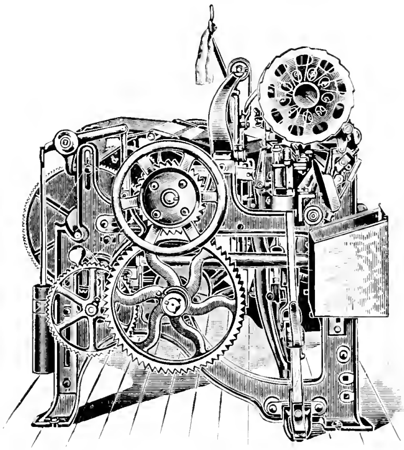


THE FIRST NORTHROP LOOM.

Designed for the weaving of Print Cloth and Sheetings solely. Used with great success on plain two-harness weaves by our original customers.

It was this model that first proved a weaver's capacity to run sixteen looms.

It incorporated the inventions of:—

James H. Northrop,
Charles F. Roper,
William F. Draper,
George Otis Draper,
Edward S. Stimpson and
John W. Keeley.

The loom frame and other conventional parts were designed for the Hopedale Machine Company under supervision of Oren B. Smith. The H. M. Co. was incorporated with the present Draper Company in 1896.

LABOR-SAVING LOOMS.

(FIRST EDITION.)

A BRIEF TREATISE ON

PLAIN WEAVING

AND THE

RECENT IMPROVEMENTS IN THAT LINE WITH SPECIAL REFERENCE TO THE . . .

NORTHROP LOOMS

MANUFACTURED BY

DRAPER COMPANY,

HOPEDALE, MASS.,

U. S. A.

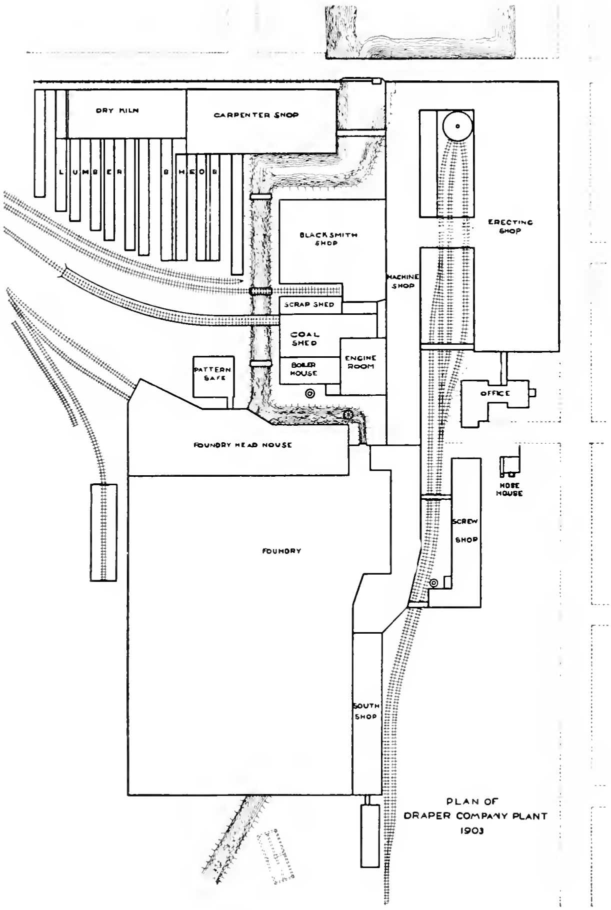
1904

WRITTEN AND COMPILED BY
GEORGE OTIS DRAPER,
SECRETARY OF THE DRAPER COMPANY.

PRINTED BY
COOK & SONS, MILFORD, MASS.

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, as improvements are often unexpectedly invented. We can hardly expect to publish a work of this size at short intervals, but shall try to keep it reasonably up to date by amended additions. New matter will be inserted in the final pages of each edition after the first.



OUR HOPEDALE PLANT IN 1904.

Scale, 315 feet to the inch.

About 27 acres of floor space in all.

FORMER LITERATURE ON THE NORTHROP LOOM.

1895.

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

Essay, *The Present Development of the Northrop Loom*, delivered by George Otis Draper 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. de Berard, 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.

Circular—*The Triumph of the Northrop Loom*, November, 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.

1900.

Circular—*The Advance of the Northrop Loom*, January, 1900.

Pamphlet—*Factory Conditions in the South*, January 20, 1900, by George Gunton, in Gunton's Lecture Bureau course.

Paper on *Method of Cost Finding* by Wm. G. Nichols, delivered at a meeting of the N. E. Cotton Manufacturers' Association at Boston, April 26, 1900. Printed in Vol. 68 of the Transactions.

Essay on *Improvements in American Cotton Machinery*, by George Otis Draper, delivered at a meeting of the Southern Cotton Spinners' Association at Charlotte, N. C., May 18, 1900. Printed in the Association records and various periodicals.

1901.

Chapter in *Textile Texts*, published by the Draper Company, spring of 1901.

Various articles in publication, *Cotton Chats*, started in July, 1901, and continued since.

Circular on *Important Discovery*, relating to method of spinning to prevent bunches in cloth, August, 1901.

1902.

Circular on *The Keene Drawing in Machine*, January, 1902.

1903.

Circular on *The Northrop Loom*, issued by the British Northrop Loom Co., January, 1903.

Essay on *Continued Development of the Northrop Loom*, delivered by General Draper at a meeting of the N. E. Cotton Manufacturers' Association in Boston, April 23, 1903, printed in Vol. 74 of the Transactions.

Various references in a book, *The American Cotton Industry*, by T. M. Young, published by Charles Scribners' Sons, 1903.

Chapter on Northrop Loom in *Textile Texts*, second edition, issued December, 1903.

Essay on *The Development of the Northrop Loom*, delivered before the Providence Society of Mechanical Engineers by George Otis Draper, printed in Providence Journal, Dec. 28, 1903 and other trade journals.

1904.

Circular on *List of Northrop Looms Sold*, issued January, 1904.

Article on *Evolution of the Cotton Industry*, published in Gunton's Magazine for February, 1904.

Pamphlet, *Labor Saving Looms*, (the present volume).

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

(This list for 1904 is only complete to April 1st.)

COLLECTED EVIDENCE.

Also Northrop Loom History, Vol. I, 1889-1892—574 pages.

Northrop Loom History, Vol. II., 1893-1896—1097 pages.

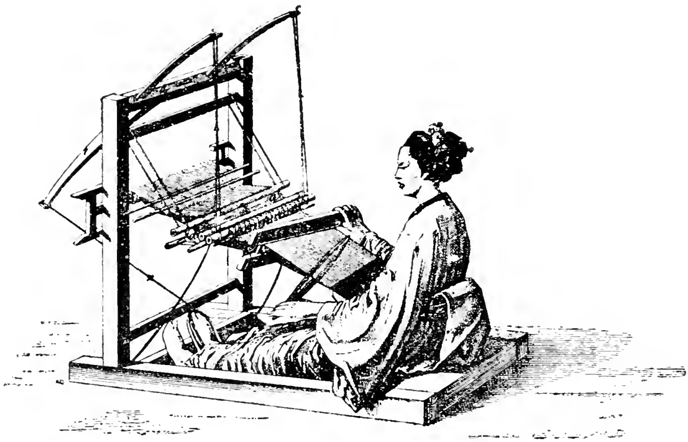
Northrop Loom History, Vol. III, 1897-1900—818 pages.

These books are by the Secretary of the Draper Company and were compiled for general reference and use by 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.

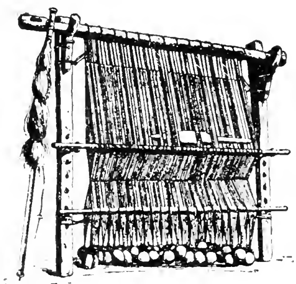
In our circular of November, 1897, we had a word to say to possible competitors which still seems pertinent. We therefore reprint a portion as a few unfortunate experimenters failed to note its truth on first appearance:

"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. 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."

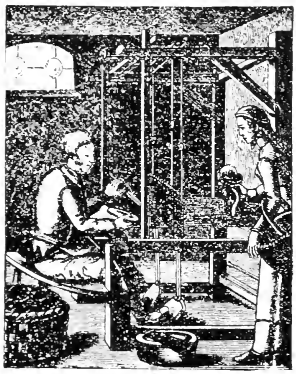
THE ART OF WEAVING.

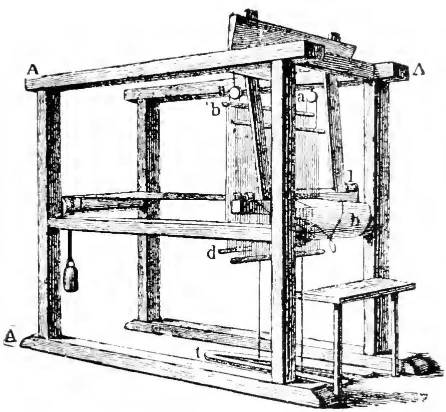


The process of weaving cloth consists in interlacing a continuous thread amidst a series of parallel threads. Without giving an exhaustive history of the art it may be pertinent for further comparison to note down certain steps in its progress. It is fairly well established to-day that woven goods were used as clothing by the ancient Egyptians fully 6000 years ago. I have seen in Switzerland a preserved section of a net woven of



twisted threads supposed to have been the work of the Lake dwellers in pre-historic times. In the earlier processes it is probable that the warp threads were stretched on pegs, the weft being inserted by the fingers. In such weaving the warp threads usually lie vertically and in fact this is the method used to-day in producing rugs in the Orient with short wefts. With the use of longer weft also came the use of a stick with a hooked end for pulling it into position. If we are to form our further comparisons on a plain print cloth of the present width of 28 inches containing 64 threads of warp and 64 of filling per inch, it is possible that the rate of weaving by this method on such goods could be figured as low as one pick per minute per operative in the earliest use. Cloth is still woven by this method in India, although a harness motion is added. History gives us no record of the time at which the warp threads were divided by harnesses and the shuttle introduced. References are made to shuttles in the Bible and other ancient books. It is probable that the general styles of hand loom weaving were very similar for many centuries without definite change until the invention of the fly shuttle by John Kay in 1733. At this time, in weaving broad cloth,





it was necessary to have two weavers at least, one at each end of the lay to throw the shuttle to the other. By Kay's invention one of these two men was dispensed with and even on narrow weaving a weaver could produce at least twice as much cloth per day.

No literature that I have run across gives any figures of production on the looms of this period and considering their crudeness in other lines, it is perhaps fair to assume that they could not produce at a greater speed than 20 picks per minute before Kay's time, probably averaging less. Kay's invention caused great commotion amongst the weaving trade and he was forced by persecution to leave the country. Cartwright's power loom patent was granted in 1785. Authorities differ as to the success of his first looms, some claiming that the early use was of no importance, while others refer to a mill of 500 looms in which Cartwright was interested, as being destroyed in 1790 by a mob in sympathy with the hand loom weavers. Whatever the cause, there were as late as 1813 but 2400 power looms in all Great Britain. The first power loom was introduced in Waltham in America in 1815. At this period one operative was required to each loom, as they had no weft stop motion and no self acting temples, the weaver having to intermittently move the flat wooden pieces with points at the end which held the cloth extended at the selvage. The invention of the rotary temple by Ira Draper in 1816, as developed several years later, allowed the operative to tend two looms instead of one. The speed of the common power loom at this time does not seem to be recorded, but it was probably between 80 and 100 picks per minute. In 1820 it is figured that there were about 15,000 power looms in England and Scotland and in 1830 perhaps 60,000. Even as late as 1840 there were said to be 250,000 hand looms still running. At this time weavers in England were not given more than one loom each, although in America they were running two looms, as the English manufacturers did not adopt the rotary temple so early as our American manufacturers. As to the comparative production of the common looms at this period, it is difficult to find any accurate basis of comparison. Hand looms were weaving print cloth as late as 1896 in Bohemia, where the production figured on 64 picks per inch in the cloth at ten hours per day would give an average of 35 picks per minute. I have been given figures of hand loom production recently that would suggest a possible speed of 60 picks per minute. About 1840 the weft fork began to be introduced and in America, by 1850, print looms were running at a speed of 150 picks per minute, with one operative tending four looms. Perhaps they even ran faster in England, but the operatives only tended two looms. From this period to 1895 the plain loom was not materially changed in principle, and yet the perfection of detail had brought the speed of the American plain loom up to 190 picks with one good weaver tending eight looms, while the English operative with looms at a speed of 220 picks per minute was tending four looms, though usually with a helper. In 1895 the Northrop looms then introduced immediately allowed one weaver to run 16 print looms at 190 picks and to-day it is assumed that a good weaver with the Northrop loom on prints can easily tend 24. In calling the speed of the American print loom 190 picks it is not intended to give a maximum. American print looms have run over 200 picks, but such is not the general practice. In the same way English looms have run higher than 220 picks, but the figures given are assumed as fair for the purposes of comparison and as illustrating the general practice.

Arranging a table of comparison, if we take 24 Northrop looms at 190 picks per minute, we have a total of 4560 picks. On the same basis, without allowance for stops, eight common looms would show 1520 picks, or four English common looms at 220 picks, 880 picks per weaver. The perfected hand loom would show perhaps 30 to 60. The power loom of 1850, at 150 picks, with four to the operative, would show 600 picks per minute, while the loom of about 1840, before the weft fork, would show with two looms per weaver at perhaps 130 picks per minute. 260 picks. Before the temple, the loom at 100 picks with one loom per weaver, would give 100 picks, while the hand loom before Kay at 20 picks, the loom of the middle ages with a possible 10 picks, and the loom of ancient history with a possible one pick per minute, brings our table down to a concrete illustration, which, even if faulty in detail, allows a comprehensive idea of the wonderful advantages since the earliest application of the art. The Northrop loom in eight years has added over 3000 picks per minute per operative; the development since 1850, 920 picks; the inventions from 1830 to 1850, 370 picks; the inventions from 1820 to 1830, 130 picks; the inventions from Kay to 1820 would add 80 picks, the progress previous to this time being represented by 20 picks. It will thus be seen that within two centuries the productive power of the operative has been increased 228 times, and it is also seen that **the advantages of the Northrop loom show twice as much in product as all of the other inventions put together.**

History is practically silent as to the inventors who supplied the earlier devices employed on the hand loom. It is not, therefore, known who suggested the idea of the harness motion with its shifting heddles, the swinging lay with its reed, the take-up roll, the early jaw temple, and the shuttle itself. Starting with Kay, the development before the Northrop loom is shown by the following table, material for which is collected from standard works on weaving. No attempt is made to include the various inventors of fancy loom devices, including the jacquard motion, the dobby motion, and other ingenious developments. It might be well, however, to note that the earliest mechanism for fancy weaving; namely, the drop box, was invented by Robert Kay, son of John, in 1760. In preparing the table it has also been thought well to limit the inventions to show only the anticipation of the general principles employed. It is impossible to properly note any but the pioneer inventors, and the dates given are usually those of their patents. Very possibly more credit is due other inventors not mentioned, for their perfection of ideas that otherwise would not have been useful.

1733. Fly shuttle, John Kay.

1786. Power loom, Edmund Cartwright.

(First suggestion of warp-stop-motion, weft-stop-motion, positive let-off and take-up.)

1796. Over-pick, binder, protector, and frog, Richard Gorton.

1796. Ratchet take-up, Robert Miller.

1803. Shedding motion, John Todd.

1816. Revolving temple, Ira Draper.

1821. Multiple harness motion, Robert Bowman.

1828. Complete power loom with modern over-pick, William Dickinson.

1830. Complete power loom, Richard Roberts.

(These two instances of complete power looms are mentioned as showing a general development of ideas not noted in detail, which together produced practical weaving machines.)

1831. Weft fork, claimed by Clinton G. Gilroy.

1834. First shuttle-changer, John Patterson Reid and Thomas Johnson.

1834. Weft fork, claimed by Ramsbottom and Holt.

1838. Picker check, Robert Pickles.

1840. Improved temple, George Draper.

1841. Weft fork improvements, William Kenworthy and James Bullough.

1842. Loose reed, James Bullough.

1845. Loom brake, John Sellers.

1846. Parallel shuttle-motion for under-pick loom, Warren W. Dutcher.

1851. Reciprocating temple. Elihu and Warren W. Dutcher.

1857. Automatic let-off. Snell and Bartlett.

1859. Rocker motion. W. Stearns.

1863. Loose frog. George Draper.

1867. Double beam let-off. Cottrell and Draper (George).

1868. Practical self-threading shuttle. J. A. Metcalf.

1868. Broad loom shuttle-motion. J. Lyall.

1869. Inside catch shuttle. J. H. Coburn.

There is quite a lapse between 1870 and 1890 in which no very important patents on plain looms were granted. In fact, looms made before 1850 continued running for years in competition with those built long after, the more modern looms not showing any notable advantage, except perhaps in heavier construction and higher possible speed. It must be remembered that I am still referring to the plain, common loom, not in any way intending to disparage the remarkable advance in the range of fancy loom devices in that period, including the hair-cloth loom, pile fabric loom, tape loom, etc., etc., etc.

Owing to an error in the index of the official British publication of Abridgements of the Specifications relating to Weaving, it was only recently that we discovered the first patent in which the idea of changing shuttles automatically is referred to. Such a reference occurs in that granted John Patterson Reid and Thomas Johnson, No. 6579, in the British Patent Office, dated March 20, 1834. The specification refers to a number of different inventions, contemplating the weaving of four webs of cloth at once in a vertical loom. It shows a mechanism designed to change the shuttles when any one weft thread breaks, or fails, the substitution occurring by an instantaneous movement, without any act of the attendant, and without stopping the loom, the mechanism being brought into action by a weft stopper annexed to the shuttle. The specification also refers to changing shuttle boxes to bring different colored weft into action. It also contains a jacquard mechanism. Both Reid and Johnson were prolific inventors, Johnson having taken out a patent as early as 1803, for a dressing machine, and Reid as early as 1827, for a lay motion. Johnson and Reid together took out several other patents for less interesting improvements.

The discovery of the Reid and Johnson patent of 1834 displaces a former claimant; namely, Charles Parker, who took out an English patent in 1840 for a very similar combination. The next invention in this line is of the year 1852. Meanwhile, however, Mr. Clinton G. Gilroy issued his noted work on weaving in 1844, in which in a satirical and humorous vein, he refers to the loom of Arphaxad, explained to Deioces, the first king of the Medes. In the description of this loom it states:

"*In order to avoid stopping the motion of the loom when one or more of the weft threads break, or become exhausted, a few spare shuttles are to be lodged in suitable receptacles, which are so arranged that the mere breaking of a weft thread will cause a change of shuttle instantaneously (by the substitution of a spare one in its stead).*"

The detail of the operation is described at some length; also the mechanism by which the loom will stop, supposing the total number of shuttles to be exhausted. He also describes a shuttle-changer for application to different colors of weft yarn to produce patterns in the cloth. The operation of the change of filling is similar to that in the Reid & Johnson and Parker patents, the details seeming to show that the author was well acquainted with the Reid & Johnson patent, and possibly the Parker patent also. Gilroy's reference is merely an indirect satire on our patent system, though many of his readers have since taken this part of his work seriously. Gilroy himself was an inventor of considerable prominence in the weaving line, and must have considered the idea of changing filling too chimerical to be practically developed.

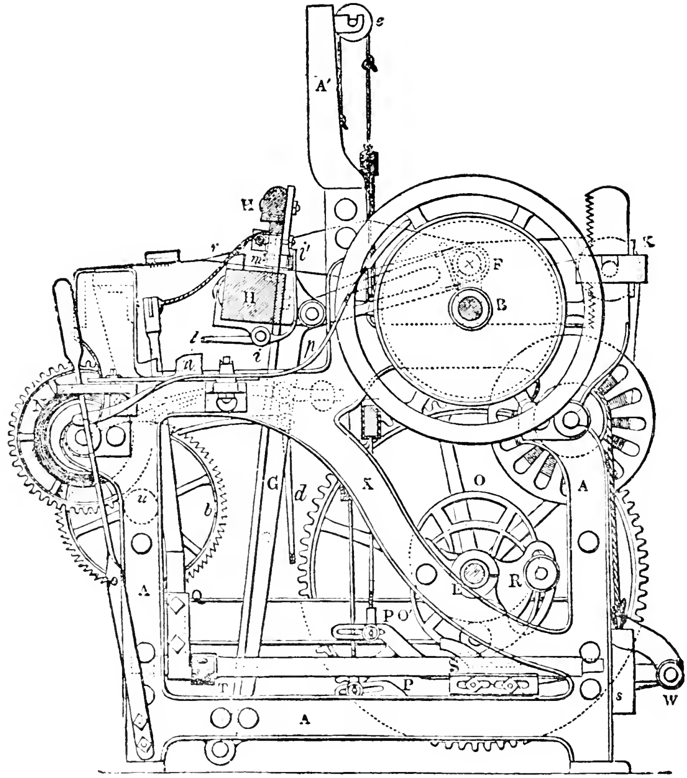


FIG. 20—ROBERTS LOOM. SIDE ELEVATION.

In our earliest public reference to the Northrop loom, namely, that quoted in the paper of our Mr. George Otis Draper, read before the New England Cotton Manufacturers' Association, at their meeting in Atlanta, October, 1895, it was stated that looms rested while improvements changed the form of other cotton machinery, "*plain weaving remaining in its elementary stage.*" Also, "*No radical change in any vital feature can be shown as the result of the last fifty years.*" These remarks awakened some comment and criticism, calling forth a reference in our circular, *The Advance of the Northrop Loom*, to the loom manufactured by Richard Roberts in 1830. We now show a print of this loom, which was sixty-five years old at the time of the Atlanta meeting, and call attention to the fact that its general design and equipment is very similar to that of common looms at the time of the introduction of the Northrop improvements. Practically all of the important elements of plain weaving are shown in precisely the same relative positions which they now occupy; in fact, the weft fork is the only notable omission.

Other authorities have since added testimony of similar sort:—

"It may safely be asserted that at the present time no subject is receiving more careful consideration than that of weaving. In its essentials the power loom has changed little since the date of its invention. It has been made heavier, the details of the let-off and the take-up and the numerous other parts have been changed in their degree of efficiency, but little in their method of operation. Yet from the beginning of the century it has been clearly foreseen that a most radical change in weaving would take place upon the invention of a simple and efficient weft supplying mechanism."—[*Henry I. Harriman at the Boston meeting of the N. E. Cot. Man. Asso.*, *April* 26, 1900.

The incompleteness of the earlier automatic looms is also verified:—

"In the case of weft supplying looms the difficulty of transferring such a large body as a shuttle, in the very short period of time given between picks, prevented their general use. The process was destructive both to the loom and the shuttle, and it is safe to say that none of these numerous inventions was ever put to practical use."—[*H. I. Harriman at Boston meeting of the N. E. Cot. Man. Asso.*, *April* 26, 1900.

"But following 1870 there was a very general absence of work on automatic looms until there appeared that remarkable series of inventions perfected by the Draper Company."—[*H I. Harriman at Boston meeting of the N. E. Cot. Man. Asso.*, *April* 26, 1900.

HISTORY OF THE NORTHROP LOOM.

In order to avoid the usually inevitable misstatements made years afterward concerning the early conception and introduction of important inventions, we will briefly record the pertinent facts concerning the early history of the Northrop loom.

The predecessors of our present Company started as far back as 1816, to perfect the power loom, Ira Draper inventing the revolving temple at this period. At the formation of the partnership of George Draper & Son in 1868, the business controlled by this firm and other Hopedale companies chiefly related to loom improvements, including let-off motions, parallel motions, thin-place preventers, loose frogs, etc. The ring and spindle inventions, however, coming in soon after, assumed such prominence that the loom department became a secondary feature. The members of the firm, however, often speculated on the possible advantages of automatic weaving, considering this as a possible field for future development.

On July 26, 1888, Mr. William F. Draper, Jr., heard of a loom invention in Providence, and saw the inventors and their device, which was an automatic shuttle-changer. He reported at home that the general idea was interesting, but the device not practical, in his opinion. Our firm then had an exhaustive investigation of the patent situation made through competent counsel. The report seemed to show that there was little novelty in this special application of the idea, but the firm had become sufficiently interested to risk a further trial of the general principle, and on December 10th voted a sum of $10,000 for experiments, and started an inventor, Mr. Alonzo E. Rhoades, on the task of devising a practical shuttle-changing loom. That Mr. Rhoades lost no time is proved by the fact that he had an operative loom ready to be started, with warp and filling, by February 28th of 1889. This loom, after being reconstructed with new patterns during the next few months, though not changed in principle, ran with good success. Some twelve years later, for purposes of patent litigation, the same loom was started up and run for days under the eye of a patent expert, accomplishing its purpose so well as to draw forth his unqualified approval.

Leaving the Rhoades loom at this stage, it is necessary to retrace our history to the year 1857, when Mr. James H. Northrop was born in Keighley, England, on May 8th of that year. After becoming an expert mechanic and factory foreman in his own country, Mr. Northrop came to this side in May, 1881, soon drifting to Hopedale, where he became employed as an expert on metal patterns. His invention of the Northrop Spooler Guide brought him to the notice of his employers, and he was selected by them to work out the idea of an automatic knot-tyer for spoolers. Although showing great ingenuity, the devices did not appear commercially practical, and the inventor became sufficiently discouraged to abandon the shop and devote his time to farming. Not finding this occupation congenial, he applied for employment some years later, in the fall of 1888, but the only opening then present was a job as mechanic at $2 per day. In February, Northrop, who had noted the progress of the Rhoades idea, spoke to Mr. George Otis Draper, who had just entered the firm of George Draper & Sons, stating that if given a chance he could put a shuttle-changer on a loom in one week's time, that could be made in quantities for a cost of $1 each. On March 5th, Mr. Draper drove to his farm and saw a rough wooden model of his idea, which was set up in his hen-house. At Mr. Draper's recommendation, the firm ordered another loom for experiments, and after its arrival Mr. Northrop was started on April 8th to work out his scheme. By May 20th he had concluded that his first idea was not practical, and having meanwhile thought out a new plan, he asked for an extension of time until the fourth of July in which to perfect it. On July 5th, the completed loom was running at speed, and as it seemed to involve more advantages than the Rhoades pattern, the weaver was taken off of the Rhoades loom and transferred to the Northrop. On October 24th a loom with new construction, from revised patterns, was running at the Seaconnet Mill in Fall River, and more looms of the same kind were started up there at intervals. Mr. Northrop had, however, meanwhile thought out his idea of changing filling in the shuttle, some of the parts of such a mechanism taking shape as early as October. The development at our works continued so favorably that by April of 1890 a lot of filling-changing looms were started in the same Seaconnet Mill, the shuttle-changing looms having been changed back to common looms, in view of the additional advantages of the filling-changing pattern.

To show the situation at this period we quote from a letter sent a prominent mill official May 15, 1890:

"Replying to your favor of the 14th inst. would say that we are getting along as rapidly as we could hope or expect with our new shuttle patent, considering the fact that we are doing what seemed to be a very difficult thing and reaching out into a field where we have nothing to guide us.

We are now running 12 looms in a mill constantly. They are producing from 5 per cent. to 10 per cent. more per loom than other looms in the same mill and are all making first-class cloth. We have not yet fully tested them to see how great a reduction we can make in the number of weavers. This we are proposing to do at the earliest moment.

We do not feel at liberty to change one or more looms for you at the present time and in explanation will map out to you our proposed course and we think you will agree with us that our policy is a wise one.

What we intend to do is to perfect by practically running as long as seems necessary these 12 looms before making or trying any more. When we have perfected these 12 looms we propose to put in 100 or 200 looms and when these 100 or 200 looms are running to our entire satisfaction we shall hope to apply the invention to the entire mill. When the entire mill is running to our satisfaction we shall then be very anxious to try our inventions at other places.

Our reasons for adopting this course are, first, we want to devote all our time and energy and inventive capacity to perfect the design in one place so as to be sure we shall make a success of it there. We believe that in this way we shall be able to put the invention on 3000 or 4000 looms or 10,000 looms much more quickly and satisfactorily than in any other way."

