doubtful if the supply would hold out. We have tested a great many varieties of birch and maple, and find that certain woods are liable to vary so much that one cannot depend upon them; that is, we would get a splendid lot of bobbins at one time and a very inferior lot at another.

Contour. On bobbins for coarse filling it is desirable to have coarser steps on the cone. We use 12 instead of the 14 on our regular bobbin. Also, for coarse filling, we find it more desirable to use notches on the barrel instead of ribs.

Rings. The split rings applied to the base of the bobbin are necessarily somewhat eliptical. In order to obviate any trouble from this source the two rings are so applied to the bobbin that the slots will not be opposite or together; thus one ring will offset the other more or less.

These rings on our filling bobbins are gauged within narrow limits, but it is evident that the wood will change more or less, either contracting or expanding them. We believe we allow ample leeway in our shuttle springs to meet the varying conditions.

Reaming. Bobbins often swell when filling is dampened, so that they will not fit the spindles. This necessitates reaming, and if the reaming is done while the bobbins are wet, enough wood will be removed so as to materially weaken the shell.

Among the peculiarities of bobbin wood, we find that the dark wood bobbins break with greater frequency. The dark wood is supposed to come from the heart of the tree.

Cone step. It will be noticed that our filling bobbins have a peculiar step at the base of the cone slightly larger in diameter than the barrel. This is designed for convenience in pulling off the unwoven filling, and the idea is protected by a patent which we control.

Doffing. We have found that it is necessary to take pains in doffing with Northrop bobbins. We prefer the manner of doffing in which the bobbin is simply dropped over the thread, rather than the process in which a preliminary wind is given by a quick hand movement. We believe the latter method causes bunches at the last end of the filling. With this custom it is also possible that the yarn may catch in the rings at the lower end of the bobbin and be broken during the doff.

Dimensions. The size of the barrel on filling bobbins is of considerable importance, as a small barrel increases the strain of spinning and a large barrel may cause the thread to break in weaving off. We have been to both extremes and think we have hit on the proper pattern for the various yarns woven in our loom.

Enamel. In order to avoid trouble with bobbins warping and shrinking, or swelling, it has been customary in certain cases to enamel them. We have tried the experiment on our looms and find that enamelling is not adapted to our purposes, as the rough treatment that our bobbin goes through in being transferred through the shuttle is certain to damage the finish, and enamelling takes the life out of the wood so as to cause it to split and crush in an objectionable manner.

Oil-filling. Where excessive trouble is experienced with bobbins warping, owing to the manner of moistening the filling, we advise that they should be filled with linseed oil, two coats of shellac being applied after they are thoroughly dry.

Spinning filling. In considering the spinning of filling for Northrop Looms, see that the spindles are well oiled, do not bind, and are free enough to run without vibration.

Fit. The next most important thing is to have good, true bobbins, so they will grasp the sleeve from one-half to five-eighths of an inch, entering the cup (if there is one on the spindle) about an eighth of an inch, and have about 1-120 of an inch space on each side of the spindle at the top bearing, which should be at least 3-4 of an inch in length. Even then, after having been in use in the weave room for a year or more, where they wet them, it will be necessary to ream them. The cup is not so necessary with our filling bobbins where there are one or more steel rings on the lower end of the bobbin that will prevent splitting.

Reamers.

When bobbins are reamed, the reamer should be watched. Not over 500 bobbins should be reamed without testing them to see if they fit properly. To ascertain this, drop the bobbin on the spindle, hold the spindle in the right hand, take hold of the bobbin near the top with the left hand and move it back and forth. If there is a little play at the upper bearing the right fit is being obtained, but if there is no play and the bobbin fits tightly on the spindle, it is evident that the reamer needs spreading.

To spread and sharpen a reamer, the temper must be drawn, the reamer placed in a vise, and the part that reams slightly spread with a light hammer and a tool made for that purpose. Of course the reamer must be re-tempered after getting the proper size. Any good mechanic can change the reamer to the proper size.

Every mill that has 10,000 filling bobbins, should have six top reamers and two "pod" reamers. A "pod" reamer is supposed to ream both the upper and lower bearings; but as the top bearing gives a great deal more trouble than the lower bearing, it is well to have a surplus of reamers. These reamers are not at all costly.

A reamer should run at least 2000 revolutions a minute—2500 would be better. A good, intelligent young man should ream from 7000 to 10,000 bobbins a day.

Every mill should have at least 20 bobbins to a spindle for each number of yarn used. A sufficient quantity of bobbins is a necessity and a good supply should always be kept on hand.

Wind.

A proper wind of filling is important in connection with proper weaving-off in the shuttle. We have found it advisable in certain cases to recommend changes in spinning filling in certain mills. We have found good results on No. 36 yarn from winding the filling with the rail going down quick and up slow; that is, in the proportion of 17 turns on the up-wind and 6 turns on the down-wind. This was on a traverse of 1 1-2 inches. With coarser yarn, No. 22 for instance, we should recommend a traverse of 1 3-4 inches.

COP LOOMS.

In weaving with cop filling, certain refinements are necessary. The cop is held on its skewer by friction, and the shock of the sudden stopping of the shuttle very often causes it to break, thereby making a serious amount of waste. It is therefore necessary to set the pick with more care than on bobbin looms. A long shuttle box is designed to aid in slowing the shuttle more gradually, and we have lengthened our lay three inches since our first pattern of loom was made. Cops.

Once in awhile we hear of cop skewers getting bent, during the transfer. If the skewer is actually caught in the shuttle, it should be examined to see if it is concentric with the base. Of course the skewer strikes the bottom of a box something of a blow, and we recommend that the cop tubes which are removed from the skewers be dropped into the box, making a cushion for the dropped skewers. Bent skewers.

One great trouble in weaving from cops is the liability of the filling knocking off. This may be due to an improper design of skewer, but if the loom itself is plainly causing the trouble, the power should be reduced, the check examined or the box tightened. The difficulty may possibly come from the spinning room, where the yarn should have been wound tighter. Splitting.

The shape of the cop skewer has a vital effect on the amount of cop waste. It will not do to assume that because a mule spindle is of a certain shape that the shuttle spindle can be designed from it, as some cops are very soft and some very hard, owing to the kind of yarn spun; some are twisted harder than others, some yarn would be coarse and others fine on the same spindle, and some would be wound tighter than others. The only way to get a proper fit is from sample cops. The skewer must also be tempered properly, so as to make it hold its shape and stay open. The mill management should never allow the weavers to pry the spindles open with a screw-driver or other tool, for if the skewers are not of the proper shape they should be replaced. It does not do to spread the skewers excessively, for they are very liable to break. It is better to make them of slightly larger diameter, if a moderate spread is found insufficient. We are informed by a shuttle maker that one customer has ordered nearly 200 different styles of skewers for his various work. We do not make our skewers, but order them outside from a competent, experienced builder, Shape of skewers. Spreading.

Samples.

getting sample cops from our customers to be fitted. If the mill steams its filling it must be careful to send sample cops after steaming—that is, in the condition in which they will be used.

WARP-STOP MOTIONS—STEEL HARNESS.

Steel heddles.

In the steel harness warp-stop motion, the heddles themselves are used to detect breaks in the warp threads and stop the loom.

Construction.

The heddles of the steel harness are suspended by the *heddle-bars*, which pass through the slots in the upper part of the heddles, the warp threads being drawn through the *eyes*, just below the slots. Between the harnesses, and bolted to the sides of the loom, is a long flat casting, called the *stop-motion girt*. This *girt* serves two purposes: to separate the harnesses and hold them in position, and to resist the action of the *feeler-bar* should a heddle drop down and be caught between it and the *girt*.

Warp stop details.