Attempts have been made by interested parties to show that these earlier trials were experimental in character, and productive of nothing practical at the time. Such, however, was not the case. These earlier trials, both of shuttle-changer and filling-changer, showed practically operative mechanisms, which were run on many looms weaving cloth for the regular mill product, with the regular mill help: in fact, when we transferred our trial of mechanisms from Fall River to another mill centre, the looms which we left were run for months by the mill help without superintendence on our part, and without even a casual inspection by any of our men.

We left the twelve looms running under the normal supervision of the mill management in March, 1891. To show how well these early mechanisms did their work we quote from the following letter received from the overseer of the room June 27, 1891:—

"I am proud to inform you that there has not been a mishap of any kind this week. The looms are weaving faster than the spinning frame can spin. Mr. ——— seems surprised to see the weavers standing at the end of the frame waiting for the doffers and their looms stopped. Notwithstanding having to wait so many times for filling, the production for the week ending 27th is seventy-eight (78) cuts."

We found it would be necessary to build complete new looms in order to derive the best results from the new mechanisms. This required an entire equipment of the necessary tools and a considerable enlargement in plant, as we had never been loom builders. We also found that it was advisable to develop a practical warp-stop-motion for use with the filling-changer, and this of itself delayed the introduction of the loom for several years. We ran into annoying mechanical difficulties, it requiring a long time to solve the apparently simple problem of tempering the shuttle springs so that they would not break. Even with the loom complete in every detail, we were not ready to take large orders until we had equipped a weave room of our own and run it continuously for many months.

To go into further detail and cover the entire ground would require more space than can now be afforded. The further contents of this book may aid in giving a proper conception of the further development; and yet the finished products shown convey no intimation of the countless experiments and trials of devices which have not entered into the accepted combination. Many of these are shown in our voluminous patents; others are still unhonored. They all form a part of the unwritten story, however, and often might furnish interesting chapters.

Our manner of developing improvements is outlined in the paper of Gen. Draper delivered before the New England Cotton Manufacturers' Association on April 22, 1903.

"Our routine has been, firstly, to run a number of looms experimentally in a room in our shop, and by means of special observers, in addition to the weavers, to note results in detail. These results are collated in daily reports, which are preserved for study and reference. Notes are made of everything outside of perfect weaving, the breakage, wear or slipping of parts, the failure of mechanism to act every time as intended, imperfections in the cloth, like thick or thin places, the number of warp and filling threads broken and why they break, if it can be known. After studying these reports in connection with personal observation of the running looms, changes are made, with a view to improvement if possible. Pieces that break are strengthened, or strains are removed; parts that slip are more securely fastened; and wear is obviated where it seems possible.

New devices are suggested to obviate cloth imperfections, or breakage of warp or filling, of bobbins or shuttles. The new parts are made and tested in comparison with the old ones, and nine times out of ten they don't work as well. Perhaps they don't overcome the difficulty; perhaps in overcoming it they introduce new ones. After one failure comes another attempt, and as a rule another failure, but something is learned from each trial and the general course is towards improvement.

The worst troubles to find and cure are those that are intermittent and infrequent. A device will work as intended a hundred or a thousand times. Then it fails once from some unknown cause; then it goes on all right as before. One seldom or never sees the failure except in result, and if it happens before one's very eyes the motions of the loom are too rapid to make eyesight of much advantage. One can only reason in these cases and, as in some other matters, unassisted reason without sufficient data comes pretty near being a *guess*. However, guess we must or let the defect continue, and in some cases we have guessed right. In others we are still guessing.

After we reach what seems a real improvement on one loom, we try it on a dozen, more or less, and keep records for a month or two. Here again disappointment often comes in and we return to fresh study and experiment. If, however, the advance proves real, we next arrange a mill test; that is, we fill an order, or a part of an order, for looms with the new device, and submit it to the tender mercies of those who have to run it practically and without any special interest beyond "day-pay and Saturday night."

This kills many an infant invention that would be of value if properly cared for. No new device in minor detail can succeed in the mill if it causes extra trouble, even if it does better work; and if any new adjustments are introduced, they are almost sure to introduce wrong setting. Lack of adjustment induces filing and chipping to attain positions that our experiments have shown to be wrong, but the fixers have not been through the experimenting and sometimes want to make improvements themselves. Cams that have been carefully worked out have been filed or ground so that they would not work as intended and the device has been condemned, and in more than one instance operating parts have been cut off with a cold chisel and the new device pronounced valueless.

After this experience we re-design, simplify and try to make the new arrangement easier to run than the old, and if we succeed and accomplish the original design, we have made a step forward.

It is fair to say that from these mill tests we often get ideas of great practical value from intelligent operators, who see necessities that had not occurred to us, more than enough, perhaps, to offset the stupid condemnation of others who do not appreciate fine points and never will until they have become a part of their regular drill, and only then because if *they* can't make a machine run, there are plenty of others who know how to do it."

Perhaps nothing in the line of history is more significant than our various statements published in the way of advertisements in trade papers. The whole of anticipation, progress and realization is thus set down as it was, or assumed to be, at the time. Those that follow are actual quotations from publications of the years mentioned.

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."

"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."

1900.

"The greater part of the cloth woven in this country is made on plain looms. We have devoted about 10 years to the perfection of the plain loom and have now made it automatic and self-protecting against errors."

"We intend to keep up with the demand for our machinery if we have to roof in the whole town."

"A new common loom in a Southern cotton mill is now a curiosity."

"We are battling with nature, filling ponds, diverting river channels, raising valleys, etc., to make room on which to continue extensions."

"We still solicit orders in the confidence that bricks and lumber may be obtained in sufficient quantity to house our increase of plant."

"Why ship cotton to Europe when mills at home can manufacture it more profitably now that improved machinery gives them another advantage?"

"The great development of the Southern cotton mill system started with the Northrop loom and the continued association of the two forms an interesting object lesson."

"We melt 100 tons of iron per day to make the castings for our Northrop looms, etc. But that is not enough. Enlargements still in progress."

"We have now sold over 60,000 Northrop looms. We are shipping 1500 a month and enlarging our works to increase that output. We are employing 2500 men and shall greatly increase this force when new shops are ready. And what does this all mean? Simply that the success of the Northrop loom is astounding, even those who have held their faith."

"The steady progress of the Northrop loom is a certain evidence of its merit. Adverse criticism has often killed a good idea in its infancy while its strength was not equal to the struggle. We escaped the fate that many prophesied. Our loom has passed the trial stage."

"Let all who favor progress unite in placing American cotton mills where they can compete with foreign countries without reducing their labor scale to the standard set in England, Germany, Russia, India, China, Japan and other outside manufacturing sections."

"We build the famous Northrop Loom. It is also manufactured by our licensees in Canada, Germany, France and Switzerland. Four of these looms are running at the Paris Exposition, attracting wide attention."

"The successful development of our loom gives a mill a 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 employes it actually lessens the investment necessary for tenements and the labor used in paying off and supervising. The possible profit from a Northrop loom 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."

"New mills are flooding us with orders, and old mills must realize that equality in competition demands equality of equipment."

"We used to claim that weavers could attend Northrop Looms in the proportion of two to one common. The users are finding this prediction far too moderate as they often run three to four times their former limit. In several mills weavers are paid less than one-half the former price for weaving cloth per cut, and yet make higher wages than when running common looms.

A mill that cannot appreciate that statement simply cannot appreciate the tale told by concrete figures. Those who attempt to sell cloth handicapped by an extra cost of from one cent per pound upward, can cling to their obsolete common looms while their more enterprising neighbors glean the profits."

"We begin to feel quite independent in our loom trade, as the results of experience have proved that our position is absolutely unassailable. A few facts speak for themselves: Good weavers running 24 to 32 print looms and 20 3-harness looms."

"In one large print mill the average number of looms per weaver is 18."

"We are employing more hands than ever worked before in an American Cotton Machine Shop and are enlarging our plant in every direction."

"Every new idea meets the same opposition, goes through the same routine. In the first few years this machine had to bear the brunt of criticism, antagonism, doubt, fear, and misrepresentation. Now it suddenly sweeps away opposition, flooding us with orders, and necessitating the doubling of our plant. We intend to keep abreast of the demand if pig iron and steel can be obtained in sufficient quantity."

"It is an interesting problem to note how much longer the old mills can continue competition, when handicapped by the obsolete common loom."

1901.

"With a record of 75,000 looms sold, it is no longer necessary for us to predict what these looms will do.

We point to what they have done."

"Although our order list lengthens and strengthens, we do not adopt the simple and inexpensive plan of building without change, but continually add improvements whenever possible."

"We shipped more than 16,000 complete Northrop looms during the last year. What better testimonial of value could be presented? With our new plant and enlarged facilities we shall easily beat that record in 1901.

This simply means that those running common looms must expect a continuously harsher competition."

"Having adopted a business founded on improvements in cotton machinery, the habit of striving after perfection leads us, at times, to give the public more than they have required. Although the Northrop loom has sold faster than we could supply the trade, we have recently made many expensive changes, in spite of the fact that our customers, if ignorant of their existence, would probably have never realized the need of them. All loom improvements tend toward increased cost of construction. We have taken the common loom and not only applied important attachments, but have also raised its mechanical grade."

"Every loom that we sell furnishes an additional argument for replacement of common looms, as each Northrop Loom increases the competition that its rivals must endure.

Those having common looms must admit that, sooner or later, the Northrop loom, or some similar type, will replace them. Then why delay? Every year of postponement could have helped to pay the cost. Those who are waiting for the similar type to be developed can hardly find a large degree of encouragement from the present situation. They used to wait, in the same way, for spindles of possible competing capacity in earlier years. They waited five, ten, twenty years,—and then finally fell into line, after losing a large share of their comparative value. Some of them lost time and money in experiments with inferior styles, and history will undoubtedly repeat itself. Some insist on patronizing cheap doctors, cheap lawyers, and cheap eggs. Perhaps they are satisfied with the results. Our loom is not cheap in price, but is certainly cheap at the price."

"The success of the Northrop Loom has forced a series of wide spreading events.

It has delivered the trade in looms, for plain fabrics, of the United States, over to a company which had never sold one loom prior to 1895. It has stimulated the building of new mills and the increase of the American textile industry to an extent never before known. It has forced us to more than double our plant, and more than treble our number of operatives.

The profits have been shared with the manufacturer, who has cheapened production; and by the laborer, who has received better wages.

While common loom mills are shut down, Northrop loom mills continue running."

"We shipped more than 25,000 complete Northrop looms during the eighteen months of January, 1900, to July, 1901. What better testimonial of value could be presented? Southern mills are taking their share, but there are still thousands of old looms that ought to be replaced."

"We shipped nearly 6,000 looms in the first three months of the year 1901.

Facts like these carry conviction to those of average comprehension. We shipped over 9,000 Northrop looms from our works in the six months ending July 1, 1901. Further comment is unnecessary."

"We enter on the seventh year of our loom business with an enormous order list, a doubled plant, and a reputation established by the experience of our customers.

Every claim has been justified, every assertion proved.

The Northrop Loom *does* halve the labor cost of weaving, *does* make better goods, and *does* earn dividends for its purchasers.

Having absolutely removed the common loom from competition, so far as new sales are concerned, we may next have to spare some slight consideration for the mushroom element of automatic substitutes designed to share the fruits of our victory. Let none of us get unduly excited, however, until their trial has proved them worthy of attention."

"We started to apply attachments to looms in order to make them more automatic. We soon found it necessary to first improve the loom itself. We believe that we are turning out a weaving machine fit to class with other developed mill machinery, and not a cheap mass of ill fitting parts, half wood, half metal, nursed into efficiency with bits of leather and string.

Our castings are machine moulded to ensure uniformity. They are drilled in jigs and assembled to gauges. We use iron and steel wherever possible. We know we put more expense into this loom than any other builder of similar machines. We are not content with having already done a larger loom business per year than any competitor. We see no reason why we should not sell all the looms needed for plain weaving."

"Our total sales to date, including old looms changed over, amount to over 74,000.

We have built up a modern plant of large capacity in order to meet the demands of our customers, and now have 22 acres of floor space in connected buildings, the greater part of which represents recent construction.

We are now ready for increased business and await it with a confidence based on the evolution of the past. It may be noticed that we refer more often to the amount of our sales than to the details of our products. The latter course would simply illustrate *our* opinion, while sales illustrate the opinion of our *customers*—and that counts."

"We know no half-truths in mechanics.

A machine is either efficient or incapable—superior or inferior.

The Northrop Loom has now been running in large quantities for more than six years. Its success is proved by the frequency of orders from those having the knowledge that comes with use. Some of the earlier customers have lately wished to actually duplicate those first machines part for part.

But we build a better loom now.

We have an experience gained by continued construction and experiment. We have vastly increased our range and our variety of models. We cannot only show a purchaser important novelties, but can refer to successful operation in any of the ordinary lines of application."

1902.

"The largest single order we have yet taken has just been placed with us for Northrop Looms by the Grosvenor Dale Co., of North Grosvenor Dale (and Grosvenor Dale), Conn.

These looms were chosen after lengthy and continued trial of former lots. These were used in a wide variety of cloth, including various standard weaves for which the Grosvenor Dale Company has long been famous. Those who have been cautiously awaiting the outcome of others' experiments may now perceive the verification of our earlier contentions."

"The Spindle and the Loom.

Our first ten years of spindle sales, about 2,000,000.

Our thirty years of spindle sales, about 20,000,000.

Every prominent mill in the country uses them in their Spinning Frames or Twisters.

And yet in the first ten years the introduction was comparatively slow.

Our first seven years of loom sales figure over 75,000 (including looms changed over), and there are only about 375,000 looms in this country to which our improvements are at present adaptable.

Every mill that waited to change spindles made a mistake. They admit it by their present policy.

A less proportion are making the mistake of indecision in the loom line, but the conservative are still ruining their chance in the same old way.

Every year of delay means just so much lost profit. The above figures of fact prove more than pages of argument. Think them over."

"On June 1st our unfilled orders for complete Northrop Looms figured exactly 15,701—and the boom has hardly started."

"Our unfilled orders for complete Northrop Looms figured exactly 21,586 July 1st, 1902. The boom is beginning to boom."

"Delegations of foreign business men, operatives and labor leaders have been visiting this country to investigate the claimed advantages of our Northrop Loom.

We started selling them eight years ago and have averaged sales of over 10,000 per year.

Outsiders are becoming alarmed and yet there are American mills still blindly buying common looms.

Not that we have any reason to complain. It takes a doubled plant to keep pace with our orders—but it ought to take a trebled plant."

"In spite of loom shipments during August of 1799 looms, our unfilled orders still amounted to over 20,000 September 1st, 1902."

"Out of 64,540 looms now running or ordered by the single state of South Carolina, 27,980 are Northrop Looms."

"20,000 looms to build. 20,000 Northrop Looms. Equivalent in cost to 60,000 common looms. 10 months' work at 2,000 looms per month and new orders coming in all the time. Works must be increased again. 300,000 looms yet to be replaced in the United States alone, and new mills being organized. Such is the situation confronting the Draper Company of Hopedale, Mass."

1903.

"We shipped 15,746 complete Northrop Looms in 1902, and applied besides, 1,028 filling changers and 1,234 warp-stop devices to looms in mills.

We commenced the new year by shipping 2,500 complete looms the first month.

Let the good work go on."

"Our present output of Northrop looms, over 2,000 per month. The majority of new orders are placed by Southern Cotton Mills."

"We have today sold over 80,000 complete Northrop looms. We have applied attachments, in addition, to over 15,000 looms. We figure that there are still 350,000 looms that must be replaced. They will vanish as surely as the common spindle and the old style card. We are enlarging our plant to prepare for their elimination. In a certain well known mill six weavers and four boys to fill hoppers run 216 Northrop looms. In another mill no weaver runs less than 24 Northrop looms. Facts like these breed conclusions."

"We have a new Northrop Loom that should be of interest to weavers of print cloth and similar goods. It has the latest large pattern hopper, our steel-harness warp stop-motion with simplified knock-off, a double fork to prevent thick and thin places, the simplest take-up ever devised, our improved Draper-Roper let-off, and a new device called the Anti-bang, which prevents jar and breakage when a shuttle is trapped. We call it the J model. Large orders already being filled."

THE PRESENT STANDING OF OUR LOOM—APRIL, 1904.

A record of over 100,000 looms actually introduced within a period of nine years, sold at prices equivalent to three times the cost of the common looms with which they compete, is certainly sufficient evidence that the Northrop loom has come to stay. The amount thus paid us for Northrop looms would actually replace three-quarters of the common cotton looms now running in the whole United States. As our last year's sales were larger than those of any previous year, it is evident that the introduction is not based on any quick enthusiasm, or false data.

We started with the assumption that the Northrop loom would enable the weaver to produce a doubled product; in fact, before even making this modest assertion, we proved its truth to our own satisfaction by running a weave room of eighty looms in our own works, for many months, open to the inspection of hundreds of practical mill men. The first looms that we put out were therefore seasoned, as it were, by experience; in fact, the first models ran so well that we have been asked in recent years to duplicate them.

It is no slight task to introduce an improved machine which aims at replacing the entire equipment of the most important section of one of the greatest industries in the world. It cannot be done in one year, or one decade. Nothing within our memory has so completely ousted competition as the high speed spindle; and yet comparison of sales will prove that our loom has met with readier appreciation in the earlier years. There are still several hundred thousand common looms which should be replaced, and which will be replaced. The delay is not due to hesitation based on disbelief, but rather a hesitation based on financial conditions. With new mills, where capital is raised by subscription, equipment with Northrop looms is becoming a matter of course; but an old mill faces a serious proposition when considering the replacement of an entire division of its plant, where the surplus is not sufficient to meet the cost, and where stockholders are not inclined to pay assessments, or take new stock. The mills that have a comparatively new equipment of common looms are naturally indisposed to reduce their valuation by considering them practically worthless for active use. We are, however, selling tons of looms for junk, that are equal, if not better, than similar looms still bought by a few obstinate adherents to obsolete methods. There is also a class of overshrewd managers who wait in hope that competition may reduce our prices, or that patents will expire in time to force a reduction to meet their demands. Nine years of constant introduction finds the anxious ones still waiting the possible competitor; and the constant improvement, with continual issue of important patents, assures us that our hold on this line will continue beyond the time to which their hopes might limit us. Meanwhile these waiting purchasers are losing the possible profits of use. The fact that they may be making favorable showings by reason of "luck" in purchase of cotton, especial advantage in situation, labor, or power, cannot disguise the fact that with the Northrop loom their profits would be still higher.

When we refer to the Northrop loom improvements, we are speaking primarily, of the filling-changer, the warp stop-motion, and their co-operating parts. Before our application of these devices, there had never been a successful use of filling-changing devices of any nature, and warp stop-motions were only used in a very limited field, a few instances being known of their application to special classes of double warp weaving. There is hardly any vital change in any line of mechanics, which so suddenly brought successful automatic mechanism into extensive use, without the preliminary record of long use of partially successful devices of similar nature. This fact is particularly curious, in view of the fact that a warp stop-motion was one of the inventions disclosed in the original power loom specification of Cartwright, as shown in his patent of 1784. Many inventors had struggled for years with the problem of automatic change of shuttles. The inventor of the Northrop filling-changing devices, however, borrowed practically nothing from the former art in this line, and when it was found necessary to incorporate a warp stop-motion with the filling-changer, there was nothing formerly developed that could be adopted, and inventors practically started in this field also without the aid of prior thought.

Neither the filling-changer nor the warp stop-motion necessarily increases production in the loom itself. The filling-changer does save time formerly occupied in changing shuttles by hand, with the loom stopped, but the warp-stop-motion actually decreases production by stopping the loom oftener than it would be stopped in the common practice of plain weaving. The combination of the two devices, however, allows the operative to multiply efficiency; for the filling-changer replaces labor, and the warp stop-motion relieves the annoyance of constant oversight. To appreciate the great saving introduced by the filling-changer, it may be well to note the operations gone through by a weaver on a plain loom, when the filling is exhausted. They follow in the sequence now recorded, the weaver performing the following functions:

1. Releases the shipper brake.
2. Pushes the lay back.
3. Withdraws the shuttle.
4. Puts the reserve shuttle in the shuttle box on the lay.
5. Pulls the shipper handle to start the loom.

6. Rubs the cloth below the breast beam to prevent a thin place, if light goods are being woven.

7. Picks up the discarded shuttle again.

8. Pulls the shuttle spindle out on an angle.

9. Removes the empty bobbin or cop tube.

10. Puts in a new bobbin or cop.

11. Pulls off a sufficient length of filling.

12. Snaps the shuttle spindle back into place.

13. Holds the filling over the shuttle eye entrance.

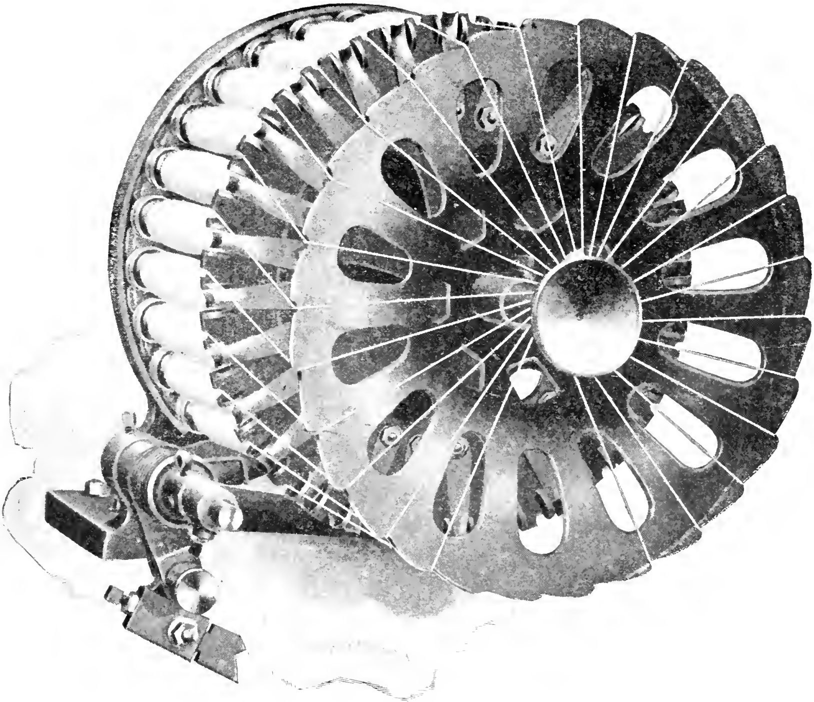
14. Sucks the filling through the eye.

15. Places the shuttle in its holder, where it remains until needed.

Now, this series of performances must be gone through with every time the filling is exhausted. On one loom, the filling may run from one minute to twenty minutes, according to the size of the yarn and the amount of yarn in the shuttle. The average time is perhaps six minutes, especially if we count the number of times that the weaver must come to the loom to start it up when the filling breaks. With a loom having an average of six minutes between such stops, the weaver must come to the loom once every ten minutes. If running eight looms, he would have such a duty nearly once a minute. With the Northrop loom, on the contrary, the weaver can fill a hopper containing 25 bobbins, which, with the same average of running time, would last two hours and a half, without requiring attendance. But a co-operating feature of great advantage with the Northrop loom is the fact that the weaver can fill the hoppers when convenient, rather than be forced to come to the looms with irritating regularity.

Referring to the associate attachment, the Warp Stop-Motion, it is, of course, well known that the warp threads will break in weaving. On a common loom, the broken thread will not be raised by its heddle, and thereby leaves an open space in the cloth, more or less visible to the eye, according to the character of the goods woven. Very often the broken end gets tangled around adjacent threads between the harness and the reed, holding several of them either above or below the tip of the shuttle, which therefore causes a defect known technically as a "float" or "overshot." If the weaver does not notice the fault promptly, the extra strain will break many of the warp threads, and in any event, a pickout is necessary. In some mills, a weaver is forced to stop all looms under his charge while attending to a pickout. It is not necessary to explain the trouble caused by these defects to any weaving expert. The temples must be pulled back, all the filling threads that have been laid since the tangle commenced removed by a tedious combing operation, the warp beam must be turned back, the tension of the cloth properly adjusted, and the loom again set in 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 that it was absolutely necessary to furnish a protection in the way of an accurate warp stop-motion, so that there should be no mental anxiety whatever, and no necessity for alert observation. It took our inventors several years to produce a practical mechanism of this nature; in fact, the introduction of the Filling Changer itself was delayed for quite a period while waiting for the associate mechanism. With the protection of the Warp Stop-Motion, a weaver is only limited in the number of looms attended, by the amount of warp breaks which must be repaired, and the number of bobbins which can be put into the hoppers within the time to be given. Under present systems, Northrop loom weavers are usually relieved of oiling and cleaning their looms, so that apart from the warp and filling duties, they have practically nothing to attend to, save the removal of the cloth.



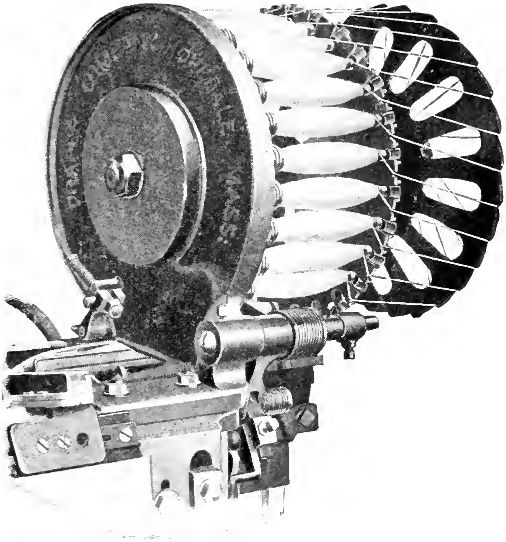
PERSPECTIVE VIEW OF LARGE HOPPER, ORIGINAL DESIGN.

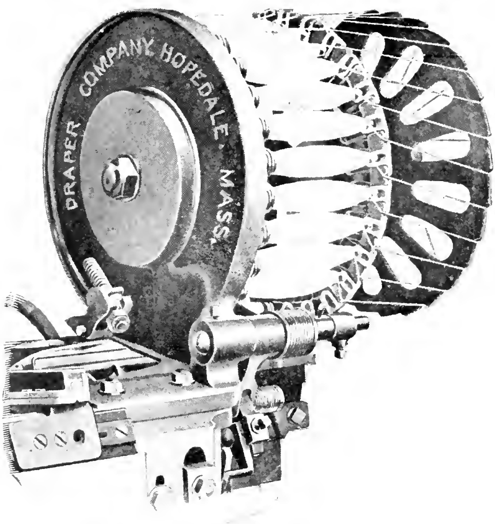
Taking the various attachments in order for detailed consideration, we shall consider the Hopper first, as the more important element of the whole combination. The cut shows the "Large Hopper," or "24-Bobbin Hopper." It is operated in rotation by the reverse motion of the transferrer. Our latest forms have a new and improved bobbin support,

provided with a leather washer cushion to prevent breakage, and we are also using a new form of bobbin tip holder, which will take either bobbins or cops, as desired. We started with a hopper that held a supply of 14 extra bobbins, but the change to the 24-bobbin hopper has proved a distinct advantage, removing the Northrop loom still further from competition with the possible perfected Shuttle-Changing loom, which would probably be limited to a reserve supply of six or eight shuttles. We proved by an absolute test on our old hopper, that a reduction in the number of bobbins held in reserve, placed an absolute restriction on the weaver's capacity; and the converse of the proposition is a natural sequence.

A vital principle of the Northrop invention is contained in the Shuttle, which is adapted not only to hold a bobbin or cop skewer, but to hold it so that it may be automatically removed by the entrance of a new bobbin or cop skewer. The spring jaws of the Northrop shuttle co-operate with the rings or ribs, on the bobbin or cop skewer, so as to hold either one normally

Our first Large Hopper. Holds twenty-four extra bobbins. Is rotated by reverse action of transferrer.





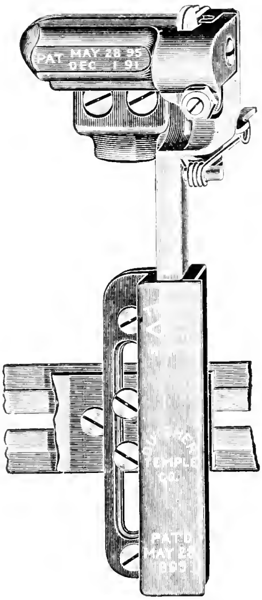
Present pattern Large Hopper. New end holders adapted for either bobbins or cop skewers. Also new bobbin support, and thread discs with wider surfaces for thread to bear against.

in proper horizontal position, and yet liberate them quickly when opened by the entrance of the new filling-holder, pressed into the shuttle from the hopper when the transferrer is in motion. The Transferrer is a simple pivoted lever with a hammer head, normally in position over the lowest bobbin in the hopper. A pivoted dog attached to a crank arm on the transferrer is normally out of reach of a moving part on the lay called a "Bunter." When the supply of filling in the running shuttle is either broken, or exhausted, the ordinary weft fork detects the fault and by simple co-operation with a moving shaft raises the dog aforesaid to meet the impact of the bunter, thereby transfering the forward movement of the lay through the transferrer pivot, to press the transferrer head down onto the reserve bobbin in the hopper, and push it into the shuttle. The bobbin formerly in the shuttle falls through the exit opening of the shuttle, down onto a guiding chute into a large box, or receptacle, attached to the loom side.

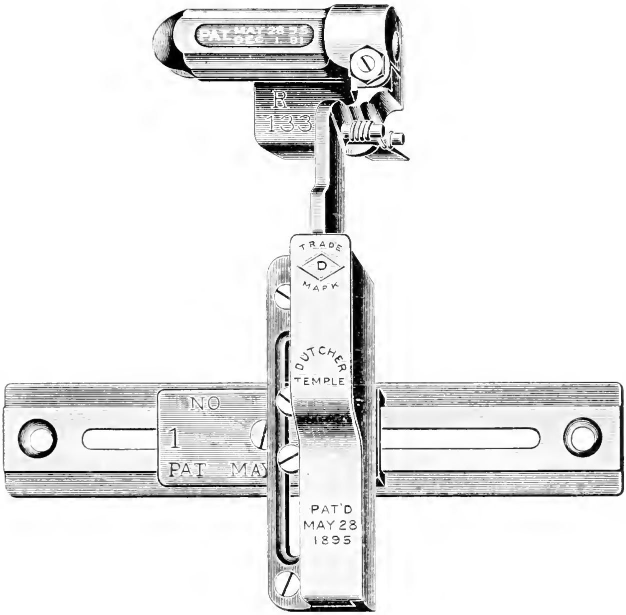
Reference to the cuts, which show various views of the shuttles, bobbins and cop skewers, will make the operation clear.

It is not only necessary that the new bobbin should be placed properly in the shuttle, but it is vitally necessary that the thread on the new bobbin should enter the shuttle eye, so that it may be properly drawn off in weaving. The threads of the bobbins in the hopper are wound round a stud in the center of the rotating hopper itself; and when a bobbin is transferred to the shuttle and the shuttle is thrown by the picker-stick, the thread still held by the hopper disc automatically enters the slotted eye of the shuttle; the final position, however, not being attained until the shuttle has been thrown back from the opposite side of the loom.

It is quite evident that when the shuttle receives the bobbin it must be under the hopper in approximately correct position. Variation is allowed by reason of the several notches in the shuttle spring, and also by reason of an incline, which guides the bobbin down into the spring, even if the shuttle be quite a distance out of place. To protect against any abnormal position, which would cause the incoming bobbin to strike a solid part of the shuttle and cause breakage, we provide a device known as the "Shuttle Position Detector," which reaches a finger across the front of the shuttle whenever the dog on the transferrer is raised. If the shuttle is in the path of this finger, the dog will not be raised sufficiently to encounter the bunter, and therefore no transfer will take place. If this be twice repeated, the loom stops automatically by a device called the misthread stop-motion, attached to the fork slide, so that the weaver knows that the shuttle is not being properly picked. The same mechanism will also stop the loom, providing the hopper is exhausted, or providing the shuttle fails twice to thread, or "misthreads," as we term the operation. It will be remembered that the thread on the incoming bobbin is attached to a stud on the hopper. It therefore extends from the stud to the cloth, and, if not attended to, would break in time from the strain, as the cloth moves towards the take-up roll, and the snapped end might fly into the cloth. We therefore provide a Thread-Cutting device, attached to the regular temple, which operates from the motion of the lay to sever any such threads close to the selvage. As it operates every time the lay beats forward, it has many chances to cut the thread.



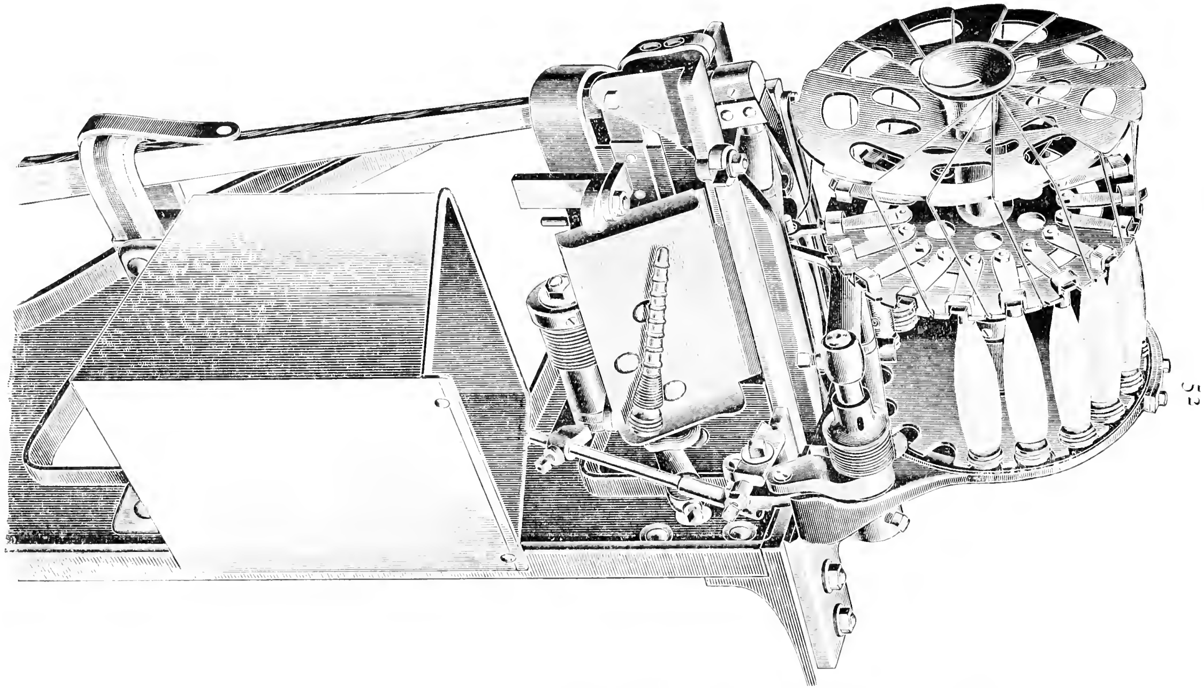
Early form of Thread-Cutting Temple.



Later form of Thread-Cutting Temple.

Made with solid heel so that a loose heel will not bring extra strain on the cutter and cause the temple to be reciprocated through the cutter.

It may be noticed that Filling-Changing mechanism includes five distinct and separate devices, namely: the Filling-Changer itself, the Shuttle, the Shuttle Position Detector, the Misthread Stop-Motion and the Thread-Cutting Temple. There are, therefore, several distinct lines, all covered by patents, many of which extend much longer than the original patents on the original mechanism.

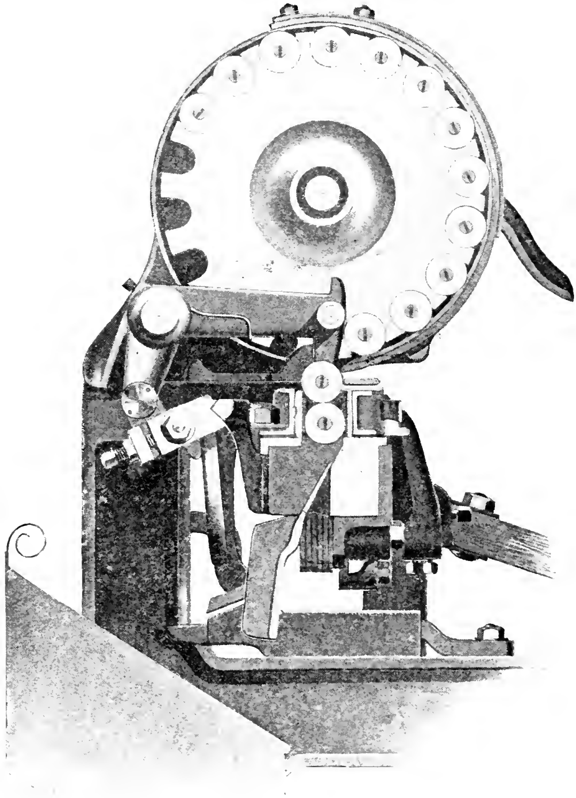


DETAIL OF HOPPER MECHANISM ON A MODEL LOOM.

(Other parts of loom erased.) Shows empty bobbin falling into box while fresh bobbin is being inserted.

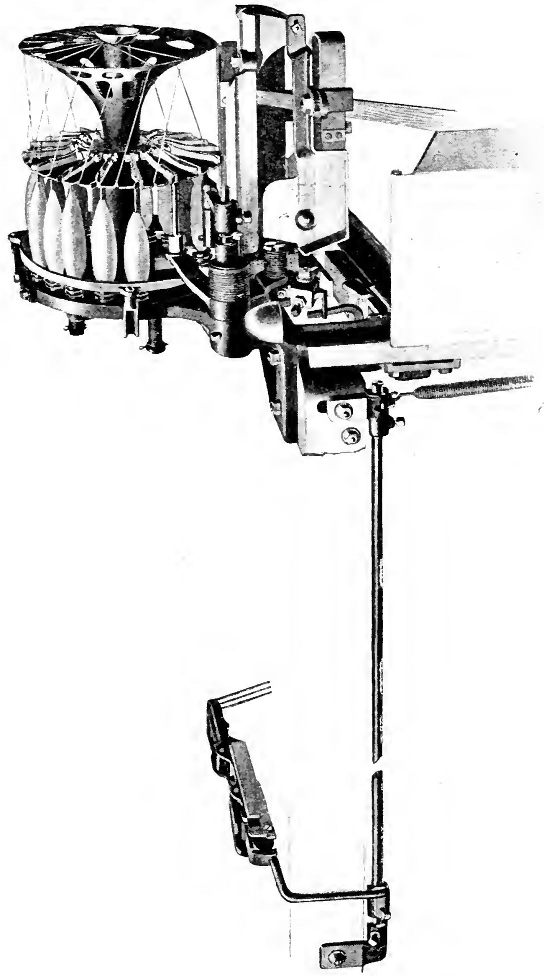
As shown, the transferrer is placing the bobbin in the shuttle, the dog being in engagement with the bunter on the lay. The empty bobbin is falling down the chute into the box. The chute as first designed was a movable part, independent of the lay itself.

This cut was made from our first model loom and happens to show the hopper on the left side, we making hoppers in rights and lefts at that time.



CROSS-SECTION OF A NO. 1 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 down the chute to reach the box. The expelled skewer is not empty in this instance, as it illustrates a case in which the filling thread broke while weaving.



DETAIL OF CONNECTION

Between the filling fork which detects the absence of filling and a No. 1 cop hopper or magazine.

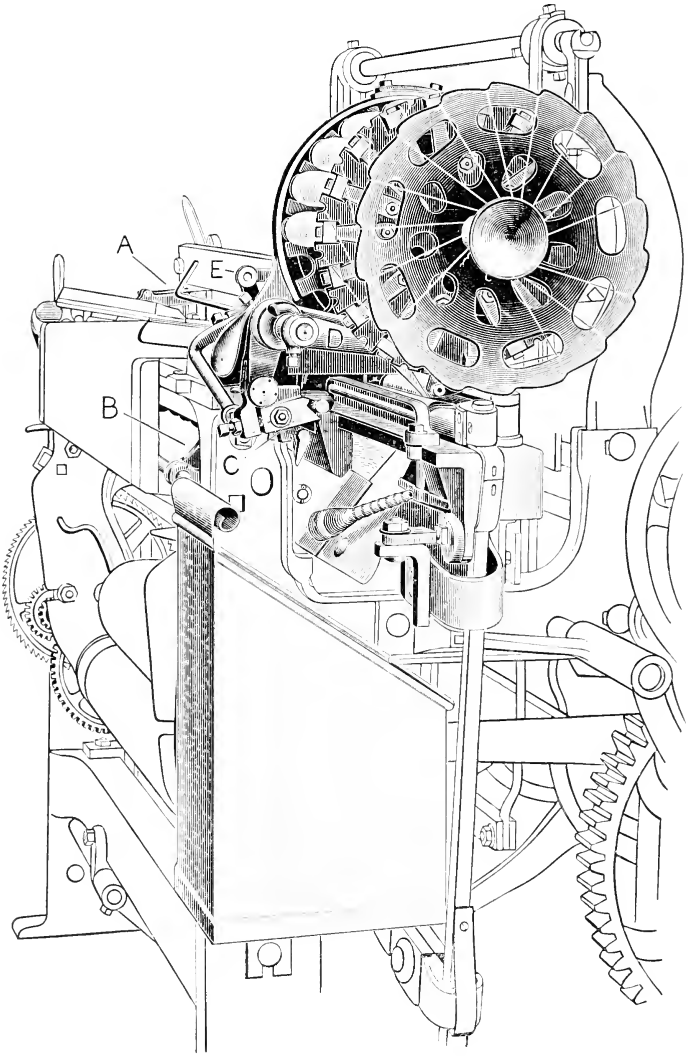
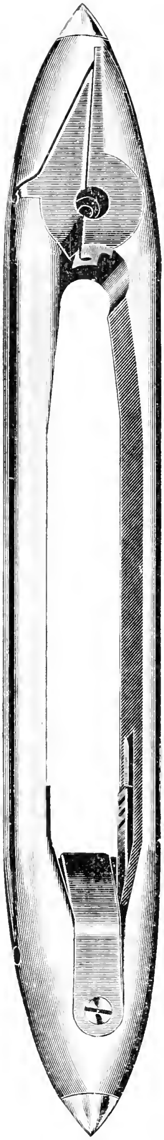


ILLUSTRATION OF HOPPER ACTION ON B MODEL LOOM.

A is the filling-fork which detects absence of filling, and through the usual catch and vibrator gives action to rod B controlling latch C.

When latch is raised it will be in contact with a bunter on the lay, thus forcibly depressing the transferrer D which pushes a bobbin from the hopper into the shuttle beneath it, at the same time expelling the one carried by the shuttle, which is then guided into the large tin box held on the loom side.

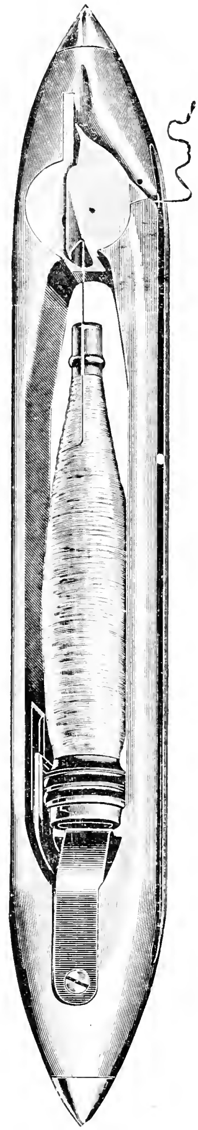
E is a portion of the device which determines the position of the shuttle in the box. If not properly in place the latch C will not engage the bunter, as the device of which E is a part will be prevented from further movement by contact with the shuttle tip, and as E and C work in unison, the movement of C is also checked. This special shuttle position detector did not go into extensive use on our own looms but was adopted as standard by our Canadian licensees.

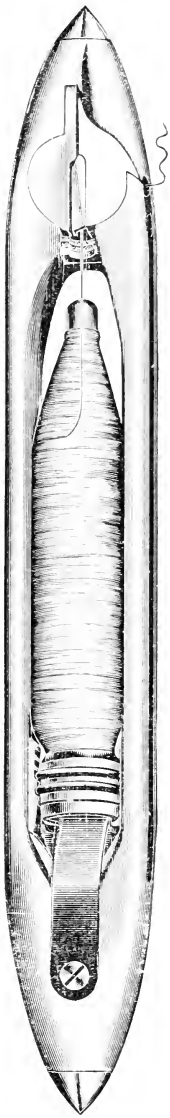


A FEW OF THE SHUTTLES USED WITH OUR NORTHROP LOOMS.

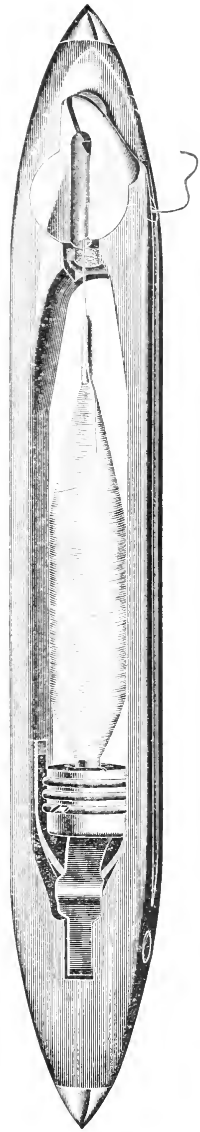
Shuttle at the left is known as the "Keeley," although incorporating the spring of J. H. Northrop and the incline cover of G. O. Draper.

Shuttle at right is known as No. 7 in our shop records. It has what we know as the "Stimpson" eye. This first model had no friction pocket and the eye casting was held by a nut on the bottom.

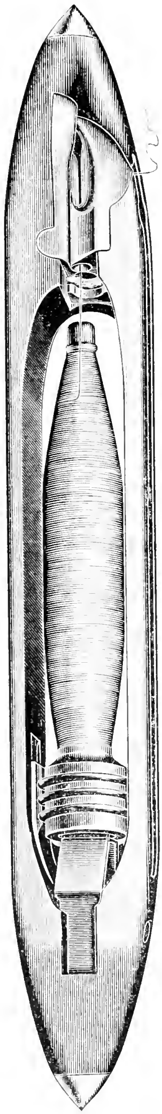




No. 16 Shuttle. Stimpson improved eye with pocket for flannel friction, the casting being held in the shuttle body by a transverse bolt and nut. Various modifications have other numbers, but this is the regular standard design which has gone into most extensive use.



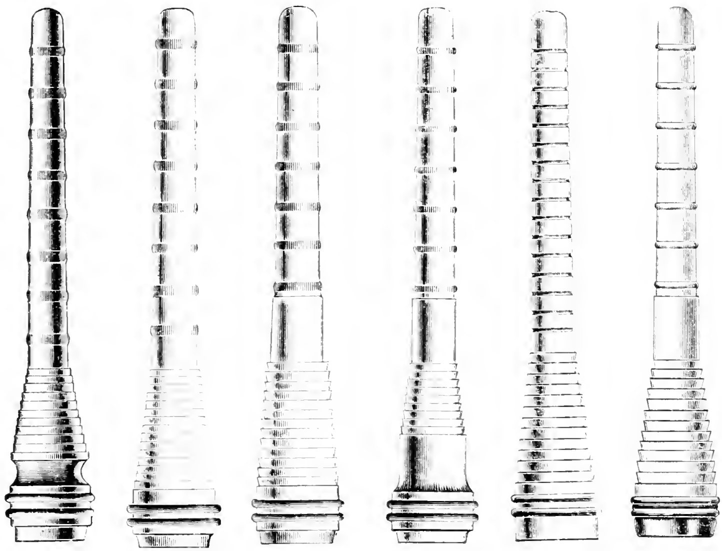
No. 167 Shuttle. Stimpson special eye and new spring and cover. A very satisfactory model. Note the new spring and cover which leave the wood of the shuttle body less cut out and therefore stronger. We have little trouble with loose springs in this design.



No. 263 Shuttle, or Jonas Northrop Eye style. Very successful on cops and coarse filling; in fact, the best threading eye which we have for all classes of work.

This shuttle saves filling breakage and makes misthreading immaterial.

We recommend it unreservedly until a better design is possible.



1 2 3 4 5 6

NORTHROP LOOM BOBBINS AND COP SKEWERS.

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

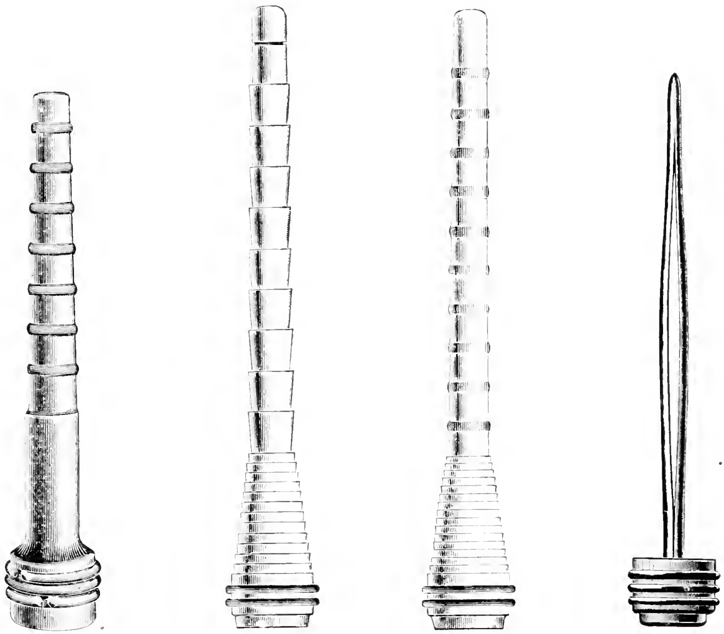
No. 2. First abandonment of groove at base.

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 on this and No. 6, made larger than formerly. We fit all our new looms to take this bobbin, as it has greater strength and is less affected by reaming. Of course, all the other patterns can have this same base. In ordering filling spindles for these bobbins be careful and specify the large cup.

No. 6. Special metal base cover extending under bobbin rings to prevent their loosening. A most important improvement.



7 8 9 10

No. 7. Feeler bobbin for use with feeler or mispick preventer loom. This style has three rings on base. Note chamfer on rings at ends. We have all our rings made in this way now, as they are less liable to catch yarn in the spinning-room.

No. 8. Long traverse bobbin, special notches on barrel.

No. 9. Long traverse bobbin with ordinary ribs.

No. 10. Cop skewer.

Our bobbins and cop skewers are made in three lengths.

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 those shown are approved by use.

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

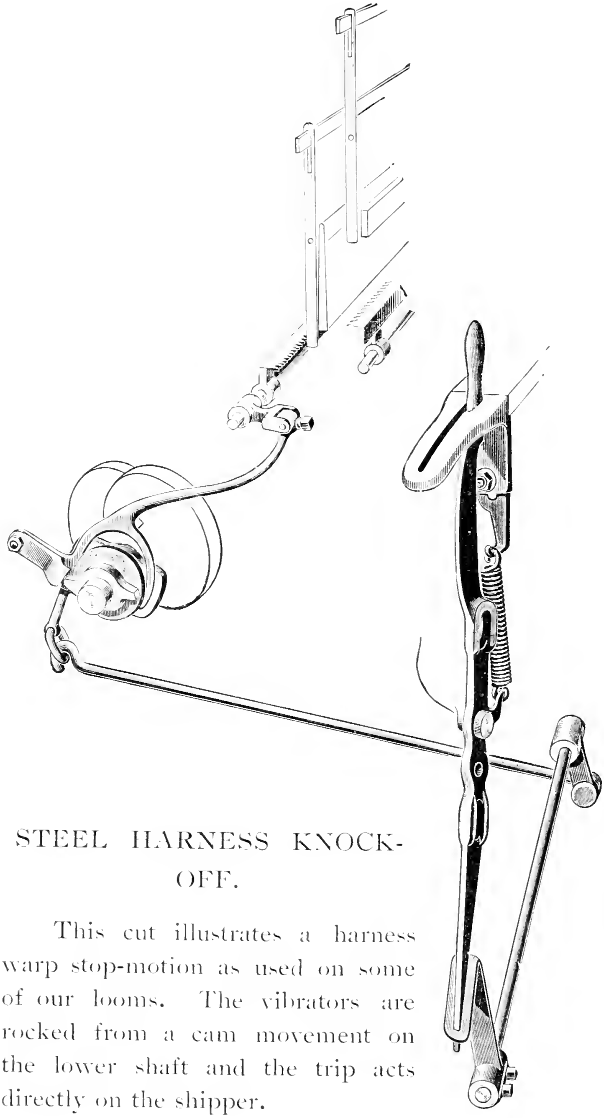
We insist on this simply to protect the successful operation of our looms. We do not take profit enough to pay us for the trouble in handling this part of the business.

"A few nights ago the night watchman of the mill told of seeing strange sights and hearing queer noises during the small hours of the morning. He is a sober man of middle age and in perfect health, so it was hard to find reason for not believing his story.

He says that shortly after midnight he heard a noise in a remote corner of the mill like the running of weaving looms. He went there and found six looms running at full speed without any apparent motive power and cloth was being woven without any guidance."—[*From dispatch to the New York World, Nov.* 17, 1900.

"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 couple 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.*



STEEL HARNESS KNOCK-OFF.

This cut illustrates a harness warp stop-motion as used on some of our looms. The vibrators are rocked from a cam movement on the lower shaft and the trip acts directly on the shipper.

WARP STOP-MOTIONS.

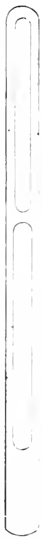
At the start of our loom introduction, we limited ourselves to the weaving of two-harness goods, utilizing simple warp stop-motion devices, which were perfectly efficient in this field. When we began to supply looms to weave with 3, 4 and 5 harnesses, together with the field covered by dobbies, it became necessary to develop new designs, so that we now have four distinct styles of warp stop-motion, and modifications in each class. Whenever possible, we recommend the use of our steel harness stop-motion. This has only been adapted to more than two harness work in recent years. With this arrangement, the heddles themselves serve as warp-stop detectors, being thin, flat steel ribbons, sufficiently stiff to act in arresting the motion of a vibrator. The heddles are strung on bars, through slots much wider than the bars themselves; thus when a thread breaks the heddle may drop a distance equivalent to the extra length of the slot, and thus come within the path of a moving vibrator which, when arrested, effects the stopping of the loom by intermediate mechanisms.

The advantages of the Steel Harness Warp Stop-Motion over all other kinds are numerous. In the first place, the heddles themselves are practically indestructible. They show no signs of wear after years of use; in fact, they are probably better for use, through the polishing given by the passing threads. The cotton harness, with which they compete, wears out, needs revarnishing and probably averages an expense for repair and replacement of perhaps a dollar a loom per year. We see no reason why the steel harness should not wear at least twenty years, saving some nineteen dollars in actual outlay, if our premises are correct. Another important advantage, especially noticeable with coarse yarn, is the saving of expense in drawing-in. Cotton harness warp stop-motions, with additional warp-stop detectors, cost more to draw in, because the drawing-in hand has to draw threads through the detectors as well as through the reed and harness. Our steel harness is even easier to draw in than the cotton harness, for the heddles may slide on the bars at will, accommodating themselves to the convenience of the operative. Another advantage of the steel heddle warp-stop is that it will stop more promptly, preventing warp runs after warp breakage; and it does not stop so often for slack threads. A further advantage, of great importance in mills where they change the product frequently, is that the steel harness heddles space themselves automatically, so that the same harness may be used for various weaves. The free lateral movement also allows the weaver readier access when repairing broken warp threads.

We have been asked more than once why it is that the shuttles in a Northrop loom fail to throw out of the loom like the common shuttle; in fact, our shuttles stay in the shade so uniformly as to question the need for shuttle guards. The reason is easily seen on investigation. Shuttles are thrown out of looms for several possible causes, but the most frequent one is the formation of floats, or the preliminary to a pickout. All of our looms will stop before a float can make serious trouble, and our steel harness warp-stop type will stop the loom before the warp threads can tangle sufficiently to swerve the shuttle from its proper course.