Upon the harness-cam shaft there is a cam upon which a follower works, which, through a small connecting rod, operates the *feeler-bars*. This cam-follower is held against the cam by means of a small coil spring. Beside this cam, and forming a part of the same casting, are two projections. Normally these projections just clear a small casting fastened to the same stud, or shaft, holding the cam-follower. When a heddle drops, the *feeler bar* strikes it, the cam-follower is thus prevented from following the cam, and the small casting on the shaft with the cam-follower is moved out of its normal position in such a way as to be struck by one of the projections beside the cam, thus moving the whole link on which the cam-follower and the small casting (called the *knock-off*) are fastened. This motion of the *link* is communicated to the shipper-handle, throwing off the belt.

But when a heddle does not drop, the *feeler bars* oscillate back and forth, the cam-follower follows the cam, and the *knock-off* is held out of the way of the projections, or lugs, on the hub of the oscillator-cam, and the loom continues running.

Adjustments.

In setting the steel harness stop-motion the first thing to do is to either throw off the belt, or remove the key which holds the end of the shipper-lever in the shipper-handle (in our later looms), and place the shipper-handle in the notch in the shipper-lock; this will bring the stop-motion into the same position as when the loom is running. Then turn the loom until the *feeler-bars* are in their extreme forward position under the *girt*. The *knock-off link* should be against its bearing in the hub of the cam, and the cam-follower should bear against the cam in its lowest place. The small casting on the same stud as the cam-follower, called the *knock-off*, should be so set that it will just clear the projections on the hub of the cam as the cam revolves on the cam-shaft.

The cam follower is held in position by a spring on the stud to which it is fastened; if it does not follow the cam as quickly as it should, tighten this spring. Care should be taken, however, not to have too much tension on this spring, but just enough to make the cam-follower work properly; otherwise the heddle would be bent by the force of the blow. The motion of this cam-follower is communicated to the *feeler-bar shaft* by means of a connecting rod, the length of which may be varied at will by turning to the right or left.

On each side of the *stop-motion girt*, under the warp and just touching it, are the *front rod* and *back rods*, which hold the heddles in place, so they will drop into position to be caught by the *feeler-bar* if a thread breaks. These rods also hold up slack threads which otherwise might allow the heddles to drop low enough to stop the loom.

Small castings called *heddle-bar collars* are placed on the heddle bars to keep the heddles in line with the yarn. There are also guides at each end of the stop-motion girt to keep the bottom parts of the heddles in line.

Shedding.

The harnesses are leveled up at the various positions of the crank: on underthrow looms from the bottom center to the front center, and on overthrow looms from the top center to the front center, according to the class of goods to be woven.

The harnesses are connected to what are termed *harness rolls* at the top of the loom. Care should be used to have the back harness connected to the largest roll, and the front harness to the smallest roll, in order to work in harmony with the harness cams. In some cases the opposite to this has been done, interfering with the proper working of the loom.

The front heddle bars are smaller than the back, and must be set in their proper position.

The front and back rods should be set just high enough to touch the yarn when the yarn is in its proper position on the race plate.

If the shade should be too high above the race-plate it can be lowered by turning down the set screws in the castings at each side of the loom upon which the harness-roll rests, and then tightening the connections between the harness-yoke and treadles by raising the cap with the spring on top and turning it. If the shade should be too low, loosen the connection between the harness-yoke and treadles and raise the castings. The shade should just clear the race plate. A great advantage with the steel harness is, that after the shade is once set, it requires very little or no attention, and new warps can be put in without altering the shade, and more quickly than with any other harness made. In putting in a warp, however, it is possible to get it tangled up; but this can be avoided by a little care and common sense on the part of the operative. After the warp is once placed in the loom there is no danger of tangling.

The bottom connection of the front harness should be placed in the second notch in the treadle and the back one in the fourth notch.

The heddle-bars must be straight. No oil should be put on the heddles or heddle bars.

Extra heddles. It sometimes becomes necessary to apply a heddle to a harness bar after the warp has been drawn in, and this is usually done by breaking open the eye and slipping it on. While this is all right as a temporary expedient, it is well to go over the harnesses and remove such heddles at times, as they are liable to catch and interfere, preventing the action of the warp stop-motion.

Magnetization. One of the most annoying troubles formerly experienced with our steel harness looms was their liability to becoming magnetized, thereby sticking together and making poor sheds. Some slight changes in construction have seemed to overcome this difficulty, as we hear very little from it except on some of our earlier looms. It is perfectly easy to remove this magnetization by holding the heddles in an electrical coil and we have demagnetized several lots for our customers.

Damaged ends. Sometimes the lower ends of the heddles are seriously bent or twisted by the action of the vibrator. This is either due to poor adjustment, which brings a too severe strain, or is sometimes caused by improper setting of the knock-off so that a dropped heddle receives several hundred or thousand blows, as the loom does not stop. The same trouble naturally occurs with detector wires as well.

Like every other mechanism that contacts with a cotton thread, the heddle is smoothed by use in a way which no previous mechanical method can attempt to duplicate. Our steel heddles will therefore work much better after a few weeks use, and cause much less warp breakage, than when on their first warp. We polish the eyes in the best manner known —in fact we use especially invented processes; but the rubbing contact of the cotton thread gives the final finish to the surface. It is impossible for this wear to ever make a sharp edge, as the thread turns its corner in such a way as to continually round the edge. Heddle eyes.

So far as our experience goes we see no reason why steel heddles should not last indefinitely. We have had sets running at least five years that are better than when made. Of course they may get bent or damaged by carelessness, but there is nothing in the normal operation to injure them. Wear.

In our great variety of experiments with various designs of steel harnesses, we have arrived at the conclusion that in order to secure the best results the heddles must be left with absolute freedom to adjust themselves to conditions. Every experiment designed to limit the position of the heddle in any way, for any purpose, has always resulted in excessive warp breakage. With certain weaves it has been noticed that the heddles will not act uniformly. the strain of the shed causing them to sway or bend to excess. Where this becomes serious we have found it advisable to simply use the cotton harness, accepting the limitations as final. Free spacing. Limits of use.

REGULAR COTTON HARNESS STOP-MOTION.

This operates on the same principle as the steel harness stop-motion, except that drop-wires are used as detectors in connection with the ordinary twine or cotton harness, instead of the heddles of the steel harness. This stop-motion may be used for from two to five-harness work inclusive; two or more threads being drawn in one drop-wire. The threads in this stop-motion are drawn through slots in the drop-wires, instead of through an eye, in addition to being drawn through the regular twine harnesses. Separate detectors.

The drop wires, or detectors, are flat pieces of steel, with two slots in each, the *drop-wire bars* passing through the upper, and the warp threads being drawn through the lower, slot. The warp threads must be drawn through the detectors so that the threads will always hold them up out of the way of the *feeler-bar* when the shade is wide open and no threads broken. On two-harness work two threads are drawn in a drop-wire, and as long as the yarn is not broken, one of the harnesses will hold up the drop-wire; but should a thread break, the detector will drop down, be caught between the *feeler-bar* and girt, and through the connections with the shipper handle stop the loom.

Construction. The *girt* is similar to that used with the steel harness, and extends across the loom about two inches back of the back harness, and just below the warp. The *feeler-shaft* to which is attached the *feeler-bar* works in bearings or brackets fastened to the girt. The *drop-wire bar* is also attached to the girt.

The *back rod* or *warp-support* is also used with this stop-motion. As with the steel harness, this is designed principally to prevent the stopping of the loom should there be any slack threads, but it also serves to keep the drop-wires in place close to the girt.

Adjustments. In setting this stop-motion, either throw off the belt or remove the key which holds the end of the shipper-lever in the shipper-handle, placing the shipper-handle in the notch in the shipper-lock, which will bring the stop-motion into the same position as when the loom is running.