In the line of steel heddle warp-stops we are absolutely without competition. No other loom builder has ever attempted to introduce this class of devices, to our knowledge.

In the earlier use of the steel harness, it was claimed that the steel heddles broke more warp threads than the twine harness. This may have been true at that time; yet the advantages were more than enough to compensate. After learning proper methods of sizing, proper shape of cams and proper arrange-



No. 2

No. 3

No. 1 Steel heddle.

No. 2 Cotton harness drop wire for "Roper" warp stop.

No. 3 Detector for single-thread stop-motion.

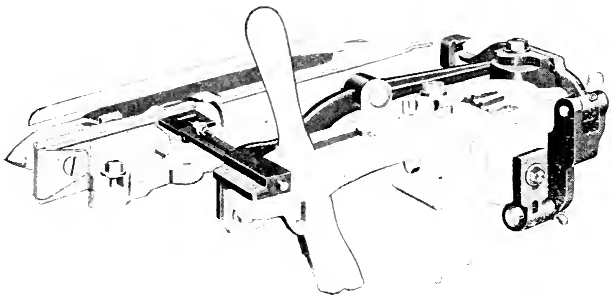
ment of heddles in their frames, we have now brought the steel heddle warp-stop where it is practically equal to the cotton harness in the number of warp faults. On regular print weaving, we find the stops for both breaks and slack threads combined, is between 10 and 15 per day, per loom, with either steel heddles or cotton harness.

At present, we do not supply steel harness mechanisms for a greater number than five harnesses.

The original cotton harness warp stop-motion which we introduced, used a drop wire device applied between the heddles and the lease rods, each detector serving for two or more threads. This could be used on looms having more than two harnesses, in a large number of applications. This motion was very successful and has been used on thousands of looms. We are recently applying a stop-motion situated between the lease rods and the harness, but which uses one detector for each thread, which looks very promising for cotton harness work with any number of harnesses.

A fourth type is known as our Single-Thread Warp Stop-Motion, and has been very largely used in recent years. In this class, one detector acts for each thread, and a peculiarity is noticed in that the detectors are arranged in two banks, and placed in the position of the usual lease rods, where they accomplish the functions of leasing devices, as well as warp stop-motions, doing away with the necessity for leasing rods, and simplifying the loom to that extent. Where drop wires are applied back of the usual lease rods, a broken warp thread does not always promptly allow the drop to operate, as the lease rods sometimes make sufficient friction on the thread to hold the drop in position.

While we are subject to more or less competition in applying warp stop-motions to old looms, our competitors are either limited to use of electrical devices, with their inherent evils, or to the use of warp stop-motions in which the detectors are subject to a more or less severe twisting strain. Our patents cover the use of serrated vibrators which can engage the detectors without twisting and bending. Sometimes the vibrators and co-operating devices on competing devices are made light and delicate, in order not to bend the drops, and therefore are less positive in action, and more liable to damage. So far as the application of warp stop-motions to other than Northrop looms is concerned, we were interested primarily in applying warp stop-motions to looms that could not use the filling-changer, such as drop box looms. We have taken little interest in attempting to introduce warp stop-motions on common looms for plain weaving, because we consider such application a mere makeshift, in view of the greater advantages of the combined filling-changing an l warp-stop, which the mills should avail themselves of, rather than attempt to try and cheapen their weaving by adding expensive devices to old machinery. Warp stop-motions of themselves, do not lessen the weaver's labor, except in the prevention of floats and overshots. Every thread that breaks must be pieced up, as formerly, and it is even possible that the additional weight of the detectors causes more breakage.

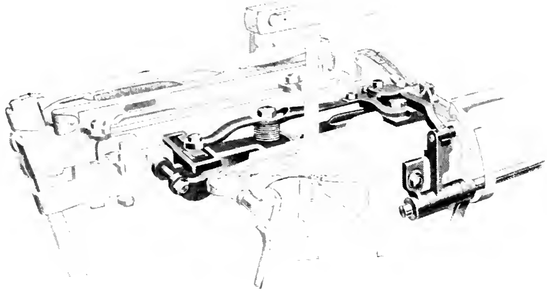


DEVICES FOR MAKING PERFECT CLOTH.

The third new attachment introduced with the advent of the Northrop Filling-Changer and the Warp Stop-Motion, is a mechanism only used on certain classes of goods, which co-operates with the filling-changer to prevent mispicks, and thus make perfect cloth. Mispicks are due to the running out, or breakage of filling, and the insertion of new filling without removing the particular thread of weft remaining in the shed, and also without inserting the new filling in the proper shed. In the general line of goods woven, mispicks have not been considered as important defects, but with other goods, such as napped fabrics and certain classes of multiple harness weaving, mispicks are not allowable. In common loom weaving, they may be obviated by extra pains and extra labor on the part of the operative, who can pick out the particular thread by hand, and turn the loom over to find the true shed before inserting the full shuttle. With automatic looms, the prevention of mispicks is attained by changing the filling before final exhaustion, so that a full thread is left in every shed. If the filling should break, the loom may be stopped automatically, so that the weaver can find the pick; or, if such breakage is not frequent, the loom may be arranged to run the chance of a mispick at such periods.

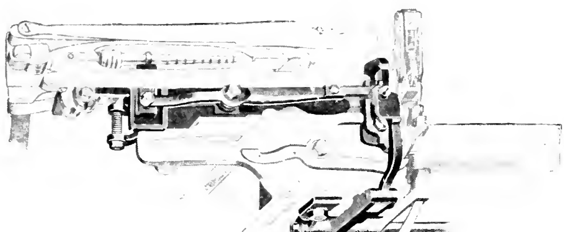
The mechanism employed for this purpose consists of a simple device called the "Feeler," because it feels of the weft in the shuttle through an opening in the shuttle side, and absolutely measures its volume. When reduced to a certain definite quantity, the feeler operates to liberate mechanism governing the action of the filling-changing devices.

The cut first printed shows our latest feeler, which is applied at the shipper end of the loom. As shown, it is in contact with the yarn in the shuttle, passing through a hole in the front box plate and a slot in the side of the shuttle itself. Like the Aumann feeler, on the opposite page, it is independent of back lash in lay and position of front plate. The operating parts are shown in full relief, and are few in number. The cuts of the Aumann feeler show the pattern in use just previous. The mechanism at this side end of the loom, however, does not accomplish all that is necessary, for the operation of the filling-changer by a feeler introduces a curious problem, the ejected bobbin having its thread extended through the shuttle



AUMANN FEELER JUST BEFORE OPERATION.

This cut shows the form of feeler mechanism devised by Mr. Louis A. Aumann, agent of the Dwight Mfg. Co. at Chicopee and modified by inventions of W. F. and C. H. Draper.

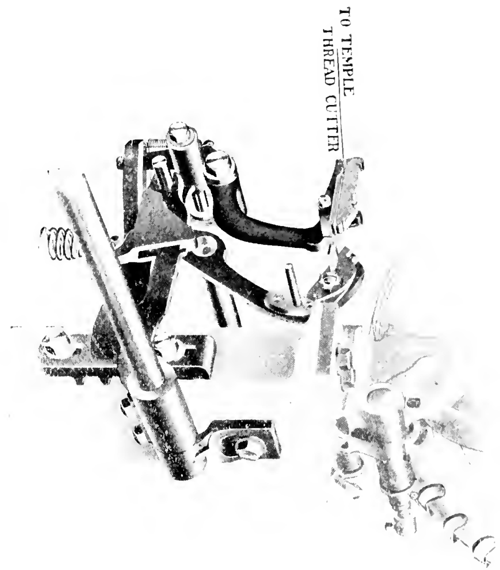


AUMANN FEELER OPERATING.

We have had these applied to thousands of looms. They are independent of the wear or alteration in the throw of the lay and therefore require practically no adjustment after the first setting.

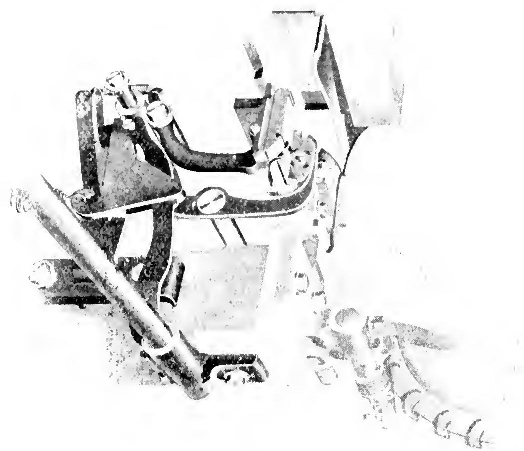
eye to the cloth, while the bobbin itself is in the receptacle, thus leaving an additional thread to be taken care of by cutting apparatus. Unfortunately, this thread does not lie in the path of the regular thread-cutter, requiring an extra cutting device to operate at the proper time. Such a device is attached to the shuttle position detector, which reaches forward to determine the position of the shuttle in the box, as the position detector passes into the path of the thread referred to. This additional cutter not only severs the thread at this point, but also holds the severed portion taut until the regular thread-cutter severs it again near the selvage of the cloth. While somewhat difficult to describe, the operation is perfectly simple and efficient.

The Feeler is practically necessary on certain classes of goods, yet objection has been raised on account of the waste yarn left on the bobbins. We have endeavored to reduce this to small limits by continual perfection of the feeler mechanism itself. We also limit the amount of waste by applying attachments to the spinning frames which spin the filling yarn, called "Bunch Builders," which govern the traverse motion so as to wind a slight preliminary bunch on the bobbins near the lower end of the traverse, so that the feeler will not operate until the bunch itself begins to be reduced in volume. We have patterns of these mechanisms to fit all the American makes of spinning frame. Another objection to the feeler has been raised on account of the extra labor necessary in removing the waste yarn from the bobbins, especially as the bobbins have sometimes been damaged by the use of knives for this purpose. We are now building little machines, in which a large, rough-surfaced roller, by rapid revolution, will easily wind off the waste yarn of several bobbins at a time, reducing the expense as compared with the former process, and causing no damage at all to the bobbins. Most of the waste yarn is easily pulled off by the fingers.



FEELER THREAD CUTTER JUST AFTER OPERATION.

With short thread held ready for temple thread cutter to operate.



FEELER THREAD CUTTER JUST BEFORE OPERATION.

THE DOUBLE FORK.

The cloth which we intend to weave on our looms may be roughly divided into three classes. First, including goods on which mispicks are not important and on which slight thick and thin places are of little moment. These are produced by the ordinary plain loom of commerce which our regular Northrop loom is replacing.

The second class includes the grades on which mispicks are considered important, and for which we apply the feeler device.

The third class includes all the goods on which mispicks are not important, but on which thick and thin places are not desired. This grade can be woven on our new double-fork looms and we expect to find all grades improved by use of this new idea.

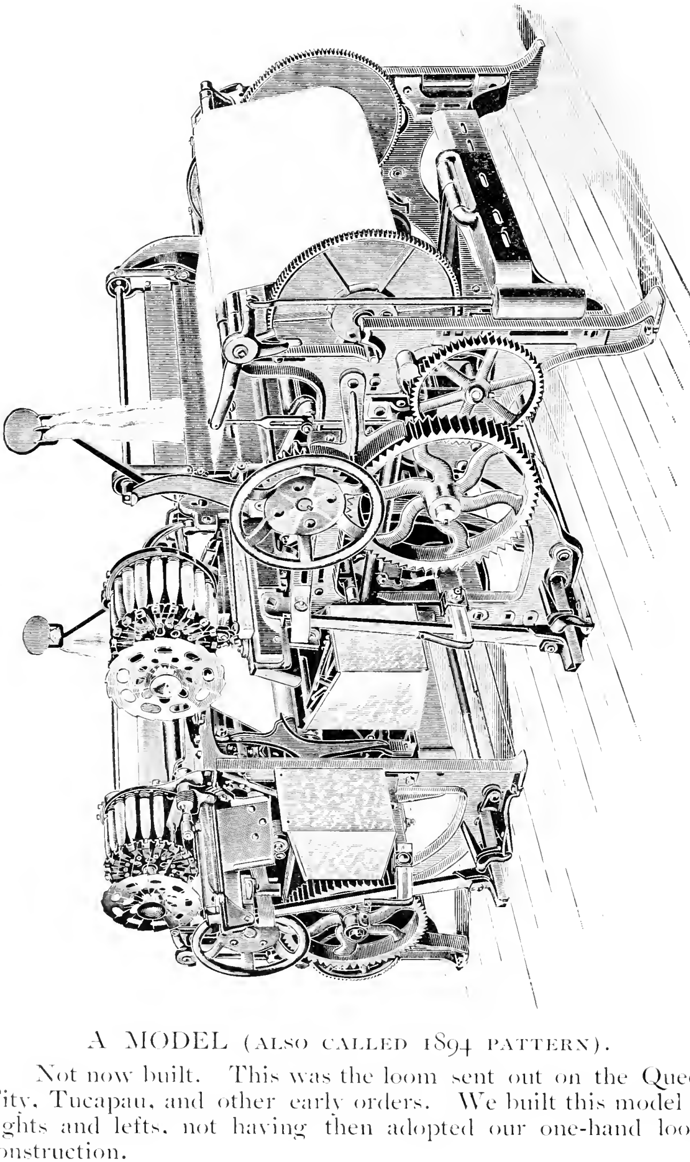
There is a prevailing notion to the effect that print cloth may have all sorts of faults, because the dyes disguise them. Anyone who looks at the cloth running over the blackboard in the cloth room of any print mill, will notice defects in every single cut of cloth woven, there being full as many with cloth woven on the common loom as with the cloth woven on the Northrop loom. The buyers have grown accustomed to these faults. When it is understood, however, that cuts of print cloth, or any other cloth, can be woven entire, without a thick or a thin place, the trade will undoubtedly demand improvement.

The Double Fork system, has already worked with great success on thousands of looms, and has recently been improved and simplified in detail. It detects the absence of filling on either side of the loom, and prevents the take-up from moving if filling is not present. With two forks, absence of filling is detected more promptly, and they also take care of any trouble caused by a dragging end of filling, which sometimes holds the fork up at the left side of the loom, if the yarn is coarse. The double fork is therefore applicable to coarse weaving, as well as very fine goods, having special advantages in each application. It is also added to Feeler looms as an additional precaution.

The Filling-Fork, whether single or double, is the most important element of the loom, to our mind. It is liable to false operation if the tines get bent, or if the lay gets out of position, or loose in its bearings. We are now making a fork in which the tines are cast in place in a solid block, and are also bringing out improvements in loom construction intended to prevent the possibility of variation in the position of the lay itself.

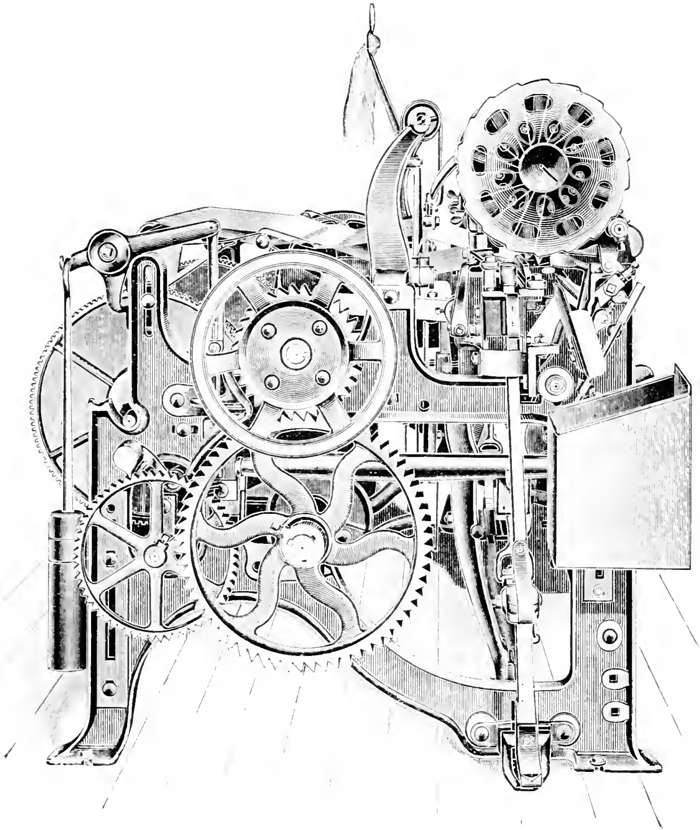
STANDARD MODELS OF LOOM CONSTRUCTION.

Having considered the different new attachments which are peculiarly adapted to automatic weaving, we next show cuts of looms complete with the devices in their relative co-operation with the standard loom organisms where their detail may be still further elaborated. Although many loom manufacturers have built from one standard set of patterns for years at a time, we have brought out ten different models, with full sets of patterns for each, within a period of ten years. These different models are not only necessary by reason of variety in width and weight of cloth woven, but also represent improvements in design of sufficient importance to warrant new construction throughout.



A MODEL (ALSO CALLED 1894 PATTERN).

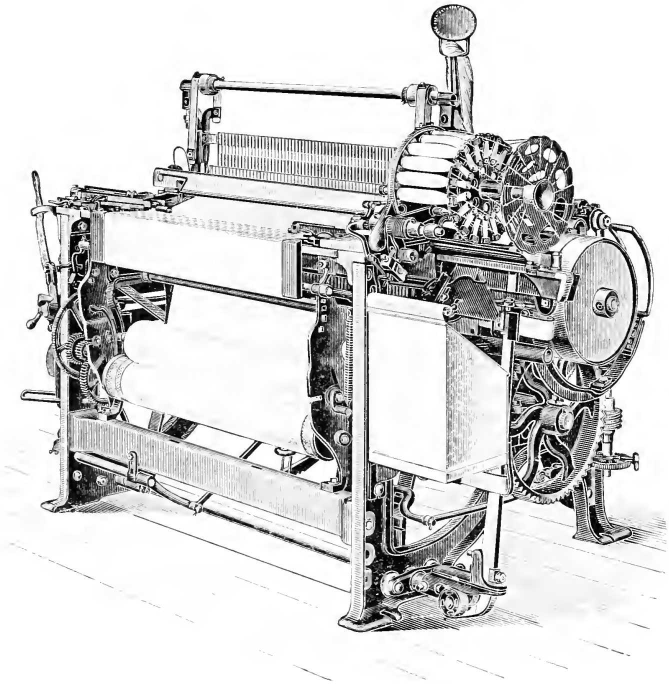
Not now built. This was the loom sent out on the Queen City, Tucapau, and other early orders. We built this model in rights and lefts, not having then adopted our one-hand loom construction.



END VIEW OF A MODEL LOOM.

Steel Harness, Saw-tooth Gearing, Shepard Let-off, Mason Take-up, Movable Bobbin-chute and other details as originally presented.

"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 eight 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 and Fabric*.

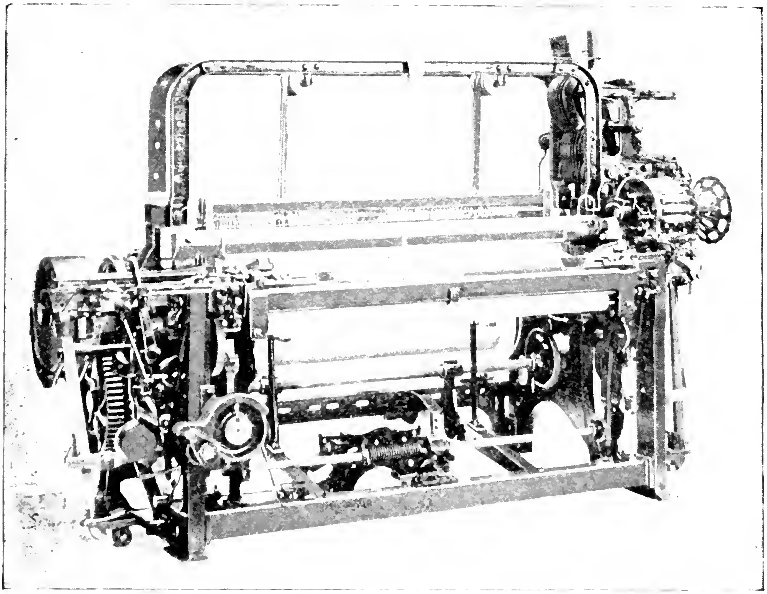


B MODEL (ALSO CALLED 1895 LOOM).

Not now built. 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).

Not now built. This was our first heavy pattern loom. It was of the One Hand construction with heavy design throughout. (No cut of this to show.)

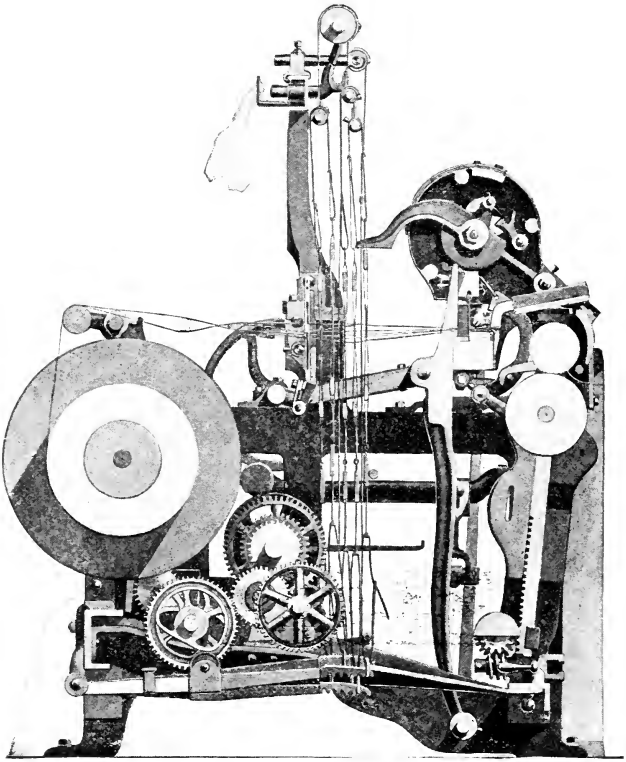


D MODEL, HEAVY STANDARD, NO. 1 HOPPER.

Cut shows dobby head applied. The take-up on this special style of D loom is of the worm gear variety.

"Constant progress has been the watchword of the last quarter of a century, and will lead in the next, so near at hand. Mr. Draper puts the Northrop loom, the latest production of his model shop, into your mill today and starts it with amazing success, but while this pattern, the product of many years of hard work of the inventor, with the added talents of many mechanics, has been in course of construction, a new and better way has been devised to accomplish desired results or to overcome some slight defect obvious in your lot of looms. And you are told that in the next lot of looms built these defects will be remedied, and too late you regret that you had not waited before giving your order.

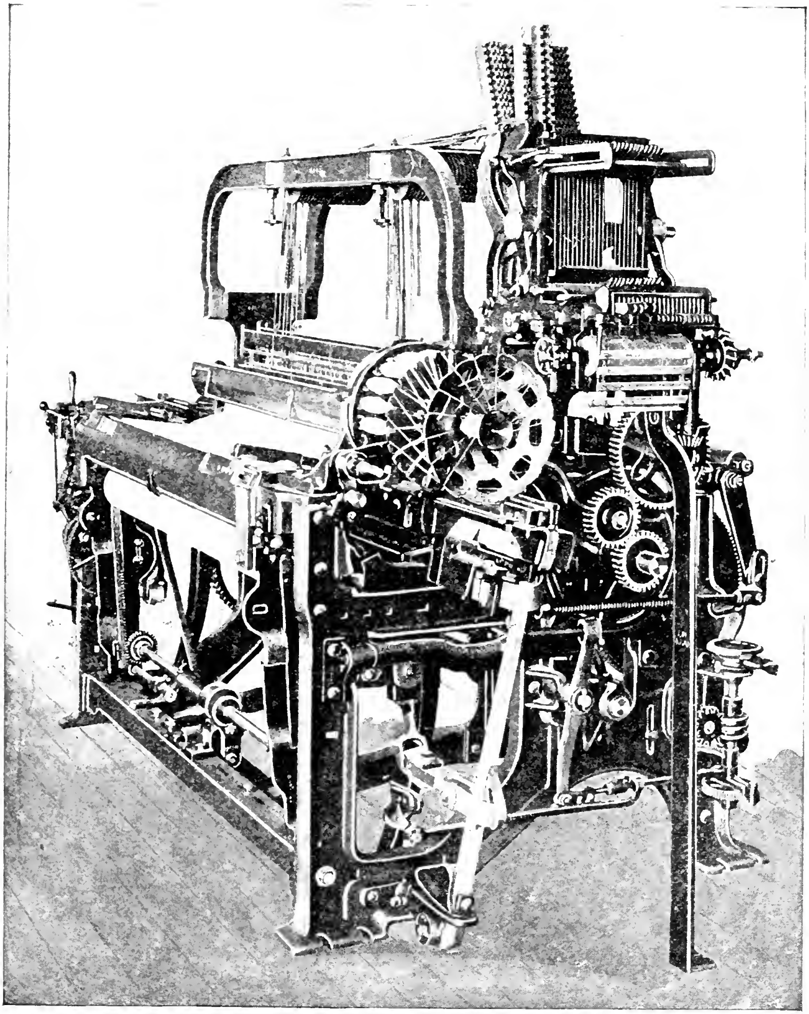
The difficulty, however, is inevitable. Evolution is constant in everything to which the mind devotes itself earnestly, honestly, and persistently—and each lot of looms turned out will naturally be superior in some respect to that which preceded it."—[*Prest. Frederick E. Clarke at Montreal meeting of the N. E. Cot. Man. Asso., Oct.* 5, 1899.



CROSS SECTION OF D MODEL LOOM.

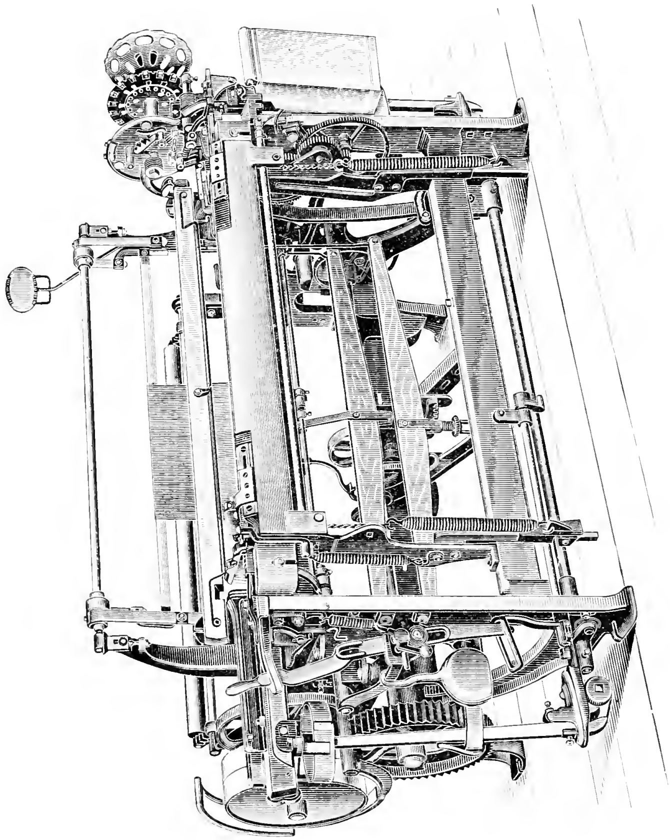
No. 1 hopper, five harness, cotton-harness, Roper warp-stop.

"The Northrop looms at this mill are running on 60s warp and 70s to 80s filling. I have never seen looms run any better, on coarse numbers even, than these are running; in fact I do not see how any looms could do better. The weavers run 16 looms each and did not seem to have anything to do. The overseer called my attention to his loom fixers on these looms sitting down by their bench sleeping, which he said was no unusual sight. He says he gets all of 95 per cent. product."—[*Extract from Expert's Report, June* 20, 1903.



D MODEL LOOM WITH DOBBY.