The cam on this stop-motion is very similar to that used with the steel harness stop-motion. One difference, however, is that it meshes into the harness cam when the harness cams are on the cam-shaft; but if the harness cams are on the auxiliary shaft the *oscillator-cam* is fastened to the cam-shaft by a set screw. The position of the *oscillator-cam* is governed entirely by the harness cams and should work in conjunction with them. When this cam is meshed with the harness-cams it must of course move with them; but when the harness-cams are on the auxiliary shaft, care must be used to run the *oscillator-cam* in the right position. In this case, when the harnesses are level or passing each other, the *oscillator-cam* should be so set that the long axis of the cam is horizontally level, or in other words, that the faces of the cam point directly to the front and back of the loom on a horizontal line with the floor. The cam-follower should just begin to rest on the face of the cam, the *feeler-bar* should be in its extreme forward position under the girt, and the *knock-off link* should contact with its bearing on the hub of the cam.

When the harness-cams are on the cam-shaft this stop-motion should be set as described in the steel harness stop-motion.

The *stop-motion girt* can be raised or lowered, and should be set in position for the *feeler-bar* to clear the drop wires when the shade is wide open and no warp threads broken. It should also be set high enough so that when the shade is wide open, it will not pull the drop-wires up to their full limit on the *drop-wire bar*. This girt can also be adjusted backward or forward so as to give room for additional harnesses.

The *feeler-bar* consists of a piece of sheet steel bent at right angles, with teeth in the edge nearest the girt, and when it has reached the end of its forward movement should pass under the girt, close to it.

SINGLE THREAD STOP-MOTION.

While the principle of operation with this stop-motion is practically the same as with the others, it differs from the regular string harness stop-motion in that only one thread is drawn through each drop-wire, instead of two or more; hence its name. Single thread detector.

This stop-motion can be used with any number of harnesses, or with Jacquard looms. The drop-wires are placed in position at the point usually occupied by the lease-rods, doing away with their use. Leasing.

This stop-motion has two or three banks of drop-wires, as required, suspended by *drop-wire bars* passing through slots in the upper parts of the drop-wires as usual. The drop-wires have a separate eye through which to draw the yarn. The *drop-wire bars* are fastened to the *box-plate ends*. Construction.

Taking the place of the girt in this stop-motion we have the *front and back box-plates*, two flat pieces of iron extending across the loom and fastened to the *box-plate ends*, which are bolted to upright pieces attached to the loom sides.

The *feeler-bar* used in this stop-motion is a flat piece of sheet steel with notched edges, placed directly under the center of the space between the *box-plates*, oscillating backward and forward. If a thread breaks and the detector drops down, the feeler bar will engage with and press it against the front or back box plate, as the case may be, stopping the loom.

To prevent the detectors from slipping to one side or the other when engaged by the feeler-bar, or from being subjected to a twisting strain and probable consequent damage to the drop-wire, a piece of steel with a serrated edge is placed on the under edge of each box-plate, so as to contact with the dropped detector.

The top edges of the box-plates are rounded and take the places of the warp-support rods in the other stop-motions.

The feeler-bar is operated by means of two connecting rods between the cam and *feeler shaft*. The cam differs from those on the other stop-motions in that it is a single cam, though it has two *knock-offs*. The connections from the cam to the shipper-handle operate the same as on the other stop-motions.

Adjustments.

In setting this stop-motion, first throw off the belt, or remove the key which holds the end of the shipper-lever in the shipper-handle, and place the handle in its notch in the shipper-lock, bringing the stop-motion into its position when the loom is running.

The *knock-off link*—the long casting which forms one of the connections with the shipper-handle—should be set against its bearing in the cam-hub, so as to have no back-lash, which might prevent the mechanism from working properly when a detector drops down. Then place the feeler-bar in the center below the box-plates and adjust the two small castings on the feeler-bar shaft, called the *tight and loose oscillator-fingers*. These should be set to project or hang evenly on each side of the shaft. On underthrow looms they will come about horizontal with the feeler-bar, projecting straight out from each side of the shaft; on overthrow looms they should hang at an angle on each side of the shaft.

Now loosen the set screw which holds the stop-motion cam on the cam-shaft and set the *tight knock-off* (a small casting fastened to the stud in the knock-off link by a set screw) so that it will clear the point on the cam-hub from a sixteenth to an eighth of an inch. Turn the cam until the cam-follower rests on the lowest point of the cam, and the feeler-bar is near the back box-plate. Then connect the *loose oscillator finger* with the cam-follower by the connecting rod, and adjust the rod so that as the cam revolves, the feeler-bar will be moved from side to side equally. When this has been done, connect the *tight oscillator-finger* with the *loose knock-off* by the connecting rod, and adjust the rod so that the knock-off will clear the point on the cam-hub as the cam revolves.

If when these connections and adjustments are made, the feeler-bar should not move an equal distance each side of the shaft, the trouble may be overcome by further adjusting the connecting rods, or perhaps by slightly changing the position of both oscillator fingers.

The spring on the stud which carries the knock-off and cam-follower should be set just tight enough so that the cam-follower will follow the cam properly. The tension of the spring on the *loose oscillator-finger* on the feeler-bar shaft should be so regulated that it will hold the two fingers together on the shaft.

Slack warp.

Slack threads often cause trouble by letting warp detectors, of any pattern, drop low enough to engage the vibrator and stop the loom, causing a serious annoyance to the weaver, who may hunt a long time for the supposedly broken thread. Sometimes the trouble is due to the whole warp being woven too slackly by improper tension of the let-off, but the greater difficulty is from individual threads. We have tried to arrange sufficient leeway to overcome this trouble, but if it is found serious, the mill should give more attention to its warping and slashing. Sometimes the relative position of the girt with relation to the whip-roll is the source of the trouble.

On some peculiar fancy weaves, where many harnesses are employed, several of the threads will remain necessarily slack all the time. If there are but a few of these threads, it is easy to obviate any trouble by letting them run without detectors, as they are not liable to break in any event, on account of their slackness. If there is a great number of such threads in the pattern it may be advisable to run them on a separate warp beam.

In 1897 a mill using both our cotton harness and steel harness devices figured some interesting totals which we give as follows:

Repairs.

	Steel Harness.	Cotton Harness.
Cost for repairs per year including stop-motion parts,	\$.604	\$1.005
Cost of drawing in warp, ...	.165	.245
	\$.769	\$1.250
		.769
Total saving for steel harness, ... or interest at five per cent. on \$9.62.		\$.481

With our present construction the repairs on the steel harness, including stop-motion parts, is even less than by the above showing.

The above figures are also considerably in favor of the cotton harness, as they had not run long enough to show as large a bill for replacement as they would show later.

WARP BREAKAGE.

Tests of warp breakage.

Ever since our experience with Northrop looms we have continually run large numbers at our works with careful supervision and inspection of product, and we believe that we have had more actual tests made of various weaving conditions than have been collected by all other experimenters on looms in all time. Some of the results are curious, showing how impossible it is to draw distinct conclusions from tests on so variable a material as cotton fibre. This is quite evident in the warp breakage as shown in tests. For instance, for several years it ran as follows on our single steel harness looms: 1893, 24 warp breaks per cut; 1894, 22; 1895, 22; 1896, 15; 1897, 12; 1898, 24; 1899, 22. As we cannot trace any reason for many of these changes, we believe they are probably due to the quality of the cotton as much as anything else. For instance, it is well known that the cotton used during 1896 and 1897 was considered remarkably good. Take note that in this last year of 1899 as before mentioned we have reduced breakage by our DOUBLE steel harness to an average of 11.

Certain adjustments and designs that favor warp breakage involve other defects. There would be less breakage if harness cams were made round, and on light narrow goods this shape can be approached. The usual cam, however, must be designed to keep the sheds open so as to give ample time for the shuttle to pass through without striking the selvages, and without allowing the sheds to close on it.

KNOTS.

With the Northrop loom the weaver's labor is practically reduced to filling the hoppers and piecing-in warp. At least two-thirds of the warp breakage comes from the knots which catch between the heddles, fray other adjoining threads, or are caught in the reed. The number of knots is reduced by spooling from large warp bobbins, and by making good yarn, which will have few piecings to cause breakage at the spooler or warper. A certain number of knots is unavoidable, and a study of the kind of knot required then becomes advisable. There are various ways of uniting two ends of thread together, those used in the mill being commonly known as the *spooler knot* and the *weaver's knot*. The spooler knot is objectionable on account of its greater size, and also from the fact that the bunch is all on one side, thereby causing greater resistance in passing around a corner or by an obstruction. The spooler's knot will also have ends of varying length, while the weaver's knot necessarily has short ends by the manner of tying it. We have gone into this question scientifically, with careful measurements, and find that the weaver's knot is 170 per cent. larger than the thread of which it is made, and therefore nearly three times as likely to cause trouble. The spooler's knot is even worse, being about 260 per cent. larger than its thread, and, as before stated, this width is unevenly distributed. We believe that on the continent of Europe spooler tenders are forced to tie weaver's knots, and we know mills in this country having weaver's knots tied at the spooler, where, after learning, the girls have spooled as great a product as formerly. We have introduced many devices in the shape of knot tyers and end cutters, but our final conclusion is that the weaver's knot is the simpler and better way to avoid the difficulty.

Cause of breakage.

Size of knots.

HARNESS CAMS.

It is absolutely necessary for good shedding to have the treadle rolls in continuous contact with the cams. If there is too much angle on the cam point there naturally will be more tendency to throw.

Cam contact.

Harness cams should be set to start opening the sheds with the lay at the bottom center of the crank. If tight selvages are desired, the cams may be delayed a little, or conversely, for loose selvages, the lay may be pushed back a little. This applies to looms running in the usual American manner known as the *underthrow*. With an overthrow loom of course the setting would be directly opposite.

Shape of cams.

We decided in 1896 to use a 45-degree rest cam with print looms, and a 90-degree rest cam with 40-inch looms. (If read with relation to the upper shaft these same cams would be known as 90 and 180 degrees rest respectively.)

The shape of a harness cam is not settled by any definite, fixed rule. Different weavers have different ideas about the amount of rest and the amount of shade opening. We endeavor to suit our cams to the goods to be woven, but it is of course possible that in certain instances it would be well to carefully examine the operation. On looms of different widths the shed opening and time of opening, as affecting the shuttle, are relatively variable; for on a wide loom the shed might close on a shuttle, whereas the same harness cam would give plenty of time on a narrow loom.

SELVAGE.

Side threads.

Selvage threads are usually looser than the rest, often causing the edge of the cloth to crinkle, or be longer than the center. This is usually due to carelessness in setting the temples. If the temple is too far back, the yarn is drawn around it in such a way as to stretch the thread, as the width of the cloth in the reed is greater than in the woven piece. If the temple roll is not free, or runs hard for any cause, it will also stretch the threads in the same way. Also, if the yarn is not put on the yarn-beam properly—that is, if it is filled higher at the ends than in the center, it will stretch the yarn.

Twisted selvage.

It is evident that where double threads are used for the selvage, that if they are passed through one harness eye they cannot control the warp stop-motion unless both of them should break at once. Many mills use twisted selvage threads, which of course overcome this difficulty. As there is more strain on the selvage, the twisted threads would seem to have the advantage also of lessening breakage.

TEMPLES AND TEMPLE THREAD CUTTER.

On the battery end of the Northrop loom is placed what is called the temple thread-cutter, the thread-cutter being attached to the temple. When a fresh bobbin or cop is inserted in the shuttle, an end of filling extends from the selvage of the cloth to the stud on the hopper; this the thread-cutter severs and prevents from being drawn into the cloth, or leaving a long end of filling attached to it. **Thread-severing device.**

The blades of the cutter are kept up out of the way of the live filling until the lay comes forward and strikes the arm of the thread-cutter, which brings the blades down into position, drives them back and cuts the thread. Threads may stick out at the selvage, and yet not indicate that the thread-cutter is not working properly. These ends are found on all cloth, and are caused by the filling running out after the shuttle has left the cloth. As these ends hang loosely, the cutter will not always engage and cut them, as it was not designed for this purpose.

Adjustment. Apply the temples to the loom in the usual manner and in the usual position, placing the temple with the thread-cutter attached, on the battery side of the loom. The temples should be so set that when the lay is fully forward they should be about a sixteenth of an inch from the reed.

In case it becomes necessary to remove the cutter, it can be done by simply detaching the spring on the cutter-arm, pulling the cutter back towards the breast-beam, and at the same time raising the front of it as high as possible. It can be replaced without difficulty.

A strip of leather should be placed on the lay opposite the temple-heel and cutter-arm, to strike them when the lay comes forward. To insure the proper working of the thread-cutter, this leather strip should be long enough to strike both the temple-heel and cutter-arm.

FEELER FILLING-CHANGER.

Pick-finder. The object in placing the "*feeler*" mechanism on the loom is to match the pick and make perfect cloth.

The feeler proper is placed on the left-hand side of the loom, the hopper being on the right-hand side. The feeler consists of an arm working in a bushing attached to the shipper-lock. One end of this arm is curved so as to extend and pass through slots in the front box-plate and shuttle, contacting with the yarn on the bobbin or cop as the lay comes forward.

When the filling in the shuttle has nearly all been woven off, and no longer contacts with the end of the feeler-arm, the filling-changing mechanism (or battery) operates, and a fresh bobbin or cop is placed in the shuttle, to be in turn ejected when its filling is almost exhausted.

In case the filling breaks before it has been woven off sufficiently to operate the feeler mechanism, the loom simply stops, thus enabling the weaver to find and match the pick, or we can arrange the mechanism to supply fresh filling at such times.

Adjustments.

To set the feeler, place an empty bobbin or cop in the shuttle, bringing the lay to its extreme forward position; turn the adjusting screw in the feeler bushing until the end of the feeler is within about the thickness of the yarn from the bobbin or cop skewer. Then take several bobbins or skewers having a small quantity of yarn on them, place one of them in the shuttle and start the loom. If it is ejected before a sufficient amount of filling is woven off, the feeler should be set nearer; if the filling runs out entirely and the bobbin or cop is not ejected, the feeler should be moved back. Several trials may be necessary before the feeler is set.

The bolt which secures the feeler-bushing to the shipper-lock must of course be loosened before attempting to move the adjusting screw, and then tightened when the adjustment has been made.

The coil spring around the hub of the feeler regulates the pressure of the feeler on the filling in the shuttle. The tension of this spring should be as light as consistent with the proper action of the feeler, and at the same time not bring too much pressure on the filling, pushing the bobbin out of line.

The small casting on the upper end of the filling-cam follower, called the *filling-rocker trip*, is adjustable and should be so set that the *filling-rocker toe* (the small steel piece which engages with it and hangs from the filling-rocker) will just clear it when the cam-follower is furthest from the breast-beam. This casting should be set so that it will engage the rocker-toe by about an eighth of an inch when the cam-follower is drawn forward and the end of the feeler is under the rocker.

The cam follower should be set just high enough to properly reset the rocker (the casting from which is suspended the small steel piece called the filling-rocker-toe,) and allow the end of the feeler to come under the rocker.

From time to time the weaver should examine the point of the feeler-arm which enters the shuttle and contacts with the filling, and if it has become rough, should rub it with a little emery cloth; otherwise it is likely to wear the filling and break it.

The pitman should be examined from time to time, to see if there is any considerable lost motion in the movement of the lay, as this will affect the amount of waste.

Extra pains should be taken to see that the shuttle boxes are properly set on the feeler end, otherwise the feeler-arm will strike the shuttle itself instead of passing through the slot and feeling the filling.

If the small adjustable steel piece in the tip of the feeler becomes worn, it should be taken off and ground until sharp.

FEELER THREAD-CUTTER.

Auxiliary thread-cutter.