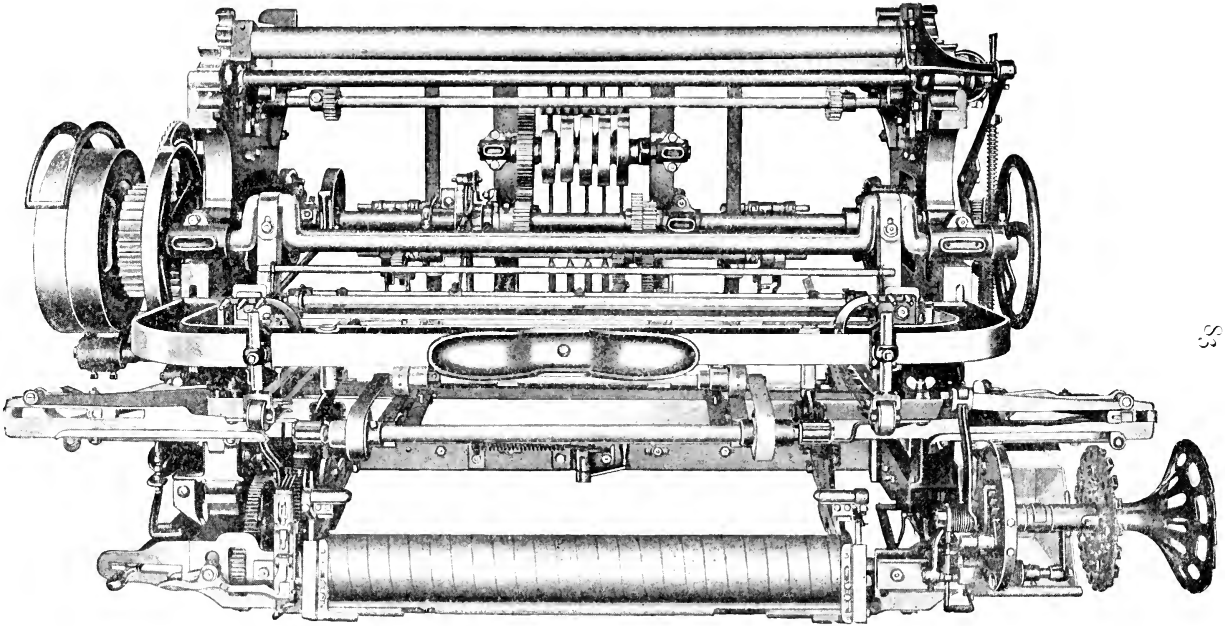
We have sold hundreds of looms for dobby weaves which are giving the best of satisfaction.



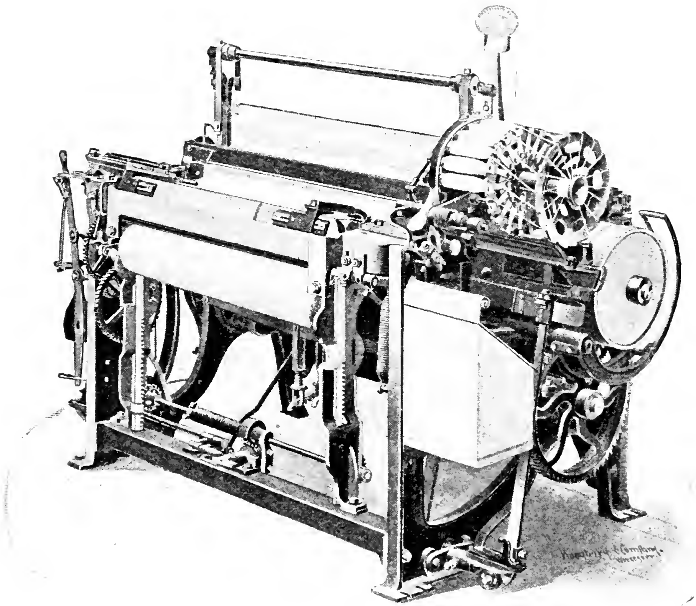
FORTY INCH E MODEL LOOM.

No. 1 Hopper. Steel Harness, original High-roll Cut Motion.

"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.*



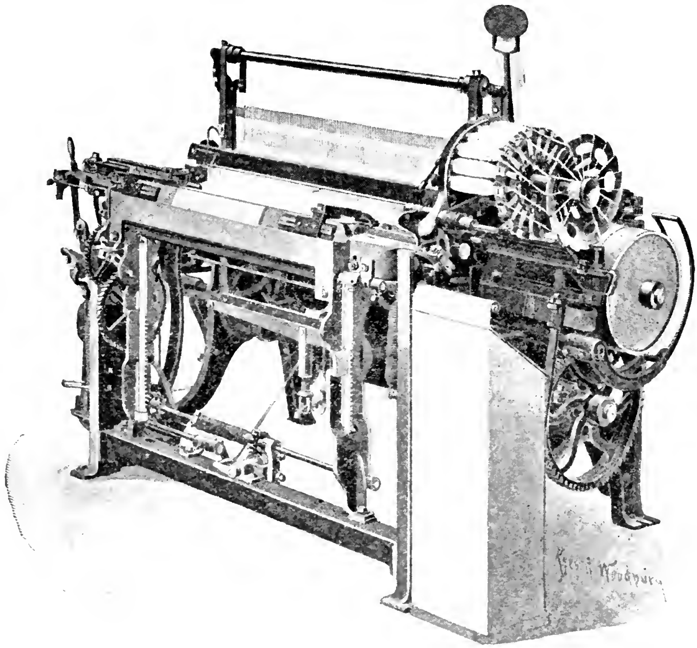
TOP VIEW OF E MODEL, FIVE CAM LOOM, NO. 1 HOPPER.



E MODEL.

Regular pattern for prints and sheetings up to 1904. Cut shows a steel harness bobbin filling loom as made in 1898 and 1899. Improvements have been added continuously, as will be shown in other cuts to follow.

"I called at the ——— Mills; found the looms running very well. They have reduced the seconds on their plain work to $1\frac{1}{2}$ per cent, and on their sateens to one-half of one per cent. This is perfectly satisfactory to them."—[*Salesman's Report*, *Oct.* 24, 1903.



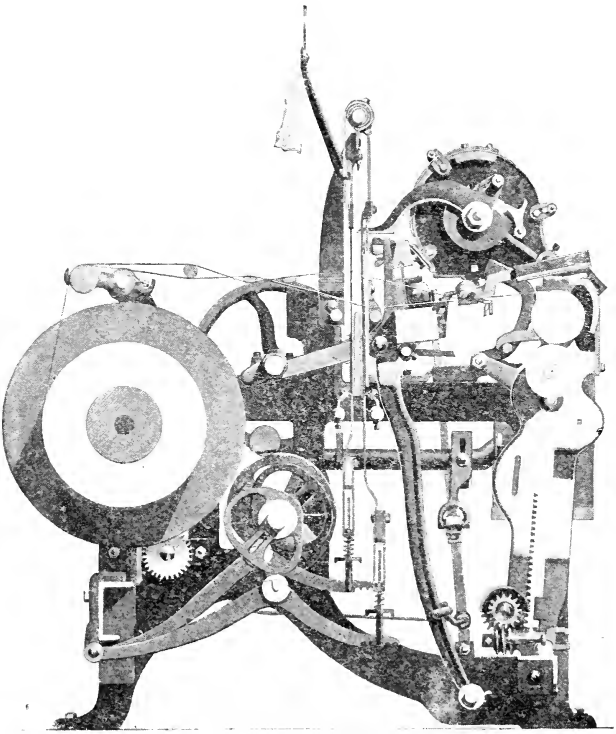
E MODEL LOOM WITH FEELER.

NO. 1 HOPPER.

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

While the cut shows the feeler on a two-harness loom, it is more customary to use this device on multiple harness weaving. The feeler shown is one of the earlier constructions.

"We looked at the Draper looms, which are running extremely well, with weavers running 16 looms each on 4-shade cotton flannel, 17s warp and 9s filling. They are doing very well with the feelers and were making little waste."—[*Salesman's Report of Nov.* 28, 1903.

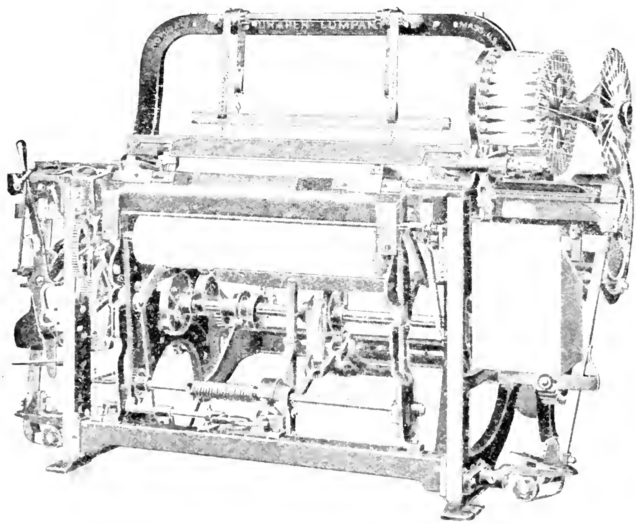


CROSS-SECTION OF E MODEL STEEL HARNESS LOOM, NO. 1 HOPPER.

(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 the half of the loom which appears in the cut.



E MODEL WITH LARGE HOPPER.

This is the regular standard type for general weaving used from 1898 to 1904 (still in use). It began to receive the large hopper as per cut in 1901. More looms have been sold of this model than any other that we have put out.

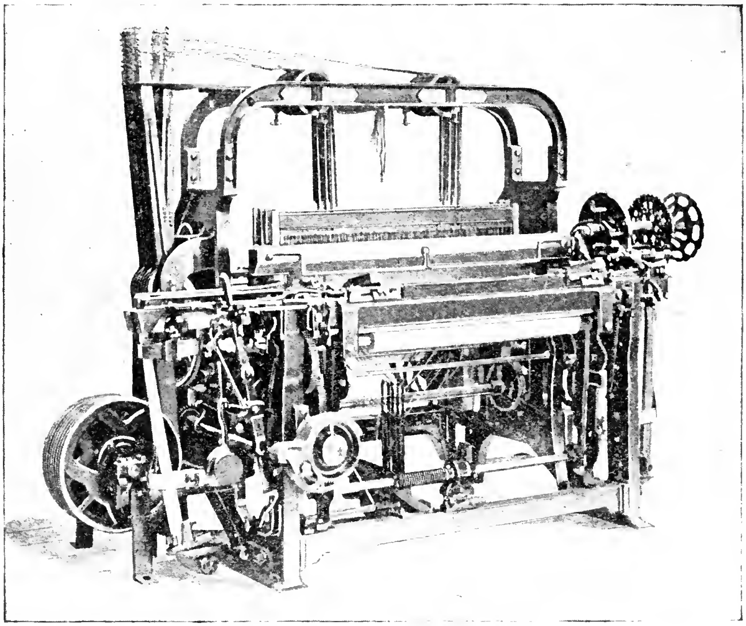
"In New England to-day the price of weaving on the ordinary looms, with the last ten per cent. that has just been given, is nineteen and eight-tenths cents—say twenty cents—per cut, that is, for fifty yards. A new loom has been invented by which the weaver can mind about twice as many, and therefore 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*.

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.

G MODEL.

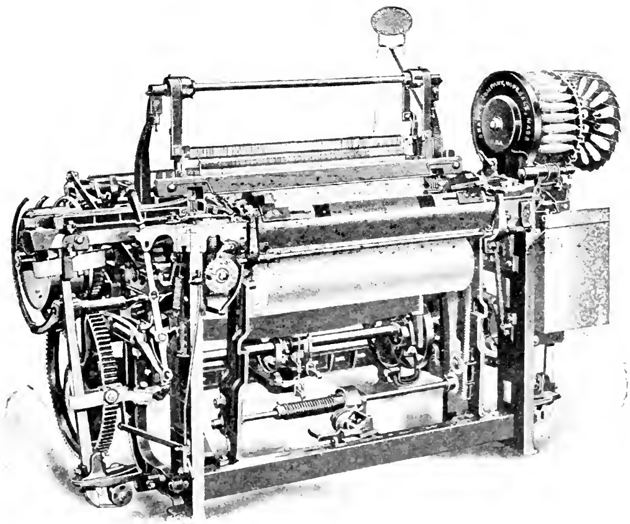
Special frame. D Model weight with E Model depth. We have no cuts to show these two latter styles.



H MODEL, HEAVY SIDE CAM LOOM, 8 HARNESS.

Frame same as D and E Models.

I MODEL, not ready for illustration. This will be of a construction somewhat similar to our present E Model and adapted for the same class of weaving.



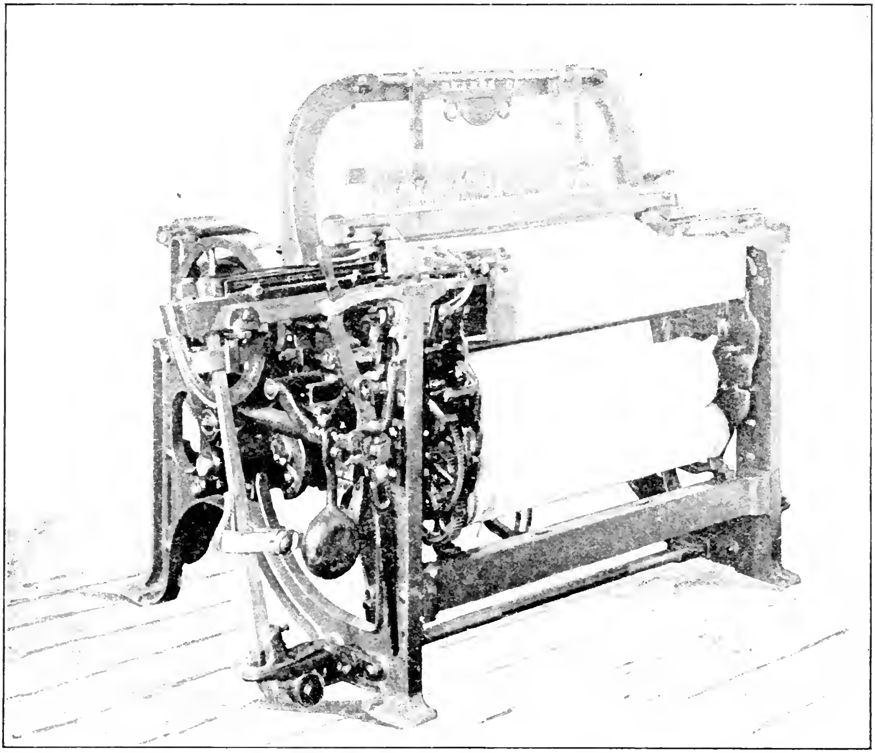
J MODEL LOOM FOR PRINT CLOTH AND LIGHT WEAVES.

There are more looms weaving plain two harness goods on print cloth style than on any other single grade of cloth. Mills can equip for this standard product and run continuously for years without necessity for changes. We started originally with a loom for weaving these goods, but in designing foresaw other uses and therefore prepared the frame and other parts for them as well. A year or so ago we made up our minds that there was a sufficient field in light narrow weaving to warrant the building of a special loom primarily adapted for this use. We have thus developed a model that takes up no more floor space than is necessary, that is no heavier than is necessary, and in which the moving parts are not clumsy and power absorbing. The fatigue of running and handling such a loom must be greatly reduced. We utilize new inventions to reduce shock, jar, smashes, etc., and in view of the light goods to be woven, protect against the slightest crack or thin place by novel mechanisms. Several of these will be particularly referred to in the special articles on take-up, double fork, anti-bang, etc. These various motions have shown so much advantage that we do not intend to limit their adoption to the J Model loom alone. There are several thousand of these looms already running and several thousand more on order. They have proved a great success, especially when fitted with the complete range of devices which we recommend for them. They will run at high speed if necessary, and with lighter power. They can be made with either front or back binders and with either steel or cotton harness, though we recommend the steel harness unreservedly for this class of work.

OUR COMMON LOOM.

We have at times filled several orders for common looms for parties who were not fully decided as to whether our mechanisms were applicable to their special kind of goods, with the idea that when we should have the necessary devices they could be attached to the looms. At the present time, however, our range of weaving is so broad that we rarely find a case where the common loom could be advised, and we foresee little future chance for their introduction.

Owing to our expensive experimenting and disregard for cost, we probably make the best common loom now in the market. Our common loom is simply our Northrop loom with the hopper and warp stop-motion left off and a slight change at the fork. With our make of loom it is, of course, guaranteed



OUR COMMON LOOM.

The cut shows the common loom of the B model type, of which we have sold several lots to purchasers who bought to equip with Northrop devices later. We have not encouraged the sale of plain looms as our force has been busy with Northrop Loom orders. It seems strange, however, that those who continue to buy common looms do not universally demand a type that will be guaranteed to receive future improvements readily.

that our devices can be easily applied, while this is not always true of looms made by other builders.

We have given fully as much attention in late years to perfecting the conventional loom parts as we have to the betterment of our own additional devices. The common loom which we should furnish would, therefore, have all of our latest improvements in the line of let-off, take-up, etc.

It is, of course, understood that the cuts which we show do not pretend to illustrate all of our loom products. Each model that we build is made in many widths, and modifications are often necessary. At present, our range in width is from looms for 28-inch goods, which will, of course, weave narrower, up to looms for cloth 108 inches wide. We call any loom a wide loom which requires additional parts, such as centre swords, double beam, etc. We have found it advisable on these wide looms to use front binders, and a simple rocker motion that will give the shuttle a smooth, straight pick.

Some classes of looms require clutch pulleys, which we can supply when ordered, but we do not recommend them for universal application.

While we prefer to sell complete looms, we can apply our devices to certain models of old looms of others' manufacture. Such changing over is especially advisable where the common loom is too valuable to be discarded, as in the case of broad looms, dobby looms, etc. We have changed over several thousand common looms with good results and have a special department for that work.

LOOM CONSTRUCTION.

Soon after the introduction of our first looms, which were made in rights and lefts, we found that the shuttle used with one type of loom threaded up better than the shuttle on the other, the eyes being entirely different in threading detail. This led to the idea of making looms all one hand, and as this change only necessitated invention in the line of shipping mechanism, we promptly adopted the idea, and have built all our looms in this way ever since. It is, of course, a great convenience to us, as builders, to have all of our looms made from the same patterns, and it must be an even greater advantage to the mills, for not only is their supply of repair parts lessened, but the weavers find it much easier to go through a set of one hand movements, rather than learn to do many operations with either hand.

It seems strange that the original error of complicating parts and detail by right and left construction was prolonged for a full century. It is, of course, still necessary to have the pulleys arranged to belt at either side of the loom, and we find it also more convenient to have our let-offs changeable in position; but the shipper handle is always at the left, and the hopper always at the right, on all looms which we have built with the exception of the A model. When we change over looms of other makes, we supply parts for both right and left hand looms, as no other builder has followed our lead, especially as the system we use is protected by several patents. It is well known that with the ordinary type of loom, as built, one hand will run better than the other, as patterns of one hand are not precise opposites to the other, and are necessarily better or worse in adaptation. This gives two differently operating constructions to bother the fixer.

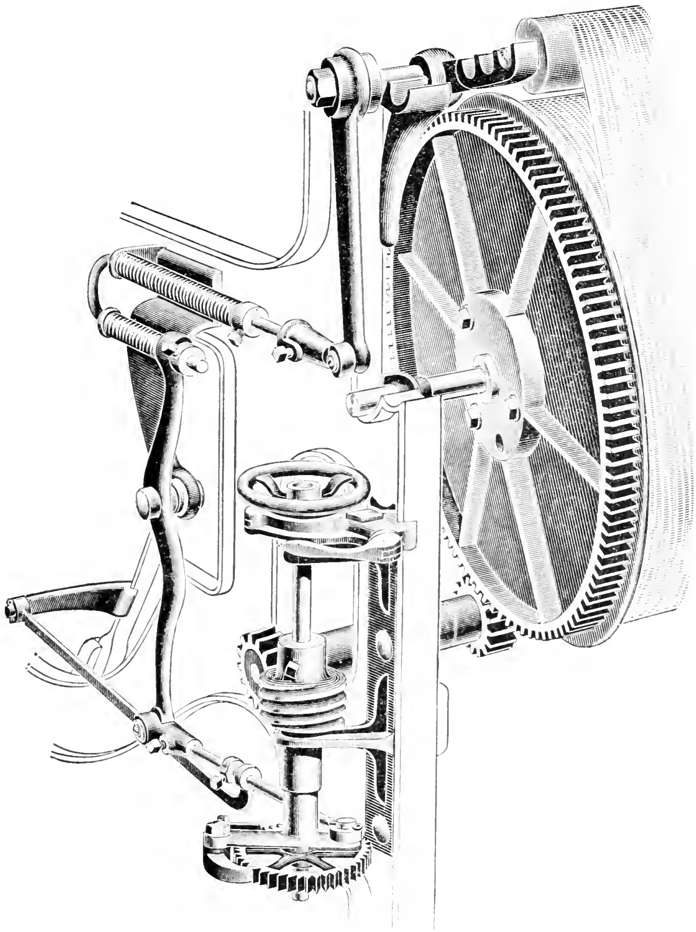
LET-OFF.

Although the Bartlett was our own original let-off, and although we did use it on thousands of our Northrop looms in an improved form, we have now replaced it by a greatly superior mechanism known as the "Draper-Roper," which is self-adjusting and thoroughly efficient for nearly all the possible requirements.

We made a curious mechanical error on these motions as first sent out, which tended to give them a bad name, but on discovery of the fault it was promptly remedied by sending correct parts to every mill where the let-offs were in use, and we now hear nothing but praise for their performances.

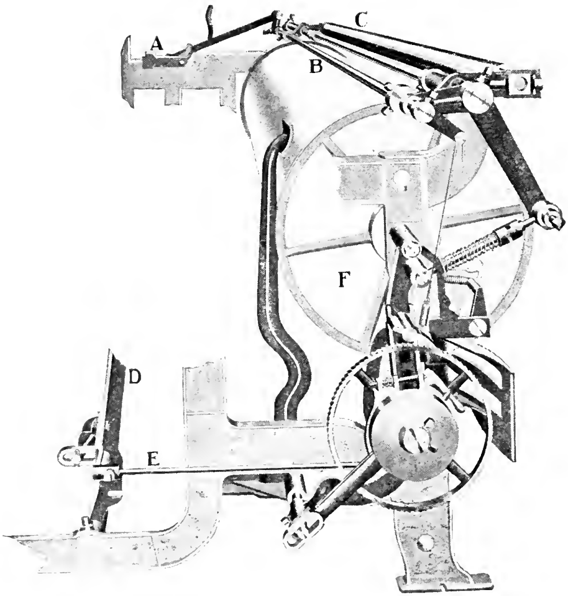
Like the Bartlett Let-off, the Draper-Roper is actuated from the motion of the lay and governed by the tension of the yarn at the whip-roll. It is, however, additionally controlled by the variation in the diameter of the warp beam, as the warp is woven off, by a follower, pressing against the beam, which by its change in angle determines the limits of motion by which the actuating parts operate. With ordinary let-offs, the cloth woven varies remarkably in width from full to empty beam, whereas with the Draper-Roper this variation is practically eliminated, so far as influence of the let-off itself is concerned. There are other causes which affect the width, and their results should not be confused with the let-off action. A recent test of actual tension at the whip roll during the entire time a beam was weaving off showed that the variation was confined between 33 1-2 and 32 pounds—certainly a remarkable uniformity for this class of mechanism.

"Their Northrop looms were all running very well: the weavers run 18 prints each, and on the wider looms 16 each; the fixers run 115 looms each."—[*Extract from Expert's Report, Jan. 2, 1904.*



BARTLETT LET-OFF.

The Bartlett was our standard until the Draper-Roper let-off appeared. We owned the original Snell and Bartlett patent and sold over 50,000 of them for use on old and new looms before 1870.



DRAPER-ROPER LET-OFF AND ANTI-BANG.

The cut shows this let-off applied to a J model loom. Note the follower which bears against the warp on the beam. The operative parts are largely hidden from view.

Note in the cut of the let-off another new idea which we call the anti-bang. The frog slide connects to the whip roll so as to release the warp in case the loom bangs off. This relieves the loom itself from shock and also prevents smashes. We believe this idea will greatly lessen loom repairs and the loosening of nuts and screws.

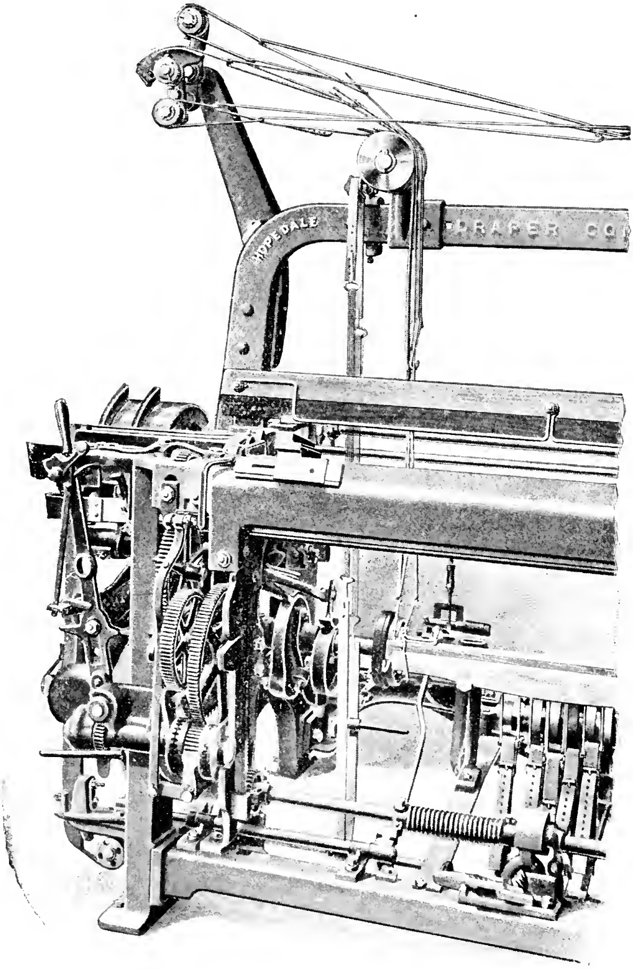
SHEDDING MECHANISM.

Our standard forms of shedding mechanism at present include the ordinary single roll with strapping at top and cam treadle drive at bottom, for two harness work, with either steel or cotton harness, the Lacey Top Rig for multiple cotton harness, and a spring compensating motion for the top rigging of our multiple steel harness mechanism. We are, however, experimenting with new motions for our steel harness looms, and shall soon introduce a complete novelty in the line of shedding mechanism, doing away with all treadles, cams, and jacks under the warp, giving more space for the warp beam and bringing all of the operating parts out where they are easily observed and adjusted. We shall have more to say publicly about this device when our patents are issued and a further trial made.

The Lacey device is simple and durable for cotton harness use, and it is always in place to hang a warp, does not wear out straps so fast as the ordinary motion, and is easily adjusted. It is quite similar to the Wyman motion used on Crompton & Knowles looms, but we think it contains important additional improvements; in fact, other loom builders have wished at times to have the privilege of using our motion on their own makes of loom.

We are ready to equip looms with side cams for special weaves, or dobbies, when desired. We have built hundreds of side cam looms for corduroy and thousands of dobby looms for various weaves.

"One man who came under my personal observation was working 27 looms. He was producing a print cloth, 28 inches wide, 60x64 ends per inch, 29's warp and 37's weft. The average for the whole mill was about 19 looms per weaver. Is it possible for our manufacturers to compete with this?"—[*English expert's report on visit to America, from English paper, October*, 1902.



DETAIL OF LACEY TOP-RIG ON D MODEL.

Our steel harness is becoming so universal that we have less field for this motion than formerly. Cut also shows our worm gear take-up with the let-back modification.

TAKE-UP AND CUT-MOTION.

Although it might have been simpler to stick to standard designs in this line, copying from well known mechanisms, we have, as a matter of fact, given as much time to the Take-Up of the loom as any other separate feature. We started with a conventional pattern, but on finding that many of our customers desired to weave large rolls of cloth, we tried to design an arrangement which would wind any size roll desired up to 18 inches in diameter. We saw that the High-Roll arrangement of cut-motion seemed to offer marked advantages in this line, although the High-Roll had never gone into noticeable use in this country and was open to many objections in the forms commonly known abroad. Mr. Northrop devised our present standard construction with the exception of quite recent changes, and the majority of our looms now in use are equipped with the High-Roll pattern.

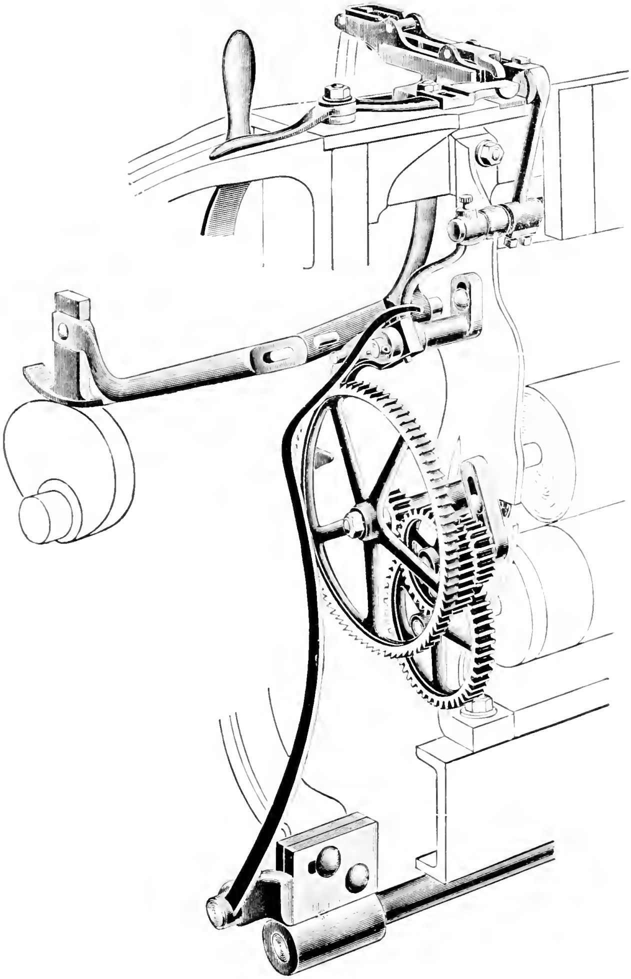
In its best known form, the cloth passes directly to the rough-surfaced roll and is wound around a core, or bar, which is pressed up against the roll by two supports operating from a coiled spring which governs a double gear and rack device. The spring is wound up by the action of the racks as the roll winds, and the cloth is removed by releasing the spring with a hand crank. There are marked advantages in this arrangement, as the cloth will not shrink or wrinkle and the width of the goods will be more uniform and the picks more even. The breast beam comes outside the cloth, protecting it from blemish when the weaver leans over the loom. The direct acting roll also helps take strain off the temples and lessens warp breakage.

On all our cut-motions we use a metal cloth roll, to which the filleting is applied, unless the goods woven demand some special surface only applicable to a wooden roll. This will not shrink or swell like a wooden roll, thereby keeping the picks per inch uniform and the yards per pound at a proper standard. We believe the mill that runs wooden rollers will make its cloth either too light or too heavy. If too heavy, the mill is giving away value without remuneration, and if too light, there will be dissatisfaction at the buying end.

Quite recently we have made an improvement by which the core or bar in the cloth roll is positively started by having geared teeth engage with gears on the large winding roll when first starting to wind. As the cloth gets larger in diameter on the roll the gear teeth move apart and unlock.

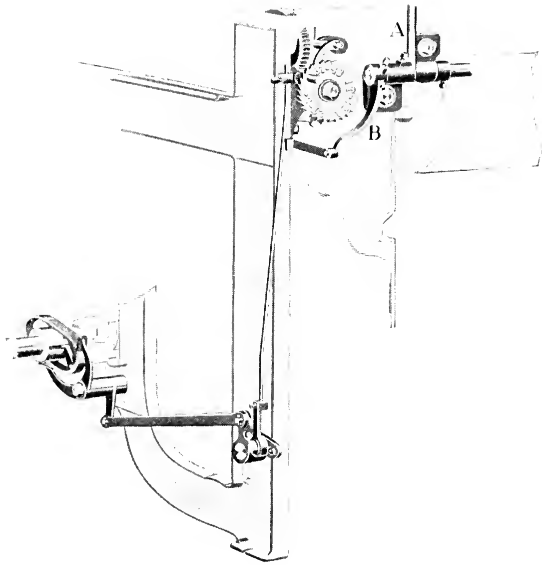
While the mechanisms just described are parts of the cut-motion, they are operated directly by the take-up devices proper which transmit movement from the lay or cam-shaft or other moving parts of the loom. We have quite a variety of mechanisms for various classes of looms, many of which we have not shown separately, and some of which have been considerably modified since the cuts were made. It is practically impossible to keep our cuts up to date in view of the rapidity of improvement in the devices themselves.

"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.*



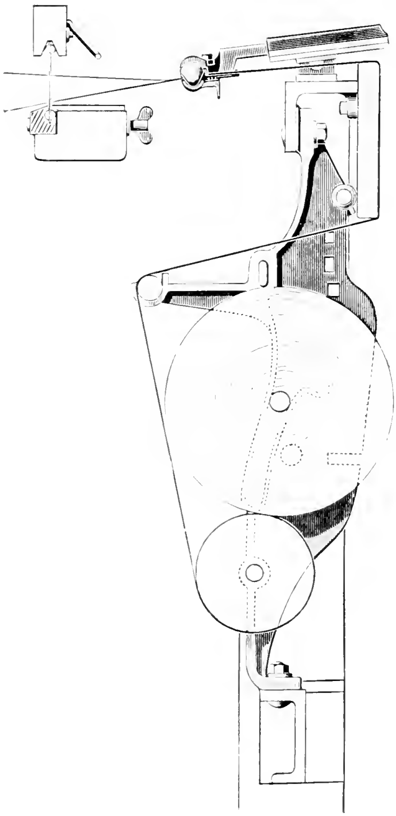
B MODEL LOOM TAKE-UP.

This take-up derives its motion from the rocking of the lay-sword. It has a let-back governed from the fork-slide. Cut also illustrates the weft-hammer and shipper knock-off.



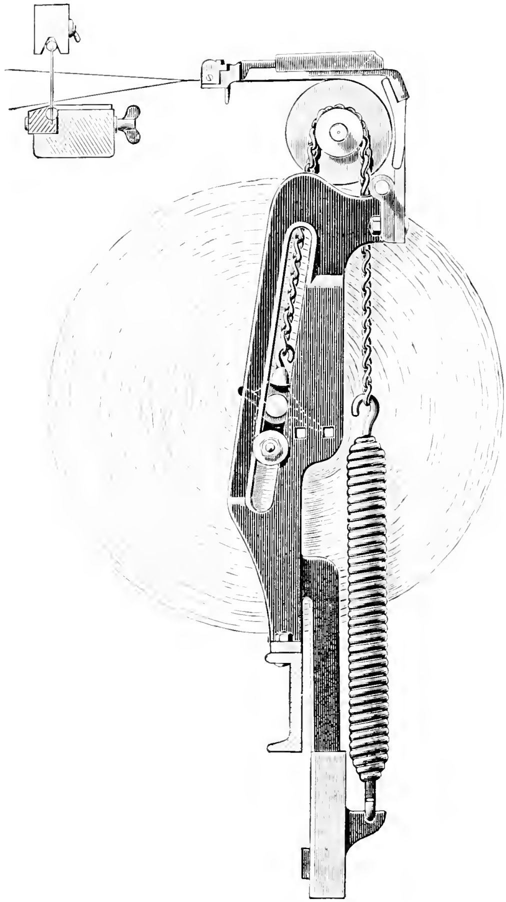
J MODEL TAKE-UP.

This take-up is extremely simple, as will be seen by the cut. It is operated by a cam on the lower loom shaft and so timed that it will not take up unless the shuttle is picked. This prevents the thin places which are sometimes formed on common and old Northrop looms if the weaver turns the loom over by hand while mending warp or before starting the shipper. The ratchet shaft operates through a worm to the take-up roll—no chance for back lash of gears. A is the upright connecting to the left-hand fork and B the lever connecting to the arresting device.



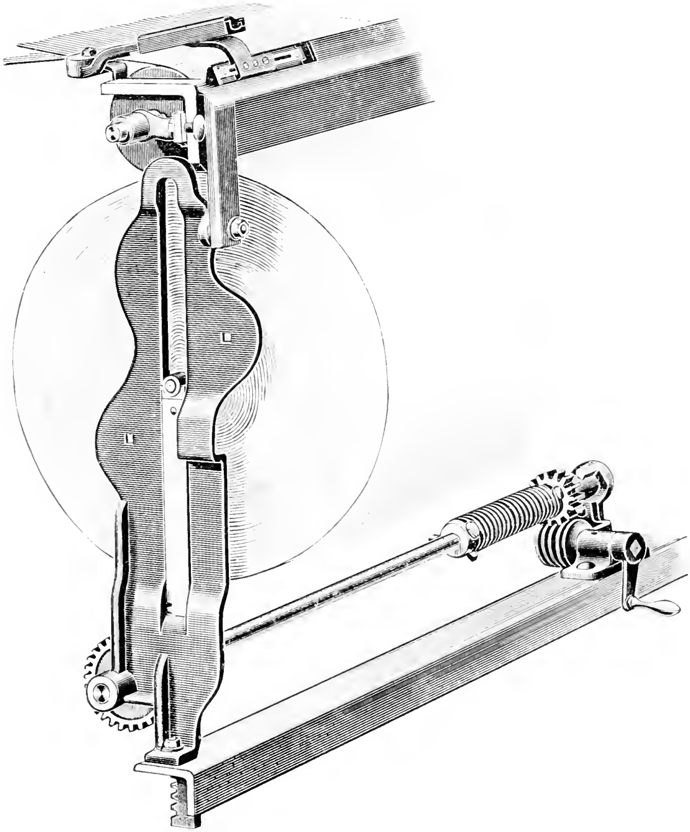
SECTION OF B MODEL LOOM CUT-MOTION WITH FULL TEN-INCH ROLL OF CLOTH.

This cut is interesting in comparison with our later motion, which has many additional advantages. The fliter or reed-holder shown is not now used.



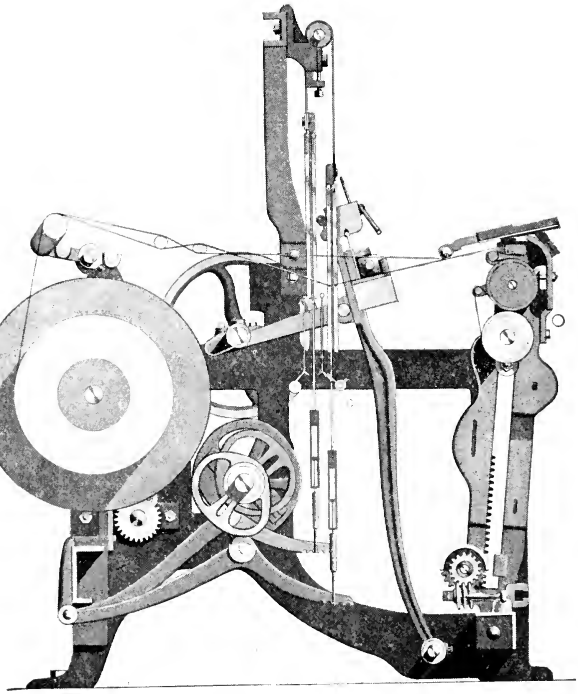
ORIGINAL HIGH ROLL CUT-MOTION FOR E MODEL LOOM.

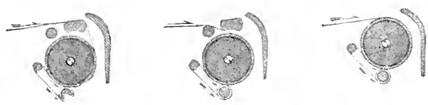
The cut illustrates our earliest pattern of High Roll cut-motion. It was quickly superseded by the next type shown.



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

This is the cut-motion which has been an integral part of the greater number of Northrop Looms sold. It has been universally satisfactory on the average line of goods. Certain cloth, however, requires greater chance to yield between the fell and the take-up roll, and we have therefore made a new construction shown on the following page, which allows various changes in wind.





OUR LATEST ARRANGEMENT OF CUT MOTION.

As will be noted in the cross-section of a Northrop loom, as shown in the cut, we have recently made a material modification in our Cut Motion, in order to cover various requirements of weaving, it being found necessary in certain instances to have a greater length of cloth from the reed to the take-up roll than our former high-roll arrangement allowed.

This arrangement allows four different systems of controlling the cloth between the reed and the roll. The purchaser of the loom can therefore suit himself as to the method employed and adapt the method to the goods. The take-up roll is given a wide range of vertical adjustment to allow for lessening the strain on either the top or bottom shade, as desired.

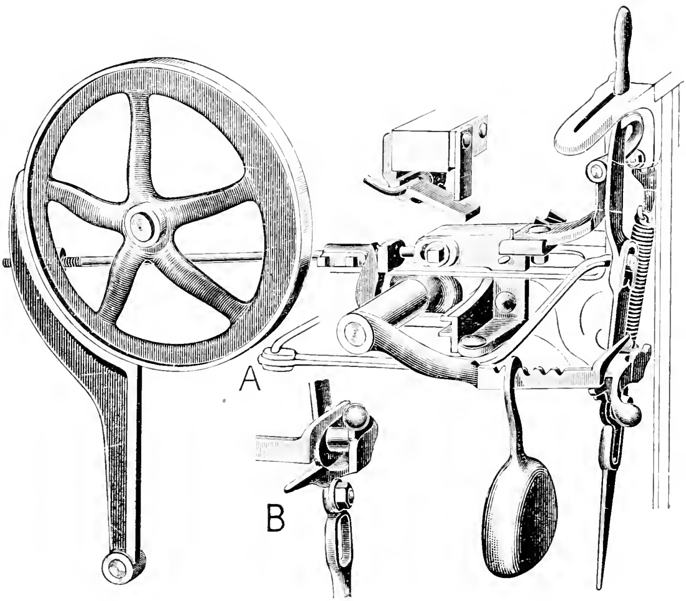
The large cut shows a cross-section of the loom without the hopper, in order to emphasize the main feature of the new parts and the three lower cuts show the alternate methods of use.

BRAKE MECHANISM.

We employ a simple and convenient filling-brake of our own design, which is actuated whenever the shipper is released. We formerly put these brakes on every loom we made, no matter what the style of weaving. Finding, however, after considerable experience, that the action of any braking device is bad for the loom in general, we prefer now to apply brakes only to the special weaves where they seem peculiarly necessary.

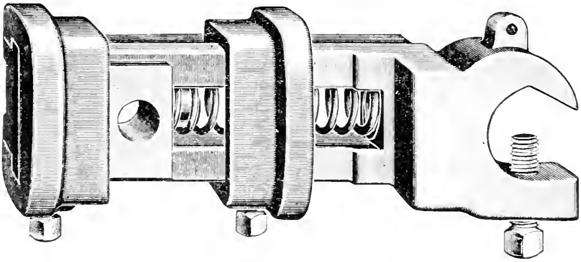
The illustration on the next page shows the brake attached to the frog in usual manner, also an independent brake actuator liberated by the shipper handle. A is a rod leading across the loom to operate the belt shipper on the other side of the loom. B shows a detail of the filling-brake lock which is liberated by the weaver before moving the lay by hand.

It would be found by close examination, that the filling-brakes on the ordinary looms used in the ordinary mills, are not continuously operative: in fact, it is probable that the great majority do not act as they should. Our own brake has the advantage of a positive screw adjustment by which it may be kept easily adjusted; but it increases repairs of various kinds enormously to stop looms suddenly, and there is no need of such quick stopping in the ordinary line of weaving.



BRAKE MECHANISM USED ON B MODEL LOOM.

"Some people say that the Draper loom is apt to make thin stripes, but from all I can hear, thin stripes are about as scarce as hen's teeth. The work runs very well, and Jesse Barton, an 18 loom weaver, says he ran a loom seven hours and never stopped, only for dinner hour. It is a common thing for looms to run four or five hours at a stretch."—[*From letter to Textile Excelsior from Warrenville, S. C., during* 1900.



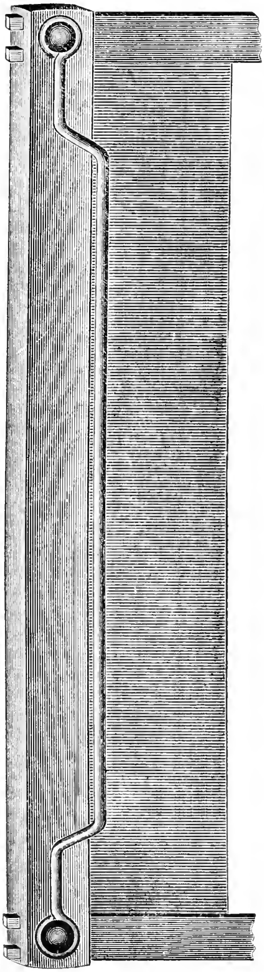
THE IMPROVED DURKIN THIN PLACE PREVENTER.

We applied thousands of these attachments to the old common looms before entering the loom field. Those who wish to get the best results out of their old looms when weaving light goods can use them to great advantage. They lessen thin and thick places, lessen the results of shuttle smashes, lessen warp breakage, and increase production. We recommend them to purchasers of our Northrop Looms who intend to weave light goods on them. Every improvement that tends to lessen the breakage of warp threads is of high importance when endeavoring to increase the number of looms per operative. A slight extra cost at the start may pay for itself many times and not always receive due credit for the performance.

The construction consists of a pair of arms fastened to the usual bar across the loom which supports or forms the whip roll, and a roller held at its ends by the sliding bearings, noted in the cut by the open hole for the journal. Where Bartlett let-offs are in use the regular roll may be used without necessity for an additional warp roller.

In our first patterns there was difficulty at times in adjusting the tension of the spring to allow definite control of the movement of the whip roll. We have now overcome this trouble by using uniform spring tension and governing the movement by adjustable stops as shown. We make patterns to fit different styles of looms.

SULLIVAN'S PATENT SHUTTLE GUARD.



These Shuttle Guards are made of the best quality coppered wire, five-sixteenths of an inch in diameter, and are long enough to reach the entire length of the hand-rail. An eye is formed in each end, and these eyes fit over the bolts which attach the hand-rail to the swords. No other fastening is required, except for certain widths of looms, when a center support is added. The guard fits closely to the hand-rail for about three inches at each end and is then bent to hang over the race in any position desired.

This form of construction and attachment makes the most simple and durable shuttle guard that has thus far been introduced.

The hand-rail is not cut or damaged in any way in making the attachment, nor are there any bolts, screws, or other fastening, such as have to be used with other guards, to work loose and annoy and hinder the weavers. There are no bolt ends projecting back of hand-rail to tear the harness. This guard can be applied for repairs where it would otherwise be necessary to renew the hand-rail, at less than half the cost of making and fitting a new hand-rail. There are thousands of them in use.

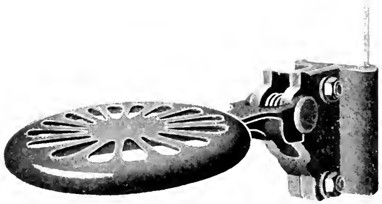


FIG. 1.

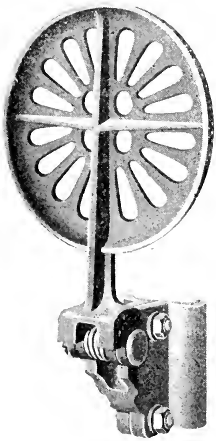


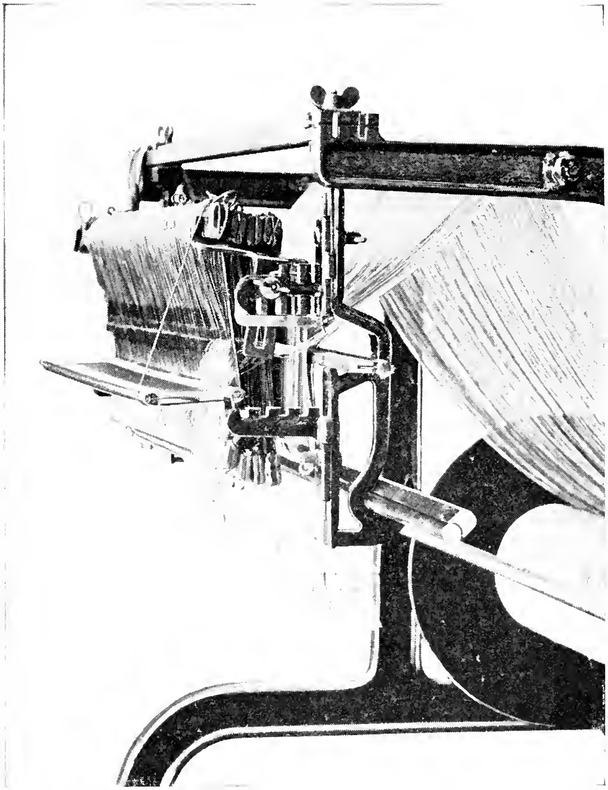
FIG. 2.

THE BOLTON LOOM-SEAT.

This novel attachment can be applied to any of our looms and is now sent out with all orders, one to each eight looms. It provides a seat for the operative that is normally held out of the way by a spring.

Fig. 1 shows the seat as held down by the weaver's weight. Fig. 2 shows it returned to position under control of its spring.

Mr. T. H. Rennie, Superintendent of the Graniteville Mfg. Co., wrote us he considered these seats an "*Indispensable adjunct to a well regulated weave-room.*"



THE KEENE DRAWING-IN FRAME.

We are introducing a drawing-in frame with attachments, especially designed for holding the warp, drop wire detectors, harness, and reed in a new and convenient manner, to assist the operative in drawing in a large number of warp ends in a given time. There has been some objection to the use of warp-stop-motions in that they caused extra expense for drawing in; but this defect is largely obviated by this present invention. Its parts are adjustable, and have a range so that they are applicable to all our various forms of warp stop-motions. Price recently reduced one-half.

SPECIFICATIONS OF NORTHROP LOOMS

ORDERED FROM THE DRAPER COMPANY, HOPEDALE, MASS.

Make out separate specifications for each style and size of loom.

For............................ Date ordered.............. 190.....
Address..
Number..............................Size.................Model..................
..... Right-Hand Belt from Above..... Left-Hand Belt from Above
..... Right-Hand Belt from Below..... Left-Hand Belt from Below
Kind of Cloth to be woven.................Width..........Sley..........
Number of Picks per inch.......... Number of threads in Warp..........
Number of Warp Yarn.......... Number of Filling Yarn..........
Shall Looms be duplicate of others in the Mill?..........................
If so, give date of previous order..
Is filling on Bobbins or Cops?..... Total length of Bobbin or Cops.....

NOTE: — It is necessary to send several sample cops with mule spindle, or bobbin and spindle. Our regular sizes of bobbins take 5 1-2 inch traverse on a bobbin 6 3-4 inches long; 6 1-8 inches on a bobbin 7 3-8 inches long; and a 6 3-4 inch traverse on a bobbin 8 inches long. Our regular cop sizes are 5 1-2, 6 1-8 and 6 3-4 traverse. Bobbins are patented, and must be ordered through us. At least 200 per loom should be provided. When cops are used we send 30 skewers with each loom for large battery; 20 skewers with each loom for small battery. These are charged extra.

Shall we make Bobbin or Cop Heads Standard Butt?..........

Give largest diameter of full filling Bobbin or Cop measured on the Yarn..........

Large or Small Battery?..........Diameter of Spinning Ring..........

Note:—Large Battery takes 25 bobbins or cops. Small battery takes 15 bobbins or cops.

What style of Take-up?..........

Note:—Our "High Roll" construction admits of winding any diameter Cloth Roll up to 17 inches. 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.

Our Standard Take-up has 1 1-4 inch up and down adjustment of sand roll. If more is required, please specify.

What style of Let-off?..........

Note:—We furnish Roper, Bartlett, Friction, Roper and Friction, or Bartlett and Friction combined.

On "F" Model looms we furnish Compound Let-off; on Corduroy looms we furnish a special Let-off.

If Friction Let-off, shall we order Chain, Fibre, or Rope Friction?..........

Will you have Drag Rolls?..........

Note:—These are used only for very heavy weaves; heavy denims and goods of this character.

We recommend for most cloths Plain Pipe Whip

Rolls: for heavy weaves, not taking Drag Rolls, Vibrating Whip Rolls: for very light weaves, Durkin Thick and Thin Place Preventors. Unless Vibrating Whip Rolls, Thick and Thin Place Preventors or Drag Rolls are specified, we shall furnish with plain Pipe Roll.

Will you have Feeler? ....

What style Warp Stop-Motion is required? ....

NOTE: — We have three styles:

Steel harness using one steel heddle for every warp thread, adapted for 2-3-4 and 5 harness work.

Drop-wire Stop-motion for cotton harness, which requires one drop wire for every two warp threads in a two-harness loom adapted for 2-3-4 and 5 harness work.

Single Thread or Lease-rod Stop-motion for cotton harness, using one drop wire for every warp thread. This stop-motion is adapted for any number of harness from 2 up.

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.

How many Steel Heddles or Drop Wires? ....

How many looms arranged for 2 Harnesses? ....

How many looms arranged for 3 Harnesses? .... How many up? .... How many down? ....

How many looms arranged for 4 Harnesses? .... How many up? .... How many down? ....

How many looms arranged for 5 Harnesses? .... How many up? .... How many down? ....

What style Harness Motion? ....

NOTE: — We furnish the regular Top Harness-motion or Side-top Compensating Motion.

We adapt our looms to take either the Crompton or Stafford Dobby.

We also furnish Special Side Cam Motion for Corduroys.

Are Cams on Cam Shaft or Auxiliary Shaft? ....

If Auxiliary Shaft, shall we send gears to run 2-3-4-5 shade? .....

Single or Double Jack Hooks? ....

On what No. of Harness shall we set up looms? ....How many up? .... How many down? ....

Shall we supply Dobby? .... How many Harnesses? .... What style? ....

Shall we supply Single or Double Spring Jack or Direct Springs? ....

Is Selvage Motion required? .... Plain or Tape? ....

What Diameter and Face of Driving Pulley? ....What width of Belt? ....

Tight and Loose or Friction Pulley? ....

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

For 2 1-2 inch belts and wider, we recommend friction pulleys.

We furnish 16 1-2 inch, 18 inch and 20 inch Beam Heads. Which do you require? ....

Distance between Heads? ....

NOTE: — For proper width between Beam Heads, we recommend 4 inches more than size of loom. For those desiring extra space we supply Beams 5 1-2 inches wider than the size of loom.

We furnish 5 inch and 6 inch diameter Yarn Beams. Which do you require? ....

NOTE: — We recommend 6 inch barrel only on fine yarns.

How many extra Shuttles? .... (Only one per loom included without extra cost.)

What style Temple will you have, 1 3-4 or 2 1-2 Roll? ....

How many Bobbins shall we order for you? .... Style .... Oil soaked ....

For what number of picks shall we set up looms? ....

NOTE: — Send us several pieces of reed such as you intend using on these looms. One piece is not sufficient. As the contraction on our High Roll Take-up is considerably less on several classes of weaves than on other looms, it would be well to write us before ordering new reeds. The maximum reed space is 5 inches wider than the size of the loom.

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

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

On Corduroy looms send us copy of Chain Draft.

We will send diagrams of floor plan after questions are answered.

By what lines shall we ship? ....

Remarks ....

....

"The Northrop loom, by increasing the capacity of the operative 300 per cent., has brought the manufacture of cotton up to a point that is considered practically perfect. In its most highly developed form this loom now enables one man to do the work of a thousand men at the beginning of the cotton industry, working by hand."—[*From article on "Evolution of the Cotton Industry," in Gunton's Magazine for Feb.*, 1904.

NORTHROP LOOM DIMENSIONS.

D–E–H–K–Modified D.