This thread-cutter, used on our feeler looms, is a device attached to a casting called the *shuttle-feeler*, which prevents a transfer of filling from the hopper to the shuttle if it is not far enough in the box to receive the bobbin or cop. If the shuttle is boxed properly, the thread-cutter performs its operation and cuts the thread.

When a transfer is called for by the feeler mechanism on the other end of the loom, this casting is thrown forward over the lay, and, assuming that the shuttle is in its proper position in the box, it cuts the thread near the nose of the shuttle and holds the end between the cloth and that point, drawing it back, as the transfer takes place, into a position where it is cut on the succeeding pick by the regular temple thread-cutter. Thus the thread is cut in two places: first, as close to the shuttle as possible, so that the end of thread on the bobbin to be ejected may be drawn out of the box; and second, it is cut close to the selvage so that the edge of the cloth is clean and no short ends are drawn in.

Different weights of filling may demand a higher or lower position of this thread-cutter as it passes over the lay. This position will be determined by a few trials. To place it in the position desired up or down, raise or lower the stand on the loom-side to which the whole device is fastened.

Never attempt to run a feeler with regular bobbins. (This has been done.)

If for any reason, the front box plate is readjusted, reset the feeler also.

INSTRUCTIONS FOR WINDING YARN ON FEELER BOBBINS.

Spinning feeler bunch.

In spinning filling yarn on feeler bobbins, it is intended that a preliminary bunch be formed around the base of the bobbin, about 2 1-8″ from the lower end, to delay action of the feeler and reduce waste.

We can send sample bobbins, having a band of color painted on the base to show the proper position.

The filling frame should be stopped to doff with the rail down in its customary position. The traverse should then be allowed to wind yarn for its first full upward movement, then down to the bottom, then up to the position at which the bunch is to be formed. The rail should be held at this point by any convenient clamp or hook, so that the filling will wind at one point until the rail comes down to it again, after which the usual traverse will continue. If ends are broken in doffing, there should be time to piece them up before the bunch is formed; if not, the spinner should wind on yarn by hand, if possible, to make a bunch at the proper point when piecing up, providing the bobbin is empty. In running the bobbins on a feeler loom, they may have no yarn left on them when ejected, without necessarily condemning the action of the feeler, as there may have been just enough yarn left to weave a full pick before a new bobbin is supplied. It is safer to set the feeler so that there will be a fair amount of yarn on ejected bobbins, so that there will be no chance of error from the filling weaving off entirely before the feeler acts. There are certain variations in the diameter of the bobbins, the eccentricities of the same, and the position in the shuttle, which have to be taken account of in adjusting the mechanism.

LET-OFF.

Let-off motions may be divided into two general classes: tension and friction. The tension device should let off a definite amount of warp at each stroke of the lay. The let-off motions that we use are so well known that it is not thought necessary to give any detailed description of their construction. Warp governing devices.

There is, however, one important point to which we desire to call particular attention, and that is that there should be plenty of delivery at the empty beam. The collar on the *trombone* which regulates the tension of the spring, should be moved back from time to time as the amount of warp on the beam diminishes, so that enough teeth of the ratchet are taken up each time to turn the beam sufficiently to deliver the same amount of warp throughout from the full to the empty beam. Generally speaking, the warp beam should turn about three times as fast at the empty as at the full beam and surely move at least one tooth of the ratchet at each motion of the lay.

Improper delivery of yarn will cause uneven strain on the cloth, make it vary in width and also cause increased warp breakage.

Sufficient friction should be put onto the *let-off wheel* to prevent it from running by the point where the pawl leaves it.

By the time this circular issues we shall very probably have perfected our new let-off, which needs no adjustment during the weaving out of a beam.

WARP BEAMS.

In order to save in waste and time, it is proper to put as much yarn on a beam as possible, although there is a certain limit, as an extreme diameter might cause too great difference in tension between the empty and full beam, and in weaving off too great a length the threads might get badly crossed up. We found a great saving in using 18-inch beams in preference to 16-inch, and think that size perfectly safe. Size of beams.

TAKE-UP.

The take-up motion now used on all styles of Northrop looms is what is called the *high-roll*. As the name implies, the take-up roll is placed high up, next to and inside the breast-beam. Cloth winding devices.

The take-up roll has at one end a gear wheel, which meshes with the *intermediate gear* which in turn meshes with the *change gear*; the change gear being driven by the *ratchet take-up wheel*, located about half way between the front girt and breast-beam. The ratchet-wheel is operated by the *take-up pawl*, which is attached to the lay-sword, and as the lay swings back takes up one tooth at every pick.

The ratchet-wheel is prevented from letting back by the *hold-back pawl* fastened to the cloth-roll stand. Inside of the hold-back pawl and on the same stud, is the *let-back pawl*. When the filling breaks, the hold-back pawl is lifted, allowing the let-back pawl to let back the ratchet wheel from one to three teeth, as the quality of the cloth may require, thus avoiding cracks or thin places.

The change gear is composed of two gears in one casting, one of which meshes into the intermediate gear, and the other into the gear on the hub of the ratchet wheel. This gear is held in place on a swinging or half circle stand. Each tooth on the large end of the change gear represents two picks. For instance, for 64 picks use a 32-tooth change gear; for 100 picks use a 50-tooth change gear, etc.

After leaving the take-up roll, the cloth is wound on a smooth iron roll called the *cloth-roll*, held in place against the take-up roll by the *cloth-roll racks*. These racks have teeth which mesh into gears at each end of the *spring-shaft*. On this shaft is a coil spring which is operated by a gear and worm-wheel attached to the front girt. Attached to the worm-wheel is a handle, by turning which the spring may be tightened, raising the rack and cloth-roll to contact with the take-up roll with sufficient force to cause the cloth to wind properly on the roll. When not in use, this handle can be put in the notch provided for it and be out of the way of the operative.

With this rack and worm-motion, the cloth can be removed from the roll at any time, and the weaver can take off the cuts when convenient.

The take-up roll is made of metal and therefore does not shrink or swell on account of the weather, as does a wooden one. Wooden plugs are inserted to which the steel fillet is fastened.

Adjustments.

The take-up roll is adjustable and can be raised or lowered, thus dispensing with the necessity of placing strips on the top edge of the breast-beam, as is now done on low-roll take-ups.

To alter the number of picks being put in, remove the change-gear and replace with one having half the number of teeth as the required number of picks to be put in, on the side of the gear which meshes into the intermediate gear.

The number of teeth to be taken up at each pick may be varied by moving the end of the take-up pawl in or out on the bracket on the lay-sword to which it is fastened.

The strength of the coil spring on the spring-shaft which holds the cloth-roll against the take-up roll, may be varied by turning the collar on the shaft to which it is fastened.

When the take-up roll is empty, and the cloth-roll is forced up against it, the worm on the spring shaft should be in such a position that the handle by which it is turned should just slide off and drop into its notch.

The loose pawl inside the hold-back pawl has three small holes through it in which to place a cotter pin. Each of these holes represents one tooth on the ratchet wheel—that is, if the cotter pin is in the first hole when the loom stops, the ratchet wheel will let back one tooth; if in the second hole, two teeth; in the third hole, three teeth, according to the demands of the cloth.

When setting the let-back pawl, turn the loom over until the filling cam-follower, or weft-hammer, is in its position nearest the breast beam; pull the filling-fork up over the hook on this cam-follower, and now the changing mechanism will be in operative position. There is a finger fastened to the starting-rod by a set screw, which should be turned until it extends under the small arm on the take-up pawl and justs lifts it out of its engagement with the rachet or pick wheel. This is to accomplish the letting back of the take-up at the time a transfer takes place. This should be looked after with great care from time to time, to see that the pawl is actually thrown out of engagement every time there is a transfer, allowing the ratchet wheel to slip around to the extent determined by the pin in the loose pawl inside the hold-back pawl. Otherwise thin places will certainly be caused.

FILLING FORK.

Trouble with the fork.