Size of Loom	Length of Lay for 14½ Shuttle 6¾ Bobbin		Length of Lay for 15⅛ Shuttle 7⅜ Bobbin		Length of Lay for 15¾ Shuttle 8 Bobbin		Total Length of Cotton Harness Space		Total Length of Multiple Steel Harness Space		Greatest Width of Cloth at Temple		Proper Width Between Beam Heads	
	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork
26	74	76	75¼	77¼	76½	78½	32	34	30	32	29	29	30	30
28	76	78	77¼	79¼	78½	80½	34	36	32	34	31	31	32	32
30	78	80	79¼	81¼	80½	82½	36	38	34	36	33	33	34	34
32	80	82	81¼	83¼	82½	84½	38	40	36	38	35	35	36	36
34	82	84	83¼	85¼	84½	86½	40	42	38	40	37	37	38	38
36	84	86	85¼	87¼	86½	88½	42	44	40	42	39	39	40	40
38	86	88	87¼	89¼	88½	90½	44	46	42	44	41	41	42	42
40	88	90	89¼	91¼	90½	92½	46	48	44	46	43	43	44	44
42	90	92	91¼	93¼	92½	94½	48	50	46	48	45	45	46	46
44	92	94	93¼	95¼	94½	96½	50	52	48	50	47	47	48	48
46	94	96	95¼	97¼	96½	98½	52	54	50	52	49	49	50	50
48	96	98	97¼	99¼	98½	100½	54	56	52	54	51	51	52	52
50	98	100	99¼	101¼	100½	102½	56	58	54	56	53	53	54	54
52	100	102	101¼	103¼	102½	104½	58	60	56	58	55	55	56	56
54	102	104	103¼	105¼	104½	106½	60	62	58	60	57	57	58	58
56	104	106	105¼	107¼	106½	108½	62	64	60	62	59	59	60	60
58	106	108	107¼	109¼	108½	110½	64	66	62	64	61	61	62	62
60	108	110	109¼	111¼	110½	112½	66	68	64	66	63	63	64	64
62	110	112	111¼	113¼	112½	114½	68	70	66	68	65	65	66	66
64	112	114	113¼	115¼	114½	116½	70	72	68	70	67	67	68	68

NORTHROP LOOM DIMENSIONS.—Continued.

D–E–H–K–Modified D.

Size of Loom	Length of Lay for $14\frac{1}{2}$ Shuttle $6\frac{3}{4}$ Bobbin		Length of Lay for $15\frac{1}{8}$ Shuttle $7\frac{3}{8}$ Bobbin		Length of Lay for $15\frac{3}{4}$ Shuttle 8 Bobbin		Total Length of Cotton Harness Space		Total Length of Multiple Steel Harness Space		Greatest Width of Cloth at Temple		Proper Width Between Beam Heads	
	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork	Single Fork	Double Fork
66	114	116	$115\frac{1}{4}$	$117\frac{1}{4}$	$116\frac{1}{2}$	$118\frac{1}{2}$	72	74	70	72	69	69	70	70
68	116	118	$117\frac{1}{4}$	$119\frac{1}{4}$	$118\frac{1}{2}$	$120\frac{1}{2}$	74	76	72	74	71	71	72	72
70	118	120	$119\frac{1}{4}$	$121\frac{1}{4}$	$120\frac{1}{2}$	$122\frac{1}{2}$	76	78	74	76	73	73	74	74
72	120	122	$121\frac{1}{4}$	$123\frac{1}{4}$	$122\frac{1}{2}$	$124\frac{1}{2}$	78	80	76	78	75	75	76	76
74	122	124	$123\frac{1}{4}$	$125\frac{1}{4}$	$124\frac{1}{2}$	$126\frac{1}{2}$	80	82	78	80	77	77	78	78
76	124	126	$125\frac{1}{4}$	$127\frac{1}{4}$	$126\frac{1}{2}$	$128\frac{1}{2}$	82	84	80	82	79	79	80	80
78	126	128	$127\frac{1}{4}$	$129\frac{1}{4}$	$128\frac{1}{2}$	$130\frac{1}{2}$	84	86	82	84	81	81	82	82
80	128	130	$129\frac{1}{4}$	$131\frac{1}{4}$	$130\frac{1}{2}$	$132\frac{1}{2}$	86	88	84	86	83	83	84	84

Note.—Depth of Looms 18-Inch Yarn Beam to 18-Inch Cloth Roll— D Model ⎫
Depth of Looms 18-Inch Yarn Beam to 18-Inch Cloth Roll— Modified D Model ⎬ $53\frac{1}{4}$ Inches.
Depth of Looms 18-Inch Yarn Beam to 18-Inch Cloth Roll— H Model ⎭
Depth of Looms 18-Inch Yarn Beam to 18-Inch Cloth Roll— E Model — $50\frac{1}{8}$ Inches.
Depth of Looms 18-Inch Yarn Beam to 18-Inch Cloth Roll— K Model — $53\frac{5}{8}$ Inches.
Depth of Looms 20-Inch Yarn Beam to 18-Inch Cloth Roll— D Model ⎫
Depth of Looms 20 Inch Yarn Beam to 18-Inch Cloth Roll— Modified D Model ⎬ $56\frac{1}{4}$ Inches.
Depth of Looms 20-Inch Yarn Beam to 18-Inch Cloth Roll— H Model ⎭
Depth of Looms 20-Inch Yarn Beam to 18-Inch Cloth Roll— E Model — $53\frac{1}{8}$ Inches.
Depth of Looms 20-Inch Yarn Beam to 18-Inch Cloth Roll— K Model — $56\frac{5}{8}$ Inches.
For proper width between Beam Heads we recommend 4 inches more than size of Loom.
For those desiring extra width, we supply Beams $5\frac{1}{2}$ inches wider than size of Loom.

F-Model Loom.

Size of Loom	Length of Lay Regular	Length of Lay Extended.	Available Harness Space	Greatest Width of Cloth at Temple	Proper Distance Between Outside Beam Heads
66	$120\frac{1}{8}$	$122\frac{3}{4}$	73	69	72
68	$122\frac{1}{8}$	$124\frac{3}{4}$	75	71	74
70	$124\frac{1}{8}$	$126\frac{3}{4}$	77	73	76
72	$126\frac{1}{8}$	$128\frac{3}{4}$	79	75	78
74	$128\frac{1}{8}$	$130\frac{3}{4}$	81	77	80
76	$130\frac{1}{8}$	$132\frac{3}{4}$	83	79	82
78	$132\frac{1}{8}$	$134\frac{3}{4}$	85	81	84
80	$134\frac{1}{8}$	$136\frac{3}{4}$	87	83	86
82	$136\frac{1}{8}$	$138\frac{3}{4}$	89	85	88
84	$138\frac{1}{8}$	$140\frac{3}{4}$	91	87	90
86	$140\frac{1}{8}$	$142\frac{3}{4}$	93	89	92
88	$142\frac{1}{8}$	$144\frac{3}{4}$	95	91	94
90	$144\frac{1}{8}$	$146\frac{3}{4}$	97	93	96
92	$146\frac{1}{8}$	$148\frac{3}{4}$	99	95	98
94	$148\frac{1}{8}$	$150\frac{3}{4}$	101	97	100
96	$150\frac{1}{8}$	$152\frac{3}{4}$	103	99	102
98	$152\frac{1}{8}$	$154\frac{3}{4}$	105	101	104
100	$154\frac{1}{8}$	$156\frac{3}{4}$	107	103	106
102	$156\frac{1}{8}$	$158\frac{3}{4}$	109	105	108
104	$158\frac{1}{8}$	$160\frac{3}{4}$	111	107	110
106	$160\frac{1}{8}$	$162\frac{3}{4}$	113	109	112
108	$162\frac{1}{8}$	$164\frac{3}{4}$	115	111	114

Note.—Largest Diameter of Cloth Roll 17 inches.

Largest Diameter of Yarn Beam $16\frac{1}{2}$ inches.

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

Depth of Loom from full $16\frac{1}{2}$ inch Yarn Beam to 17 inch Cloth Roll $54\frac{5}{8}$ inches.

Use two Beams per Loom.

J-Model Loom.

SINGLE AND DOUBLE FORK.

Size of Loom	Length of Lay for $14\frac{1}{2}$ Shuttle $6\frac{3}{4}$ Bobbin	Length of Lay for $15\frac{1}{8}$ Shuttle $7\frac{3}{8}$ Bobbin	Length of Lay for $15\frac{3}{4}$ Shuttle 8 Bobbin	Total Length of Cotton Harness Space	Total Length of Multiple Steel Harness Space.	Greatest Width of Cloth at Temple	Proper Width Between Beam Heads.
28	76	$77\frac{1}{4}$	$78\frac{1}{2}$	34	32	31	32
30	78	$79\frac{1}{4}$	$80\frac{1}{2}$	36	34	33	34
32	80	$81\frac{1}{4}$	$82\frac{1}{2}$	38	36	35	36

NOTE.—Depth of Loom from full 18-Inch Yarn Beam to 18-Inch Cloth Roll $46\frac{1}{2}$ Inches.

INSTRUCTIONS FOR RUNNING NORTHROP LOOMS.

The experience of the last nine years is by no means sufficient to absolutely settle all points of discussion. We learn more about the art of weaving every week, and consider the possibilities of further knowledge and improvement practically exhaustless. Many volumes have already been written about the detail of plain weaving with common looms, so we shall try to stick more closely to the new features introduced by the novel mechanisms on our own looms.

While these new devices necessarily introduce new problems, there is nothing very intricate about their operation. The fact that thousands have been running for years should give the Fixers self confidence.

HOPPER (OR BATTERY) ADJUSTMENT.

In setting the *Hopper*, first see that the *filling-fork* passes freely through the *grate*. Then place the *filling-motion finger* against the *filling-fork slide*, and the lever on the *starting rod* at the hopper side of the loom, to which the *starting rod spring* is connected, can then be set so as to cause the *shuttle position detector* to clear the shuttle when the lay is at its extreme forward position. 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 position detector across the mouth of the shuttle box. The end of the shuttle position detector should come very close to the *back box plate*, when the lay is all the way forward.

The position of the detector 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 detector. To see if the detector works properly, pull the shuttle far enough out of the box so that it will strike it. This should cause the *latch-finger* on the hopper to clear the *bunter* as the lay comes forward and the detector 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 how far it is pressed into the shuttle. Should it go too far down and push the bobbin by the shuttle spring centre, the latch-finger must be set further back by means of the *adjusting screw* at the rear. Should the bobbin, or cop, not go down far enough into the spring to be firmly held, 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 the downward stroke. The wrought iron end of the transferrer, called the *transferrer-fork*, which helps to press the bobbin, or cop, into the shuttle, should be directly over the centre of the shuttle opening, and if out of position, should be bent into place.

When the shuttle position detector 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 centre 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 pins* in the *lay sword* upon which the *pitman* works. Be careful and turn both pins, or else the lay will have a complex motion, for one distance between centres will be longer than the other. If the pitman is too badly worn to allow of this adjustment, it should be replaced by a new one.

If, by reason of a *badly worn picker*, the bobbin, or cop, is placed in the shuttle so as to strike high up on the *shuttle cover*, an additional piece of leather should be put *under the leather on the lay end*, to compensate for the wear of the picker.

The foregoing adjustments will remedy any ordinary trouble, not occasioned by breakage. The hopper, as a rule, gives very little trouble and requires scarcely any adjustment.

The rotation of the *hopper disc* should always bring a bobbin into proper position. The *disc bearing* should be kept properly oiled, care being taken not to drip oil on the bobbins. If the weavers leave gaps between bobbins when filling the hopper, they may have trouble. They should not allow these gaps to occur, as it is perfectly easy to turn the hopper back and fill it properly.

SHUTTLES.

The latest Northrop shuttle takes either bobbins or cops. It is shaped to prevent filling from throwing forward and escaping from the *eye*, or looping around the *horn*. As fastened in the wood, there is no chance for catching either filling or warp threads.

The *spring cover* at the rear is *inclined* so that if the shuttle is too far into the box, the bobbin, when striking the incline, can push the shuttle into place so that the bobbin can enter the spring properly.

If the *thread entrances* to the eye get jammed or closed, they can be opened by knife blade, or other tool, but care should be taken not to open these entrances any wider than they were originally.

If the eye becomes clogged with cotton or lint, it should be cleaned out.

A small piece of *flannel* is placed at the throat of the shuttle for friction, which can be easily renewed. When coarse filling is used, it may be necessary to put bunches of slasher-waste, or bristles, through holes in the side of the shuttle, to make additional friction. These must be put in by the loom fixers, as we cannot send them out in this way, not knowing just what conditions arise in weaving.

If the *shuttle spring* gets loose, it should be tightened up by turning the *fastening screw*. Shuttles should not be allowed to run with loose springs. We believe we have made considerable improvement in this direction by our latest spring and fastening.

If trouble is found with *cut filling*, the wood near the shuttle eye may have become rough, and should be smoothed with fine sand paper, or emery. Any small slivers or sharp edges should be removed by the same means.

If warp threads should be broken out by the shuttle, it may be that the tips are blunt or rough, in which case the trouble may be remedied by polishing 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. Our recent models of temples are designed to prevent this from happening. Of course, the fixer should follow up his work and see that the protectors are properly operative.

Shuttles have been split by *bobbin rings* wedging between the *spring grips*, but this is of rare occurrence. We grind the ends of our springs now, so as to limit the chance of their pressing against the shuttle sides. Of course, it is possible to break shuttles, if bobbins are caught during transfer, or if certain parts of the loom are broken or inoperative. In spite of all the chances, our shuttles wear very well, considering that one shuttle runs continuously, the wear not being divided between two shuttles, as in the common loom.

We furnish all the shuttles used with our looms, so have an actual record of their life, which runs over, rather than under, six months on the average. Excessive wear is often due to sharp reeds.

SHUTTLE WOOD.

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. Shuttles are sometimes treated with hot solutions of wax or oil. This may improve the surface smoothness, but if not carefully followed up, may injure the stock.

SHUTTLE DESIGN.

Shuttles are shaped to run true and balance as well as possible. With the weight continually changing and shifting, as the yarn weaves off, it is impossible to keep the centre of gravity in a uniform position. The shuttle is also pulled out of place by the drag of the yarn, which varies in tension as the bobbin or cop winds off.

A perfect design would have the shuttle points on a line that would pass through the centre of gravity, with the weight fairly well distributed on each side of the centre.

Shuttles made for *front-binder looms* have a longer back, so that the pressure of the binder in its last contact will not change the direction of the shuttle. We made all our looms with *back binders* for years, but are now having very good success with front binders on recent models.

MISTHREADING.

We use this term to illustrate the failure of the shuttle to thread itself properly. With our recent shuttles this fault is almost entirely obviated. It is possible, however, if the filling be weak, or should the shuttle be picked too hard, that the yarn may be broken before it has a chance to thread up. The shuttle eye may possible get jammed or choked by lint so that the thread cannot enter at all. If this happens, the fork will be raised all right, for the thread will draw off the top of the shuttle on its first flight. When the shuttle is picked back, however, the thread will be broken, calling for a new transfer of filling and making a curious looking defect in the cloth, as the shuttle will continue to lay threads going from the hopper and will lay none on the return. In weaving two shade goods this action puts several threads in one shade. In fact, it may continue this operation until all the bobbins have been transferred out of the hopper. Our present looms are so set as to stop for a double misthread, but even this will not prevent the fault just mentioned, as the fork will be raised intermittently. The *misthread detector* on the fork will act, however, if no thread is laid in front of the fork twice running. It may be possible for the fixer or the weaver to intentionally disarrange this motion so as to prevent the looms from stopping, but this should not be allowed, as it might cause a bad thin place if the hopper became exhausted or any accident caused repeated misthreading. The fact that the loom is found stopped, even when there is not a warp break or slack thread, does not necessarily mean that the shuttle has been misthreading. It is possible that the *shuttle position detector* may have prevented the shuttle from receiving a bobbin twice in succession, and this would cause the loom to stop just the same as if it had failed to thread twice running. If the loom is found stopped with an empty bobbin in the shuttle it is a sure sign that the shuttle position detector has found the shuttle out of place. This means that the pick should be set so that the shuttle will go fully into the box or not rebound. Men with inventive capacity often attempt to improve on our shuttle eye, and we do not assume that improvement is not possible where we have made so many changes ourselves. It is necessary, however, to recognize the requirements of the case, as a shuttle eye for universal use must be adapted not only for threading easily, but also prevent the filling from throwing ahead and getting out of the slot. It must also provide for easy passage of bunches, be practically self cleaning, give a proper friction, not weaken the wood materially, have sufficient weight to balance the metal parts at the other end, be fitted in the wood so as not to catch warp or filling, and be designed for easy molding and machine work. As to the simple problem of threading shuttles, as far back as 1894 we could transfer over 1,000 bobbins without a misthread. These records cannot be attained, however, without proper setting of the loom. We believe the set of the pick has more to do with this trouble than anything else, and recommend a light, easy pick with moderate pressure of the binder. We learned years ago that the amount of misthreading was affected by the 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.

BREAKING OF FILLING.

Every break in the filling causes extra labor, as the weaver must put a bobbin in the hopper twice at least in order to have its supply of filling woven off. Every bobbin ought to weave off clean, except on feeler looms, but a harsh pick may break filling by the jerk or cause it to throw out of the shuttle and catch on other adjacent parts. Sometimes the yarn wraps around the point of the bobbin or skewer while running off. With our earlier shuttle we expected breakage on No. 36 filling at least one in ten bobbins, whereas we do not now expect more than one in twenty-five. It is easy to note how filling is running by casually glancing at the hoppers in the weave room to see how many partly filled bobbins have been put back in the hoppers. Filling sometimes catches on the *picker* or *picker stick*. Care should be taken to allow no cracks, projections, or corners where the thread may loop when throwing out of the shuttle. With cop filling the yarn sometimes catches in the slot of the skewer. More trouble is occasioned by *split cops*, due either to shock in the shuttle box or poor design of spindle or skewer. This fault can be largely governed by the set of the pick and use of proper checks. There are many *checks* in the market which box the shuttle properly, but a shuttle must be received *easily* to prevent cop splitting, and there are very few checks which are adapted to this requirement and also to controlling the shuttle properly.

BOBBINS.

We have received a long and varied education in the requirements of filling bobbins as we have purchased all of those used on our Northrop Looms ever since we commenced to build them. The complaints of our customers therefore all pass through our own office, although up to the present time we have not had anything to do with their manufacture. Bobbin wood is liable to serious fluctuation, especially when not *carefully selected* and *carefully dried*. We believe the greater part of the trouble with bobbins getting out of shape is due to short seasoning, it being necessary to carry a very large stock of blanks in order to have sufficient supply of thoroughly seasoned wood on hand. Changes in the wood itself not only require reaming and the weeding out of badly warped bobbins, but also cause *loosening of the rings* before the bobbins are otherwise worn out. It is, of course, necessary for our loom that the bobbin rings should hold firmly so that the bobbin will lie properly in the shuttle. We insist on careful gauging of both wood and rings at the start, but the wood may change after the gauging process. The split rings applied to the bobbins are necessarily somewhat elliptical. In order to obviate trouble from this source the rings are applied so that the slots will not be opposite each other. The bobbins will swell if filling is dampened so that they will not fit the spindles. This necessitates reaming, but the reaming should not be done while the bobbins are wet, as too much wood will then be removed. We are now introducing spindles with a *centrifugal clutch* that allows a loose fit with the bobbin on the clutch and allows more leeway for the fit. We believe this is one of the most important improvements ever made in the art. The contour of the bobbin varies with the kind of yarn spun. Bobbins for coarse filling require coarser steps on the cone. With coarse yarn we use 12 steps, for print yarn 14. For coarse filling we usually recommend grooves on the barrel instead of ribs. We have made careful experiments in order to determine the proper size of barrel for filling bobbins, and our standard patterns are all of uniform diameter. To avoid trouble with damp filling as much as possible we advise that the bobbins be filled with linseed oil and two coats of shellac applied after they are dried. Much trouble is found with filling yarn because the bobbins do not fit down properly on the spindles. We expect to obviate this trouble entirely with our new spindle, but the fault will necessarily continue in old mills. With the old pattern of spindle the bobbins should fit the sleeve at from one-half to five-eighths of an inch, entering the cup (if there be one) at about one-eighth of an inch, fitting loose at the upper bearing, which should be at least 3-4 of an inch in length. Cups are really not necessary on our filling bobbins as the steel rings prevent splitting.

REAMING BOBBINS.

When the bobbins are reamed the reamer should be carefully watched. Not over 500 bobbins should be reamed without testing the fit. Try the spindle in the bobbin and feel if there is play at the upper bearing. If not, the reamer needs *spreading*. To spread and sharpen a reamer, the *temper* must be *drawn*, the reamer placed in a vice and the part that reams slightly spread with a light hammer and a tool made for that purpose. The reamer must then be tempered. Any good mechanic can change the reamer to the proper size. A mill with 10,000 filling bobbins should have at least six top reamers and two "pod" reamers. The upper bearing gives a great deal more trouble than the lower bearing and it is well to have a surplus. Run the reamer at least 2,000 revolutions a minute,—2,500 is better. A good man should ream from 7,000 to 10,000 bobbins a day. Every mill should have at least 20 bobbins to a spindle to each number of yarn used. To weave off in the shuttle properly the filling wind should be considered. We have found many mills where changes in the traverse would give better results. On 36 yarn we find best results with the rail going down quick and up slow in the proportion of 17 turns on the up-wind to 6 turns on the down-wind. This is on a traverse of 1 1-2 inches. With coarser yarn like No. 22 we should recommend 1 3-4 inches.

PREVENTING BUNCHES IN CLOTH.

All weavers know that when the last end of filling winds off from a bobbin it is liable to make a bunch in the cloth. Careful investigation has determined that these bunches are practically always due to the bobbins *which did not start up properly* when doffing and therefore require to be wound on by hand a few turns in order to piece up. These few turns are not wound tight enough to wind off properly and very possibly all come off together, which accounts for the fault noted. There is a common method of doffing which also aggravates this difficulty, when the doffers wind the yarn on the bobbins by giving it a few twists around the base instead of using the *socket doff.* The socket doff is certainly preferable. In order to avoid the trouble from the bunch with the bobbins not starting properly, Mr. Charles H. Arnold of Grosvenor Dale, Conn., designed a method in which the doffers are provided with bobbins having sufficient yarn spun on them so that they can be pieced up. Whenever an end does not start in doffing, the doffer removes the empty bobbin and *replaces* it with the bobbin already provided with enough yarn to piece up. In the weaving of fine goods this change reduces the seconds at once to a marked degree. The extra bobbins are of course furnished by spinning a slight amount of yarn on some extra bobbins at the frame and then removing them for use as noted. It is, of course, somewhat difficult to secure co-operation between the two departments, the spinner not often willing to go to extra work on the weaver's account. It is only, however, in this way that good results are obtained. Mr. Arnold's idea is patented, but we allow its free use to all owners of Northrop Looms.

WINDING BUNCHES FOR FEELER BOBBINS.

The bobbins used on our feeler looms are preferably spun with a *preliminary bunch*, the object being to reduce waste by preventing the operation of the feeler until all the yarn and part of the bunch have been exhausted. This bunch is wound about 2 1-8 inches from the lower end of the bobbin and is about 3-8 of an inch in length. We supply mechanism especially designed to govern the traverse of the spinning frames to automatically wind this bunch and have them in use in many mills on various makes of frames. They are perfectly satisfactory in every instance where given a little *care* and *oversight*. No mechanism will run in a cotton mill without being properly *oiled* and *cleaned*. It is evident that if a feeler loom is set to work with a bunch that every bobbin *should have a bunch*. Bobbins, therefore, which fail to start up at the doff should be replaced with special bobbins provided in advance, already having the bunches wound on them. It is, of course, possible to wind bunches on filling frames without automatic mechanism by simply holding the rail at the transfer point either by hand or by clamp. This method would, however, require special attention by an intelligent hand at the proper time.

COP LOOMS.

In weaving with cop filling more care is necessary than with bobbins. Bobbin filling rarely *loops off*, while cops break in two for insignificant reasons. Our skewers are made from conventional patterns by an experienced builder and are designed to fit the sample cops which are sent us. We have to fit the skewers to the cops, as it will not do to assume that all cops are alike because they are spun on similar mule spindles. Some yarn is twisted harder than others and yarn is often spun both coarse and fine on the same spindle. Proper temper is very important, as the skewer should not only have the proper shape, but hold it and stay open. Many fixers spread skewers with a screw-driver or other tool, but this is very liable to break them. When a mill uses steamed cops it should be careful to send us sample cops after being steamed. Trouble with cops splitting is not necessarily due to improper shape of skewer or excessive pick at the loom. It may possibly be due to the lack of proper wind in the spinning room. Sometimes cop skewers on our looms get bent by catching in the shuttle. They should be carefully examined at intervals to see that they are perfectly true. During the transfer the skewer strikes into the box with something of a blow and we recommend that the cop tubes which are removed from the skewers be dropped in the box to make a cushion.

WARP STOP-MOTIONS. THE STEEL HARNESS.

With our *steel harness warp stop-motion* the heddles themselves are used as detectors to effect the stopping of the loom if a warp thread breaks or becomes too slack. Originally we only applied the steel harness for two-harness weaving, but are now using it for two, three, four and five-shade work with great success. The heddles of the steel harness are suspended by the *heddle bars* which pass through *slots* in the upper part of the heddles, the warp threads being drawn through the *eyes* near the center. The lower ends of the heddles are free from the moving frame, but are guided by stationary devices which prevent their swaying too much either forward or sideways. Between the harnesses is a long, flat casting called the *stop-motion girt,* which serves two purposes: first, to separate the harnesses and hold them in position, and second, to resist the action of the *feeler bar* should a heddle drop down and be caught between it and the *girt.*

KNOCK-OFF MECHANISM.

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.* Between this cam, and forming a part of the same casting, are two *projections.* Normally, these projections just clear the *knock-off,* which is a small casting fastened to the same stud or shaft that holds the cam follower. When the heddle drops, the feeler bar strikes it. The cam follower is thus prevented from following the cam, and the knock-off on the shaft with the 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 knock-off are fastened. This motion of the link is communicated to the *shipper handle,* throwing off the belt. When a heddle does not drop, the feeler bars oscillate back and forth, 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 on this stop-motion is very similar to that used with the cotton harness stop-motion. 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, which it does when the harness-cams are on the cam shaft, 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, so 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 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.

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 harness. 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. If the heddles bind in any way on the heddle-bar it will show reedy cloth, and also be a serious strain on the yarn. No oil should be put on the heddles or heddle bars.

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 in the drawing-in room before re-drawing, and remove such heddles, as they are liable to catch and interfere, preventing the action of the warp stop-motion.

One of the most annoying troubles formerly experienced with our steel harness looms was their liability to become *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.

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.

So far as our experience goes we see no reason why steel heddles should not last indefinitely. We have had sets running at least eight 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.

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 excess of 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 use separators, which keep the heddles from swaying.

COTTON HARNESS STOP-MOTION, ROPER TYPE.

With this attachment, the ordinary *twine* or *cotton harness* is used, the stop-motion being applied between the *harnesses* and the *lease rods*, *two* or more threads being drawn through *each drop wire*. The threads in this stop-motion pass through *long slots* in the wires instead of *round eyes*, there being *two* such slots,—one for the passage of the *threads*, and the other for the passage of the *drop wire bar*. We sometimes use a separate *free bar* or *weight* passed through the *lower slot* and resting *on the detectors* to keep them *vertical* in action. The *feeler bar girt*, *knock-off*, etc., are similar to those already described. We also use a *back rod* or *warp support*, as with the steel harness. 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 can also be adjusted backward or forward so as to give room for additional harnesses. The *feeler bar*, which is the piece of sheet steel bent at right angles with teeth in the edge, should be set so that when it has reached the end of its forward movement, it will pass *under the girt* close to it. While this form of stop-motion will apply for many forms of three, four and five harness weaves, there are special classes of shading to which it will not apply. We have therefore introduced the third form, the *single thread* stop-motion, which can be used with any style of weaving, including *dobbies* and *jacquards*.

SINGLE THREAD STOP-MOTION.