A filling fork can act improperly by rebounding in such a manner as to avoid catching on the hook of the cam follower. That is, such faults are known in general weaving. We have never detected any such defects with our own fork, as the balance is designed with special reference to overcoming any such trouble. An improper action, which is rather due to improper conditions than to any defect in the fork proper, sometimes occurs when the filling drags after breaking, or is exhausted, just as the shuttle enters the left-hand box. It must necessarily leave a tail of some length when so doing, and if the filling is coarse it may possibly raise the fork, which will thereby not detect the actual absence of filling in the shuttle. It is doubtful if this occurs very often, but it represents one of those minor difficulties which must be realized in order to avoid misconception.

We formerly had trouble with our fork by making it so light that lint on the lay in front of the grate would operate it. This caused the loom to run after the filling was exhausted, making a thin place. We found another trouble with our original fork made with two tines, in that the filling would not always operate it and thereby caused the filling to change before running out. With our present three-tined fork we have very little trouble.

Style of construction.

There is some difference of opinion among weavers as to whether the tines of a fork should be rigid, or allowed to bend, so that the fixer can change them. We have tried both kinds in large numbers, and are distinctly of the opinion that the rigid tines are better, for otherwise it would be doubtful whether any two forks would be alike. The fork governs so many vital points on our looms that we must insist that it be properly used and carefully watched. The fork should of course easily pass through the grate, or otherwise it may be tilted by striking the grate, thereby changing the filling unnecessarily. We find that the thin places which sometimes occur in our cloth are almost always due to the forks striking the grate, when the lay has any side play, due to wearing of parts or other causes. Careful watching will detect such an error very promptly.

LOOM LAY.

Design.

A stiff, heavy lay is absolutely necessary to weave heavy goods, although if the stiffness could be had without the weight, it would probably accomplish the same purpose. The hand-rail must of necessity be stiff in proportion.

The position of the pivot from which the lay swings is a somewhat mooted question. If the lay is pivoted in the center of its swing there will be less strain on the driving parts. If the lay is pivoted in front of the center it will put the greatest strain on the lower half of the warp, thereby helping give cover to the cloth.

The usual loom-lay is made of wood, and as its length is relatively great with relation to its cross-section, there are great chances for warping and twisting. The lumber from which lays are made should be thoroughly seasoned, and should not be finally used until after having set for months in a roughed-out condition. The raceway for the shuttle should be absolutely true, and it is advisable to go over looms with a straight-edge at times to detect any error. The race board must be slightly lower than the level of the shuttle boxes, in order to allow for the thickness of the threads which rest on the race underneath the shuttle.

REED.

The reed should be either set in an exact plane with the shuttle box back plates, or slightly back to allow for variations, as it will plane the shuttle if too far front. It should be at exact right angles with the shuttle race, the hand rail or reed-cap being filed to fit, and forced firmly into place. **Position.**

The purpose of the reed is simply to beat in the filling threads and furnish a back guide for the shuttle, although it might be possible to throw a shuttle so truly that it would never touch the reed. As the dents furnish more or less of an obstruction to any bunches or knots in the yarn, it is advisable to have them as thin as is practicable, in order that they may offer little surface for side contact, and also be free to give slightly when necessary.

In order to have a good running reed, the edges of the dents should be round and smooth—this will not only prevent excessive wear on the shuttles, but will also prevent a large percentage of warp breakage; they should also be made considerably deeper—this would insure a greater amount of elasticity and also greatly reduce warp breakage. This is something that mill managers building new mills should look into, as it can be done in a new mill much better than in an old one. **Smooth dents.**

Fliter.

The manner of holding a reed in the lay involves certain vexations, as reeds are bound to vary more or less. For this reason we adopted an adjustable fliter device by which the reed could be positively clamped, no matter what its size. If this idea were intelligently used we believe there would be no trouble, but it is evident that if the bolts governing the fliter are screwed up too tight by the thumb nuts at the front, the reed will be forced forward so as to very possibly project in front of the plane of the shuttle box back. We have lately adopted a modification of the original reed groove, which we think will overcome former difficulties, and be more reliable than the more complicated fliter device.

Fit.

In order to properly fit our reed, lay-groove or fliter, whichever is used, it is necessary to send the loom-builder several pieces of different reeds so as to get the positive variations.

PITMANS.

Crank Connection.

When the lay is at the end of its forward stroke, it must be in position to allow the fresh bobbin or cop to be transferred to the shuttle. If the pitman become so much worn as to throw the lay out of position to admit of the proper transfer of the bobbin or cop from the hopper, the eccentric pin at the lay end of the pitman can be turned to adjust the throw and compensate for the wear on the pitman. If the pitmans should become so badly worn that the proper adjustment cannot be obtained by means of the eccentric pin, they should be replaced with new ones.

Adjustments.

A piece of leather is inserted in the pitman straps at the lay end, to prevent wear on the eccentric pin, the leather being replaced when necessary. In order to avoid *back-lash* it is of course necessary to securely fasten the straps on the pitmans, as cracks or thin places in the cloth are apt to be made when the loom stops if the pitmans are loose.

SHUTTLE BOXES.

Box-plates.

The back box-plates are set at exact right angles with the lay-end plates. This is done by filing the ribs, or *fitting strips* at the back of the plate. The back box plates must be set in the same plane, or in line with each other, with the reed slightly back of this line.

The front box plates should be set so that the top will lean *slightly* toward the back box-plates, thus reducing the liability of the shuttle rising in the box. If it is set at an exact right angle with the lay-end plate it will probably work all right, but care must be taken to see that it does not lean *from* the back box-plate. At the same time it must not lean too much toward the back box-plate, as that would cause unnecessary wear on the top edge of the shuttle.

The front box-plates, being adjustable, should be set so as to line the rear shuttle point in the center of the picker stick slot. To adjust the binder, loosen the nut on the bottom of the lay, and the screw which passes through the binder bearing, and turn the bushing with the fingers until adjusted to the proper position. **Binder.**

There is a great variety of preference in binder materials. They are made of wood, wood with leather face, wood with steel face, cast iron with leather face, cast iron polished, and wrought iron. The trouble with binders made of two different materials is that it is difficult to prevent the different parts separating. We prefer a highly polished cast iron binder, in one piece, for our own use. There is also considerable question between front and back binders. Front binders are uniformly used with a protector motion, which has a center dagger acting on the center of the breast beam. It has been found necessary to use wooden breast beams with center daggers in order to avoid shocks and breakage. It is claimed that a front binder is more apt to cut the filling. The main advantage argued for this style is that the shuttle will be lined by the back box plate, which is pretty sure to be straight, while with a back binder the front plates are hardly ever set straight. We use the back binder because we prefer the iron loom construction with the side daggers. We also find the back binder accommodates our filling changer device better. Nearly all English looms run with back binders, and we do not think they have any perceptible disadvantage. **Material.**

PROTECTOR.

The protector mechanism on a Northrop loom does not differ in principle from that used on other looms, and therefore a detailed descrip- **Dagger.**

tion of it here is unnecessary. We have, however, adopted a new style of frog. In the case of the ordinary frog and a back binder, when the loom bangs off, with the shuttle part way in the box, the whole force due to the momentum of the lay is transmitted through the protector rod, dagger-finger and binder to the shuttle, thus many times breaking the sides, especially since it is pinched in its weakest place. With our new frog this has been overcome by means of a peculiarly shaped steel piece in the frog, which when struck by the protector slightly lifts the point of the dagger, thus removing all pressure from the shuttle.

Adjustments.

Should the protector-rod become loose through wear, the caps which hold it to the lay-swords can be filed and the trouble overcome.

The pressure of the binder-fingers on the binders is regulated by the protector-rod spring, in the usual way.

BRAKE.

Stopping mechanism.

We have lately adopted an improved brake mechanism which stops the loom with the harnesses in line and the lay in the proper position for drawing in a broken thread. Also, with this device, when the loom stops, the shuttle is usually in the box in position to start up again. Recent improvement in adjustments prevents thin places, and by always stopping with the shuttle in the box, and the lay in position for drawing in a thread, lightens the labor of the weaver.

Adjustments.

In adjusting the connection between the brake and the protector mechanism, care should be used to see that the action of the frog does not bring pressure upon the brake before the belt is shipped.

Care should also be taken to have the brake always set up so as to fit the shape of the wheel, or in other words, bear upon as much of the surface of the wheel as possible. This can be done by means of the adjustment at the bottom end of the brake.

The brake mechanism should be given attention from time to time, and kept in good working condition, in order to obtain the best results.

LOOM ADJUSTMENTS.

General points.

Every new loom will jar screwed parts loose in the first few days it is run. Care should be taken to go over screws and nuts carefully and tighten them up securely.

For an easy operation of warp, the threads should lie in a straight line from breast-beam or breast-roll to whip-roll, with the harnesses together. To make cover on the cloth, however, it is necessary to bring an extra strain on the lower shed by raising the whip-roll, breast-beam or breast-roller, or both. Our looms, built with breast-roller, are provided with an adjustment, so that its vertical position may be changed. Our whip-rolls are made adjustable for the same purpose.

In weaving drills or twills, the usual loom adjustment needs reversal in several cases. The whip roll and breast beam should be practically as low as the race of the lay.

Whatever adjustments relate to providing time for the shuttle to pass through the shed, must vary with relation to the width of the loom. It is obvious that on a wide loom more time is necessary. Certain changes in loom construction may affect this point more than any possible changes on adjustment; for instance, an overthrow loom gives more time than an underthrow. If the crank-shaft center is set lower than usual with relation to the lay pitman pivot, the effect is somewhat similar. Also, the use of a short pitman accomplishes the same purpose by extending the bearing for the lay pitman pivot.

The pick motion should be set so that the shuttle should just begin to move when the lay is in the centre of its back stroke.

DRAWING-IN WARP.

Changing warps.

In view of the slight extra cost of drawing warp when additional warp stop detectors are employed, the question of twisting in warp has been considered. We made some experiments in this direction and found there was an actual saving in time of 15 minutes per warp. The loom was kept from producing, however, during the time of twisting, and it is evident that any crossed threads on the old beam must stay crossed on the new. Some mills now twist in warp in a frame apart from the loom. This practice seems to overcome all difficulties.

SIZING WARP.

Preparation of warps.

When using the drop-wire stop-motion with cotton harness, it is necessary to size the warp with more care, taking pains to put the size *into* the yarn, instead of on the outside, as is the custom in a great many mills. The test of proper sizing is the amount of lint and the warp breakage. No. 28 yarn should not break more than 10 to 20 threads per day with a cotton harness stop-motion on ordinary goods. The slasher speed may be varied if necessary. Slow speed gives a larger per cent. of size. With the steel harness motion extra sizing is not necessary—in fact, it may increase warp breakage. We recommend the following mixtures for our drop-wire cotton harness device:

Formulae.

Sizing for Sheetings: 100 gallons of water, 70 lbs. potato starch, 4 to 5 lbs. of tallow, 1 gill turpentine, 1 gill of blue vitriol; boil 20 minutes, or longer if necessary.

Sizing for Prints: 120 gallons of water, 60 lbs. potato starch, 2 lbs. of tallow, 7 lbs. of Victoria zinc; boil from 20 to 30 minutes.

Sizing for Medium Weight Goods: 120 gallons of water, 65 lbs. of potato starch, 7 lbs. of tallow, 5 lbs. of alum; boil 30 minutes.

LOOM POWER.

Energy consumed.

We believe there is quite a misconception on the question of the amount of horse-power required by a loom. The old standard authorities figured from tests made with looms of the old light patterns, run at low speeds. With our first print cloth loom we had an admirable opportunity to determine this point, as we ran a room full of 80 looms from a separate engine and could indicate the power absolutely. The tests showed that at 190 picks the loom ran 3 3-4 to the horse power, not counting the shafting. We know of no reason why other print cloth looms should not take equal power, and we therefore consider this a safe basis to figure on.

CLEANING LOOMS.

Care and lubrication.

It is of course essential that looms be kept properly cleaned and oiled. Different mills have different customs in this respect; some of them insist that the weaver shall clean and oil his own looms, while others have special cleaners and oilers. A loom should be thoroughly cleaned and oiled every time a new warp is put in, and kept reasonably clean between these periods. If the weaver is made responsible for the oiling, there is no excuse when poor cloth is made by reason of ineffective operation by worn parts. Cleaning boys can be employed at low wages who should be fully as effectual for this style of labor.

REPAIRS.

Replacements.

An average figuring of repairs is impossible without a continuous record for over a considerable length of time. We can get at certain elements fairly well, from the amount of parts which we sell, but of course a great many parts are ordered to be kept as stock on hand. From an average of the parts furnished eight mills, we figured for 1896 that the repair cost per loom per month was 12 1-4 cents, not including shuttles. This does not take account of strapping, which we did not furnish. From figures given us by some of the mills individually, we believe this average very fair. There has been so much loose talk about the great repair cost on Northrop looms that we believe it is necessary to have these details appreciated. We believe the repair cost on the average common loom, including shuttles, runs at least $3 per loom per year, and our own cost, plus shuttles and strapping, would certainly be under $4. In fact, mills running common looms and Northrop looms on the same goods, have actually written us that the repair cost on the Northrop looms was less than on the common looms.

Yearly cost.

PRODUCTION.

Gain in product.

As is now well known, the Northrop loom allows the machinery to run without the attention of the weaver, so that the belt can be left on the tight pulley during the noon hour, thereby gaining quite an increase of production. It is also possible to run the looms some time after the help have left at night, if it is advisable to keep the engine going overtime. The production per loom is therefore much higher than in the ordinary mill. In fact, without counting the gain by overtime, the production on our Northrop looms has uniformly averaged greater than on common looms at the same speed and on the same goods. 97 per cent. of the actual figured production is quite common. This simply means that the Northrop loom weavers are not so hard pushed as the common loom weavers, and it is a question as to whether there might not be economy in giving them more looms.

In our experimental weave room, with 80 looms running about 185 picks, we found the average production for five 16-loom weavers averaged

Cuts per week.

84 1-2 cuts per week of 55 hours for 1894.

In April, 1896, it was reported from a Northrop loom print mill, that weavers on 16 looms averaged 95.63 cuts per week, weavers on 20 looms 121 cuts per week, weavers on 24 looms 147 cuts per week. One exceptionally good 24-loom weaver had a continuous average of 161 cuts for a long period. The average of the mill at that time was 15.23 looms per weaver.

At an outside common loom print mill in 1894 we found the production 46 yards of cloth per loom per day, with week of 58 hours, 62 picks per inch, and speed of 195 picks per minute. The average number of looms per weaver was 7 1-4.

LOOM SPEED.

Advice on speed.

As often stated, we are not believers in high speed for looms. We recommend 185 picks for 28-inch looms, 170 picks for 36-inch looms, and 160 picks for 40-inch looms.

Simply as a matter of interest we might state that we ran one of our looms at 280 picks, in order to test our devices, back in 1893. There is nothing in the application of our improvements that limits the loom speed. There is no gain, in our opinion, in forcing production in this way, thereby increasing the expense of fixing and the cost of repairs. It is well-known that English looms have run 20 per cent. higher than American looms, but the reason is said to be due to the influence of the trade unions, who will not allow weavers to run but a certain restricted number. The manufacturer in self defense endeavors to get as much product from the loom as possible, even if he thereby increases the weaver's work in an unfair proportion. From our long experience in testing looms under variable conditions, we know that high speed increases warp breakage very materially, makes it difficult to set the pick, and introduces a jar and wear that is bad for the machine. On the other hand, our filling changer is absolutely helped by high speed, as the operation is quicker and the ejection of the spent bobbin more positive.

COSTS.

It was learned in England in 1895 that they figured the cost per loom of a plain weaving mill including land, buildings, power plant, machinery and supplies at $110 per loom. Outside estimates.

In 1894 we learned that an outside builder's estimate on a print loom weighing 900 lbs., figured stock, $27, labor, $9, painting, $3, general expense and profit, $11; total, $50. At the present day the usual print loom is made with more iron than then figured. While looms are often sold below this price, it is well known that prices on one lot of machinery are often shaded where the profit is expected on something else. It is often better to sell machinery at less than cost in dull times rather than have the plant idle.

WASTE.

In our experimental weave room, with 80 looms, for 1894 the waste averaged 8 lbs. of waste, bobbin filling, and 47 lbs. of sweepings per week of 55 hours. Waste.

We had the filling waste carefully collected and weighed in a Northrop loom print mill for several weeks, and found it averaged .14 pounds per loom per week.

LOOM TESTS.

In 1894 we made a test for one week on eight looms in one of the best print mills of Fall River, with the following results:

Average stops per loom per day of ten hours Loom stops.

for warp breaks	28.
to cut knots off warp	2.
to change shuttle	68.
(Shuttles were also changed during some of the warp-stops.) Total	98.

During the running of the looms there was an average of 2 pick-outs per day on the eight looms, and 13 scratch-ups.

Common print cloth looms tested October, 1899, stopped 80 times for filling, and 20 times for warp, per day. This means 800 stops per day on eight looms, or once every 45 seconds.

LOOM EQUIPMENT.

Extras.

The usual common loom as sold by the trade includes no extras and no parts not secured to the loom, except the beams, one and one-half being figured to each loom. The Northrop loom is furnished with one shuttle per loom, and one set of heddles, providing the harness warp stop-motion is ordered; otherwise a set of detectors goes with the loom; also check stands, shuttle guard and filling fork. The following list specifies the extras which are usually purchased from supply dealers:

LUG STRAPS,
LEASE RODS,
JACK STICKS,
STRAPPING,
HARNESSES,
REEDS,
LEASE-ROD HOLDERS,
THIN-PLACE PREVENTERS,
EXTRA PICK GEARS.

The base price of a common loom is understood to apply to two-harness work; and auxiliary shaft, with cams for 3, 4, or 5-shade motions, also selvage motions, are figured extra.

DOUBLE-PICK CLOTH.

Two threads in a pick.

A great many inventions have been theoretically perfected for producing cloth with two filling threads in a shed, the object being to weave twice as fast with some of the devices, and to weave without carrying a filling supply, with others. Some have accomplished the idea by putting two bobbins in a shuttle, some by winding two threads of filling on a bobbin, and others by having an outside supply of filling with a double thread carried across by a needle or traveling carrier. With the latter class the loom does not weave twice as rapidly, for the carrier must return without laying a thread, thereby making no gain over the usual loom. It is perfectly possible to duplicate the high production performances with Northrop looms by simply winding double yarn on the bobbin. The real trouble is encountered in marketing the goods, for there is no great demand for such cloth at the present time.

CLOTH DEFECTS.

Imperfections.

Cloth is inspected to detect imperfections, such as thick and thin places, oil stains, scratch ups, thread runs, coarse threads, too many threads in an eye or in the dent of the reed than there should be, overshots, skips, kinks, and possible errors in loops, unevenness, surface conditions, weight and width.

Thick and thin places are usually caused by the let-off or the take-up motion not working properly, and, on the Northrop loom, by the filling-fork getting out of order. Oil stains are usually the result of carelessness on the part of the operative. Scratch ups and thread runs on our loom are practically a thing of the past; if the warp stop-motion is kept in order as it is intended, there is not one chance in one hundred of having those imperfections. Coarse or extra threads can readily be seen, and there is no excuse for a weaver allowing them to be woven in the cloth. Overshots are usually caused by waste or long knots getting in the shed and cannot always be avoided, but are greatly reduced on our loom, as we have taken great pains to get the picking and harness cams as nearly right as possible. A poor harness or pick cam will cause a great amount of this trouble. Skips are usually caused by the harness not being properly adjusted, the picking not being set right, or the picker not being put on as it should be. Kinks are usually the result of using filling not properly conditioned, although there are times when kinks are put in by weaving goods too narrow for the width of the loom, or running a filling fork too heavy for the numbers of the filling being used; then again the friction in the shuttle may not be right, or there may be too much power on the loom.

Loops are almost always caused by the harness not being shaded properly, especially on five-harness goods. Uneven cloth is usually the result of the let-off or take-up not working right, although uneven filling will also give the goods the appearance of being woven uneven. Surface conditions of the goods—this is a matter we cannot say very much about here, as they are usually made to suit the buyer, and the same class or grade of goods is made with some slight difference in the different mills. Weight and width must be kept right and our high roll take-up motion, other conditions being equal, will make goods nearer right than any loom on the market at the present day.

Mis-picks.

It is evident that with ordinary two-harness weaving, the common action of the filling fork will sometimes cause two picks in the same shed. On print cloth and sheetings, or, in fact, on any usual two-shade work, there is no apparent blemish visible except on close examination. When the filling runs out the shed is usually but partly filled. For certain purposes, such as napping, it is absolutely necessary to find the pick, no mispicks being allowed. In common loom weaving it is of course possible for the weaver when inserting new filling to turn the loom back to find the pick, and then carefully insert the shuttle at the precise point where the filling expired. Another method is to stop the loom by hand, just before the filling is woven off. This latter practice is usual where the weaver tends but one or two looms and can constantly keep watch of the amount of filling in the shuttle. The custom of turning the loom over to find the pick is not often made obligatory. With the Northrop loom the usual filling changer pays no attention to the arrangement of the sheds, but our feeler device, which inserts new filling just before the expiration of the old, attends to this requirement automatically, thereby making perfect cloth. Our regular Northrop loom on three-shade work will make less mis-picks than the ordinary common loom run in the usual way, as the filling is inserted by the hopper device so as to naturally fill the empty shed when the cam returns to it.

Cover.

The question of the cover on cloth introduces many chances for experiment, different experts arriving at the same results by many different ways. The soft feel which is sometimes desirable is usually obtained by weaving with the upper shed slack. Soft twisted filling undoubtedly aids, so that cop filling has some advantage over bobbin filling in this respect. The height of the breast beam and the whip roll of course has an effect on the tension of the different sheds. The position of the lay pivot can also change the angle of the beating-up, to aid in the general effect. It has been claimed that the weight of our drop wires when used with a cotton harness took some of the desired slackness out of the top shade, but we have never yet seen a cloth which we could not duplicate so far as appearance was concerned.

Bare cloth, or cloth lacking cover, is often due to the harness cam not being suitable to the goods woven.

Blemishes.

Sometimes the warp or cloth is soiled by dirt falling down through belt holes in the floor above. Belt hole guards are absolutely necessary in such instances. Sometimes filling bobbins drop on the floor and get dirty. With our first looms our tin bobbin boxes were not large enough, so that ejected bobbins would sometimes be thrown on the floor, and if they had any yarn left on them it might easily be soiled. If too much oil is put on a running part the surplus may very easily be thrown in such directions that it will either strike the bobbins in the hopper, or the warp. Sometimes oil on the shafting above the loom drops down on the cloth or the warp.

Quite a few defects in cloth are entirely beyond the weaving department, being due to the condition of the warp and filling as presented for weaving. The manner of winding the filling yarn on the bobbin or cop is of great importance, as with a poor wind it is often possible for rings of yarn to slip off making double filling in the cloth.

We have now told what we know of our own devices. We shall undoubtedly continue to learn new points, which will give us an excuse for publishing another circular at some future period. We are always glad to correspond with those who use or contemplate using our looms.

THE DRAPER COMPANY,

Hopedale, Mass.