With this construction, there is *one detector* for *each thread.* We apply it in several ways, our more common method in the past being to arrange the detectors in *two banks*, and use them also to do all *leasing* instead of the ordinary *lease rods.* We can make it in *three banks* if necessary. When used in two banks, there are *front* and *back box plates* instead of the center girt. The *feeler bar* is different in being a flat piece of steel with notched edges, oscillating between the two banks. To prevent detectors from slipping or bending under the twisting strain, we place *serrated pieces of steel* on the bottoms of the box plates. The top edges of the box plates serve as *warp supports.* The feeler bar having double action needs two *knock-offs* and two *connecting rods* between the *cam* and the *follower shaft.*

ADJUSTMENT.

In setting this stop-motion, throw off belt or remove key as before, placing the shipper handle in its notch in the shipper lock. Set the *knock-off link*, (the long casting forming connection to the shipper handle.) against its *bearing* on the *cam hub* so as to have no back lash. Then place the feeler bar in the center between the box plates and adjust the *two small castings* on the feeler bar shaft which we call the *tight* and *loose oscillator fingers.* These should project or hang evenly on each side of the shaft. Now loosen the *set screw* which holds the *stop-motion cam* on the *cam shaft* so as to be able to revolve the stop-motion cam by hand and set the *tight knock-off*, the small casting fastened to the stud in the *knock-off link* by a set screw, so that it will clear the point of the cam hub 1-16 to 1-8 of an inch. Turn the cam by hand 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* that is on the feeler bar shaft with the cam follower by means of 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 that is on the feeler bar shaft with the loose knock-off by means of the connecting rod and *adjust the rod* so that the knock-off will clear the point of 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. 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.

RELEASE MOTION.

With all of our warp stop-motions except the steel harness, trouble was formerly experienced on account of the feeler bars grasping and holding the detector after the loom had been stopped by a broken end. In such a case the end was drawn in without raising the detector, so that the loom was stopped a second time, or else the weaver was compelled to find the detector and release it from the grasp of the feeler bar by hand.

We now apply with our cotton harness warp stop-motions, devices which automatically release a dropped detector upon stoppage of the loom. This feature involves almost no additional parts, is positive in action, and saves considerable time for the weaver. It is exclusive with us, and fully covered by patent.

SLACK THREADS.

Slack threads often cause trouble by letting warp detectors of any pattern drop low enough to engage the vibrator and stop the loom, causing 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 slack 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 the 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 loose threads in the pattern, it may be advisable to run them on a *separate warp beam*.

WARP BREAKAGE.

Ever since our first experiments with Northrop Looms, we have continuously run large numbers of them in our own shops with careful supervision and inspection of product, and we feel 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 definite conclusions from machinery that employs so variable a material as cotton fibre. We keep an actual record of warp breakage and find that it varies in different years from as high as 24 warp breaks per loom per cut in one year down to an average of 12 in another, with no perceptible change in conditions other than the quality of the cotton used in making the yarn. All know that the fibre of different crops is not similar. Under the ordinary conditions we expect that the breakage on print warp with either steel or cotton harness should average between 10 and 15 breaks per cut. If warp breakage were to be reduced without attention being paid to other factors, looms would be quite differently designed. In order to produce *cover* on the cloth the yarn is *strained harder* in the *lower shade* and shedding cams are given a *jerky motion* in order to keep the shades open for the shuttle to pass properly. Our steel harness will break more ends for the first few weeks while the yarn is giving a final polish to the eyes. *Bad reeds* are liable to cause trouble, in fact many mills appear to buy their reeds without any consideration of quality whatever.

KNOTS.

It was figured some years ago that two-thirds of the warp breakage on a loom came from the *knots* made in piecing the yarn together, as these knots would fray adjoining threads or be caught *in the reeds* or *between the heddles*. 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, but the way the knot is *tied* affects the situation materially. in the old hand method the operative at the spooler tied a knot with long ends, so that for some time we advised the tying of a *weaver's knot* at the spooler, which would not only have short ends, but be less objectionable in size. We believe that in Europe spooler tenders are forced to tie a weaver's knot, and some mills who adopted the practice here found no trouble after getting the help trained, the girls spooling as great a product as before. Since the introduction of the *automatic knot tyer*, however, spooler knots as tied by machinery become much less objectionable as the machine leaves short ends and apparently ties the knot hard and compact. The automatic knot-tyer has gone into such extensive use that our recommendation is practically superfluous.

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. Harness cams should be set to start opening the shades 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 *under-throw*. With *over-throw* looms, of course, the setting would be directly opposite. We built several orders of over-throw looms for certain of our customers at one time, but found that they had no appreciable advantages which could not be secured as well by simple changes in design on the under-throw principle. As to *shape* of harness cams we decided after extensive tests to use a 60° rest cam with all widths of loom up to and including 40 inch. If read with relation to the upper shaft, these cams would be known as 120° rest cams. On wider looms the rest is made longer until on 108-inch looms we put on 180° rest cams. There is no definite fixed rule about the shape of the cam. Different weavers have different ideas as to the amount of rest and the amount of shade opening. We try to satisfy our customers according to the goods woven and the width of loom weaving them. In many cases the proper cam can only be determined after experiment.

SELVAGE.

Selvage threads are usually looser than the others, often causing the edge of the cloth to crinkle or be longer than the center. This is due to carelessness in setting the *temples*. If the temple is too far back, the yarn will *draw around* it and 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 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, the yarn will be stretched. Where *double threads* are used for the selvage and pass 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 trouble. As there is more strain on the selvage threads the twisted threads would seem to have an advantage also in *lessening warp breakage.*

CARE OF TEMPLES AND TEMPLE THREAD CUTTERS.

To insure proper care of temples, system is necessary and we strongly recommend the practice of all up-to-date mills who have the loom fixers *take out the temple rolls* and thoroughly clean them and slightly *oil the pins* that hold the roll in place every time a warp is run out before a new one is allowed to be started. The fixer should also examine the *temple thread cutter* at the same time. With this amount of care the usual troubles will be entirely eliminated. The temple thread cutter is only supposed to cut the thread leading from the hopper stud to the cloth *when the filling is changed.* A loose thread at the selvage left by the filling running out will not necessarily be cut by the thread cutter, so that the presence of such threads does not indicate that the thread cutter is not working. These loose threads are common on all looms. In setting temples, place the lay fully forward and adjust the *temple head* to be about 1-16 of an inch from the *reed.* The *thread cutter knife* can be removed by detaching the *spring* on the *cutter arm* and pulling the cutter out, 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. The strip at the thread cutter side should be long enough to strike both the *temple heel* and the *cutter arm*.

FEELER FILLING CHANGER.

The *feeler motion* is placed on the left hand side of the loom when the hopper is on the right hand side. It is set to pass through *slots* in the *front box plate* and *shuttle*, coming in contact with the yarn on the bobbin or cop as the lay beats forward. When the filling in the shuttle has been nearly woven off so that it will no longer move the feeler, the *filling-changing mechanism* or *battery* operates, supplying a fresh bobbin or cop to the shuttle when it is thrown to the other side of the loom. In case the filling breaks before it has been woven off sufficiently to operate the feeler, the loom will stop, thus enabling the weaver to find and *match the pick* by hand, as in common loom weaving. The mechanism can be set, however, so that it will supply fresh filling at such times. This makes infrequent faults and on some goods where it would not do to have mispicks every time the filling changed, it might do no harm to have a mispick at long intervals between breakages in the filling. To set the feeler, place an *empty* bobbin or cop skewer in the shuttle and bring the lay to its extreme forward position. Turn the *adjusting screw* in the feeler until its end is about the thickness of a layer of yarn from the bobbin or skewer. Then take several bobbins or skewers having a small quantity of yarn on them, place one in the shuttle, and start the loom. If it is thrown out before enough filling is woven off, set the feeler nearer. If the filling runs out entirely before the bobbin or skewer is thrown out, the feeler adjustment should be moved back. Several trials may be necessary before the feeler is set properly. The *coil spring* around the *shank* of the feeler regulates the pressure on the filling in the shuttle. The tension on this spring should be as light as is consistent with proper action. If too strong, it will push the bobbin out of line. From time to time the weaver should examine the *front* of the feeler arm which enters the shuttle and contacts with the filling. If rough, it should be rubbed with a little *emery cloth* or it may wear the filling and break it. While our present feelers are set to run independent of back lash, and looseness in the lay pitmen, it is well, of course, to have lost motion taken up. Extra pains should be taken to see that the shuttle boxes are properly set at the feeler end or the feeler may *strike the shuttle* itself instead of passing through the slot.

FEELER THREAD CUTTER.

The *thread cutter* used as an auxiliary on our feeler looms is attached to the casting called the *shuttle position detector*, which is moved up to the lay whenever a change of filling is called for. If the shuttle is boxed properly so that the detector does not contact with the tip, the thread cutter will cut the filling which extends from the cloth to the bobbin, the full supply not being woven fully off. A *clamping device* holds the end extending from the cloth to the cutter in position so that the *regular temple thread* *cutter* will cut it again close to the cloth. The thread is thus cut in two places: first, as close to the shuttle as possible, so that the bobbin when expelled can easily drag it out: and next, it is cut close to the selvage. In setting the cutter, take pains to see that the jaws will engage the thread properly. *Heavy filling* may require a slightly different setting than *light filling*. To raise or lower the device, change the position of the *stand* on the loom side to which the whole device is fastened. It seems almost useless to explain that the feeler requires special bobbins with cylindrical contour, but parties have actually tried to run the feeler with regular bobbins at times. With our earlier forms of feeler any change in position of the *front box plate* required readjustment of the feeler itself. This is not necessary with the two styles illustrated in this book.

LET-OFF.

Let-off motions may be divided into two general classes, *tension* and *friction*. Tension devices are intended to let off a definite amount of warp at each stroke of the lay. It is evident that as the warp beam runs out, it is necessary to turn it in proportion to the reduction in diameter, as there must be more movement when nearing the empty beam. With the *Bartlett let-off*, it is usually necessary to regulate the tension by adjustment of the *collar* on the *trombone* as the beam weaves off, so that enough teeth of the *ratchet* will be taken up each time. Generally speaking, the warp beam should turn about *three times* as fast when empty as when full, and surely move at least *one tooth* of the rachet at each motion of the lay. Improper delivery of yarn will cause uneven strain of the cloth, making it vary in width and also increase warp breakage. Sufficient *friction* should be put on the *let-off wheel* to prevent it from running by the point where the pawl leaves it. The let-off motions that we now use are the *Bartlett, friction with rope chain or leatheroids*, and our latest mechanism called the *Draper-Roper self-adjusting let-off*. The Bartlett and friction are standard devices needing no special description here. The self-adjusting let-off is what its name implies, that is, when the tension is once set, there should be no need of adjusting it at any time for the class of goods being woven. If the goods are changed the tension can be changed to accommodate the new conditions. This let-off will keep the cloth at more uniform width than any other, because the tension is also uniform. No special reference to detail is necessary as the adjustments are similar to the Bartlett.

WARP BEAMS.

There is, of course, an advantage in putting as much yarn as possible on the beam, and our new let-off will allow large beams with little trouble, as the tension can be regulated to the greater difference in diameters. The larger the beam the more the trouble with *crossed threads*. We soon changed from 16 to 18-inch beams, and furnish 20-inch beams for coarse yarn. At the present time we do not recommend larger than 18-inch for fine numbers.

TAKE-UP.

The *take-up motion* in use on all present styles of Northrop Looms is what we call the *high roll.* As the name implies, the take-up roll is placed high up, next to and inside the breast beam. This roll has a *gear wheel* at one end meshing with an *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. This description refers to the E Model looms. The J Model take-up is quite different. 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 an 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 usually represents two picks; for instance, for 64 picks use a 32-tooth change gear, and a 50 gear for 100 picks. 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. The cloth roll as we now make it has *teeth cut in the ends* to be turned by *gears* on the *take-up roll shaft,* so that the cloth roll will get a *positive rotation* while starting to wind the cloth. As soon as a little cloth is wound, these teeth will not mesh and the rest of the cloth will be wound by friction alone.

The *cloth roll racks* have teeth meshing into gears at each end of the *spring shaft*. The *spring* is wound up by a *gear* and *worm wheel* and *handle* attached to the *front girt*. When not in use, the handle can be put in the *notch* provided for it and be out of the way of the operative. Cloth can be removed from the roll at any time, the weaver taking off cuts when convenient. As the *take-up roll* is made of *metal*, it will not change on account of the weather like a wooden one. The *fillet* is fastened to *wooden blocks* inserted into holes in the metal roll. The take-up roll is *adjustable vertically* and can be raised or lowered to adjust the level of the cloth on the lay and give cover. Our new pattern of take-up lets the cloth run over *several stationary rolls* before giving any contact with the take-up roll, so as to give more stretch to the cloth between the take-up roll and the lay, which is desirable on certain classes of goods. With the new form of take-up the cloth can be run direct to the roll if desired. The strength of the *coil spring* on the *spring shaft* may be varied by turning the *collar* 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 an extra pin. Each of these holes represents one tooth on the ratchet wheel, that is, if the extra pin is in the first hole when the loom stops the ratchet 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 change 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 just lifts it out of its engagement with the *ratchet* or *pick wheel.* This is to accomplish the letting back of the take-up at the time transfer takes place. This should be looked after from time to time with great care, 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.

A *filling fork* can act improperly by rebounding so as to avoid catching on the *hook* of the *cam follower.* Our own fork is designed to balance properly; in fact, we think it the best balanced fork in use. A fork can also operate improperly by being raised by a *dragging filling thread*, after the filling in the shuttle is exausted. If the shuttle drags the thread end into the *left hand box*, unless the filling is rather coarse, it probably will not have strength enough to raise the fork. Our *double fork*, however, will protect against any such trouble by detecting from the other end of the loom if one fork be operating improperly.

If a fork is very light in action, it may be lifted by lint collecting in front of the *grid.* The more common trouble, however, is due to the lay shifting position, so that the *fork tines* will strike the grid and thus be improperly raised when the filling is absent. Of course, any false operation of the filling fork when used singly will cause thin places when the filling runs out, as no change of filling will be called for so long as the fork continues to lift.

Our *double fork* gives a double chance against faulty operation; but even with the double fork a shifting lay may operate both improperly. We therefore designed some of our early fork stands to be guided by the lay so that if the loom shifted, the stands would shift also. More recently, however, we have adopted a *lay guide* attached to the loom frame and sliding in another casting bolted to the lay, so that the side position of the lay must always be constant.

Filling forks are made in two general styles, one with *soft metal tines*, so that the fixer can bend them into any shape desired; the other made of tempered metal, so they cannot be bent. We prefer to make our forks right at the start, using tempered wire, so that they cannot be bent. In our present construction, the tines are *cast* into place and their position is absolutely fixed and unchangeable. Our present forks are all made with *three tines*, although we have furnished *four tine forks* for special light goods.

LOOM LAY.

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.

Much trouble is experienced with lays if the wood is not properly seasoned before use. We find it advisable to rough out our lays and let them season some time before finishing. We carry a large stock of lay timber on hand ahead of orders, so that we shall not be forced to use unseasoned stock by any uncommon demand.

The position of the *pivot* from which the lay swings with relation to the position of the *crank shaft* determines the *eccentricity* of the lay's motion, which is advisable in order to give the shuttle more time in crossing, and also to help give *cover* to the cloth.

After a great deal of experimenting, we have adopted a design suggested by Mr. Robert Burgess, then agent of the Grinnell Corporation, who tested looms of various constructions for us in determining this point. It is, of course, understood that all of these jerky motions make the loom run harder, and probably bring more strain on the warp, but long experience has determined that it is better to sacrifice smooth running to other considerations.

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 *raceboard* should 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 set at exact right angles with the shuttle race, the *hand rail or reed-cap* being filed to fit, and forced firmly into place.

The purpose of the reed is simply to beat in the filling threads, and furnish a *back guide* for the shuttle. 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 *straight* and *smooth*. In nearly every case where mills have complained of shuttles wearing excessively on the back, it has been because the dents of the reed were sharp, scraping the backs of the shuttles like a fine file, and *fluting* them so that they looked something like a miniature washboard.

In the manufacture of reeds, the straightening and polishing of the dents is by far the most expensive and slowest part of reed making, and when not properly done, simply indicates a poor job, and an attempt to make an extra profit. *Sharp reeds* are also very hard on the warp yarn, the blame of bad running warp often being put on the quality of the yarn, when it is really the reeds that make the trouble. To test a sharp reed, draw the finger nail edgewise across it, and if it wears the nail, the reed is sharp and not properly polished. The dents should not bite the nail any, and should, of course, be in line. Manufacturers should insist on having smooth reeds, and inspect them carefully to be sure that they get what they order. There are reed manufacturers who supply proper reeds and have pride in their reputation. It is not our business to recommend special dealers, but we are often tempted to when noting what inferior supplies are sometimes attached to our looms.

The reed dents should be as thin as possible, to allow elasticity and can, of, course, be made deeper, if the thinning is inexpedient without it. The manner of holding a reed in the lay is not so positive as it might be, since reeds vary so much in contour. We formerly used an *adjustable fliter* by which the reed could be positively clamped, no matter what its size. The idea was good in itself, but we found that fixers were liable to screw the bolts up *too tight* and pull the reed in front of the shuttle box. We have therefore gone back to the old *reed groove* system, but have improved its form so that it seems sufficiently efficient. In order to fit this groove properly, it is necessary for customers to send us *several pieces of different reeds*, so that we may know how much their size varies.

THROW OF LAY.

When the lay is at the end of its forward stroke it must be in position to allow proper delivery of a fresh bobbin or cop to the shuttle. Any wear of parts that allows the lay to throw forward too much should be taken up, and if it becomes necessary to shorten the pitman to take up wear, the position of the lay can still be corrected by adjusting the *eccentric pins* in the *lay swords* to which the pitmen are fastened. Of course it is only necessary to adjust the pin at the hopper end of the lay in order to get the shuttle box properly under the hopper, but great pains must be taken to adjust *the pin at the other end of the lay* exactly the same amount, or else the lay will have a curious eccentric motion, one end beating up further than the other, causing the shuttle to wear into the reed or strike the shuttle box sides improperly. If the wooden parts of the pitmen wear so badly that the eccentric pins will not furnish sufficient adjustment, the wooden parts should be *replaced*. If too much play is allowed in the pitmen bearings, there is possibility of cracks or slight thin places in the cloth when the loom stops.

SHUTTLE BOXES.

The *back box plates* are set at exact right angles with the lay end plates by filing the *ribs* or *fitting strips* at the back of the plates. The *back box plates* must be set in line with each other, the reed being preferably set slightly back of this line, as it will not do to run any chances of having the reed in front of this line. A long *steel straight edge* is necessary in order to try the plates and see that they keep in position. The front box plates should be set so that the top will lean slightly toward the back box plates, thereby reducing the liability of the shuttle raising in the box. If set at a right angle it will probably work all right, but it must not lean *from* the back box plate. At the same time it must not lean much toward the back box plate or it will wear the top of the shuttle. With *back binder* looms, the front plates are adjustable and should be set so as to line the point of the shuttle *in the centre* of the picker stick slot. With the front box plate in position, adjust the binder properly by loosening the *nut* on the bottom of the lay and the *screw* which passes through the binder bearing, turning the *eccentric bushing* with the fingers until adjusted to the proper position. We have had a great deal of experience with different binder materials, at first being ready to follow the request of our customers, until we had definitely settled the matter to our own satisfaction. A binder may be of wood, wood with leather face, wood with steel face, wrought iron, cast iron, or iron with leather attached. We now prefer a *wooden binder faced with leather*, as we find that leather does not wear the shuttle so badly as either wood or iron. Iron binders bring a hard pressure on the shuttle *when the loom bangs-off* with the shuttle part way in the box, the whole force of the momentum of the lay being transferred through the protector rod, binder fingers, and binder to the shuttle, often breaking its sides, as it is pinched in its weakest part. The wooden binder will give sufficiently to relieve the shuttle, and we think the shuttle boxing is better also as there is more spring to the wood and less weight to be moved.

PROTECTOR.

The *protector mechanism* on the Northrop Loom does not differ in principle from that on other looms, so that detailed explanation is unnecessary. On our recent models we use a novel method of adjusting the *binder finger*, which we think will appeal to fixers. *Protector rods* sometimes become loose through wear. The *caps* which hold them can be tightened by filing. The pressure of the *binder fingers* on the *binders* is regulated by a *protector rod spring* in the usual way. Now that we are building *front binder looms*, we use a novelty of construction which enables us to still employ the ordinary *frog* and *dagger* protection.

BRAKE.

All looms are equipped with *brakes*, but in one class of looms the brake is worked solely from the *protector motion* when the loom bangs off, while on another class the brake also operates every time the *shipper handle* is thrown off. The latter system is known as the "*Filling-Brake system*," for with the common looms the brake is thus applied whenever the loom is stopped by the filling motion or fork. There is no question but that the application of the brake brings serious jar and strain on a loom. We know this positively, for we have many records taken of looms used with and without the filling-brake attachment, showing that looms which do not apply the brake at these frequent intervals, run with much less cost for repair, and much less loom fixing. We thought at one time the brake was also responsible for breaking of *crank shafts*, but further investigation proved that the more frequent reason for crank shaft breakage came from the strain of a *tight belt*, as noticed particularly in mills where looms were driven from small pulleys underneath the floor, with *short belts* necessarily kept very tight.

While, therefore, we have a filling-brake system, and a most efficient one at that, we have recently discontinued its use on looms weaving goods where the picks were so frequent that the stopping of the loom did not make any possibility of a crack or thin place. On light goods we shall continue to apply them, and the parts, of course, are applicable to looms which may be sent out without them. Our loom has less use for a brake than the common loom as it does not stop for filling exhaustion or breakage.

Any brake, to work properly, should be carefully adjusted. When the brake acts by the motion of the frog holder it should not bring pressure upon the wheel before the belt is shipped. The braking surface should be set so as to bear upon as much of the surface of the wheel as is possible. This can be done by means of the adjustment at the bottom end of the brake. The *leather* on the brake will necessarily wear more or less, requiring attention in order to obtain the best results.

LOOM ADJUSTMENTS.

Every new loom will jar screwed parts loose in the first few days it is run. All screws and nuts should be gone over carefully, tightening them securely when loose. There are many theories about the proper adjustment of *whip-roll*, *harnesses*, and *breast-beam* or *breast-roll*. If *cover* is desired, an extra strain should be brought on the *lower shed* by raising the whip-roll, breast-beam or breast-roll, or both. Our *high-roll looms* are provided with liberal adjustment for change in vertical position. *Whip-rolls* are also adjustable for the same purpose.

In weaving drills or twills, strain is frequently brought on the *top shade* by preference. When this is necessary, the whip-roll and breast-beam should be practically as low as the race of the lay.

It is, of course, necessary to adjust the shedding motion and timing of the picks so that the shuttle can pass through the shed without too much friction. These adjustments must vary with the width of the cloth woven, as it is obvious that with a wide loom more time is necessary. Looms are built with the crank shaft set lower than the lay pitman pivot, in order to give more time for the shuttle. The use of a *short pitman* accomplishes the same purpose, if the bearing for the pitman is extended, but this construction necessitates *heavier sword castings*, and is not so desirable for that reason.

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

DRAWING-IN WARP.

Drawing-in is necessarily expensive, and the question of twisting in warp has therefore been considered. We have made experiments in this direction, finding there was an actual saving in time of about 15 minutes per warp. The loom was kept from producing, however, during the time of twisting. Of course, warps can be twisted in outside the loom, in a frame made for that purpose.

Our steel harness requires no extra labor, while drop wire warp-stops add to the cost of drawing-in. Large beams naturally reduce the expense.

The *Keene drawing-in frame* is of great advantage for any of our stop-motions.

SIZING WARP.

Where *drop wires* are used with cotton harness, it is necessary to size the warp with additional care, taking pains to put the sizing *into* the yarn instead of on the outside, as is the custom in a great many mills. The test of proper sizing is found in the amount of *lint* noticed, and the average *warp breakage* counted. No. 28 warp yarn should not break more than 10 to 12 threads per day with a cotton harness stop-motion on ordinary goods. Slow speed at the slasher gives a larger percentage of size. With our steel harness, extra sizing is not necessary; in fact, not advisable, as it may actually increase warp breakage. We recommend the following mixtures for our cotton harness drop-wire system:

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.

For steel harness simply add more water to the above mixtures. Experiment will determine the proper amount for the conditions presented.

LOOM POWER.

We believe that all authorities are wrong on the question of the amount of horse-power required for the looms built today. The old experts figured from tests made with light pattern looms, run at low speeds. Every builder puts more weight into his loom today, and higher speeds are in vogue. It is possible that our loom requires slightly more power than the common loom for the same goods, as it uses a heavier shuttle, and we believe in a stiff, heavy lay. With our first print-cloth loom we had an admirable opportunity for test, as we ran a room of 80 looms from a single engine, and could indicate the power absolutely. At 190 picks, they showed 3 3-4 looms to the horse-power, not counting the shafting.

CLEANING LOOMS.

It seems needless to emphasize the necessity of keeping any machine properly cleaned and properly oiled. Different mills have different systems in this respect, some insisting that the weaver shall clean and oil his own looms, while others have special cleaners and oilers. A loom should surely be cleaned and oiled every time a new warp is put in, and it should also be kept reasonably clean between such periods. The high-speeded mechanism needs oiling more frequently, and it should be remembered that every place where two metal surfaces are in rubbing contact demands oil.

While we have never gone into the question of testing oils for looms, we believe that poor oil can do as much harm in the weave room as in the spinning room, and we recommend following the advice of competent oil experts, even if their recommendation seems to involve slight increase of cost in the oil itself.

REPAIRS.

It is somewhat difficult to get at average figures of expense in this line, for new looms will need more frequent repair until the weavers and fixers get used to them. We can figure fairly well ourselves from the amount of parts sold to our customers, although many orders are for parts to be kept as stock on hand. Sometime ago we figured the average repair cost per loom per month at 12 1-4 cents, not including *shuttles* or *strapping*. We understand the repair cost of the common loom, including shuttles, is about $3 per loom per year, and we estimate that the cost on our own looms would certainly be under $4; in fact, there are mills using both common and Northrop looms, which inform us that the repairs on their Northrop looms are *actually less* than on the common.

PRODUCTION.

Many mills take advantage of the capacity of the Northrop loom for running without the attention of the weaver by starting the machinery before the weaver arrives and also running during the noon hour and possibly sometime after the weaver has left at night. In such mills the production is often over 100 per cent. of that possible during regular hours. The comparison with common looms, which produce less than 90 per cent., is interesting. It is quite common for Northrop looms to give 95 to 97 per cent. of product without the gain by running over time. A mill should not be especially proud of this showing, however, for it simply proves that their weavers are *not spread out* over their *proper number* of looms. It may take many years to kill the popular fallacy that production of cloth per loom is the great end for attainment. *Production per weaver* is rather the end that should be aimed at.

LOOM SPEED.

We have never favored high speed for looms, although the Northrop loom can run at high speed if necessary. Simply as an experiment we have run one of our print looms at 280 picks. We have had looms running for weeks at a speed of 220 picks. There is nothing in the addition of our novel mechanism which limits the speed in any way. Our reason for advising low speed, therefore, is not because our loom is handicapped, nor because we wish to sell more looms, as some uncharitable persons have asserted. Increase of speed increases the breakage of warp, requires more fixing and costs more for repairs. Since the introduction of the Northrop loom many mills in this country have speeded their common looms. Perhaps they wish to wear them out more rapidly and thus be ready earlier for replacement by Northrop looms. We doubt if there is any other good reason for the change. They run looms at high speed in England, but simply because of the domination of the trades-unions, which will not allow weavers to run more than four looms. Under such circumstances the manufacturer is bound to get all the product he can from each loom without caring especially whether he increases the number of duties necessary.

COSTS.

The common plain loom, as ordinarily built, is largely a foundry product and the cost necessarily varies with the market prices of raw materials. In 1894 we learned that an outside builder estimated that a print loom weighing 900 pounds figured $27 for stock, $9 for labor, $3 for painting and $11 for general expenses with profit, making a total of $50. Most builders put more iron in their plain looms today, very possibly patterning after our own increase when we first commenced the building of looms. We invite comparison of our loom as a machine product with any other made, for we not only secure uniformity by machine moulding, but we also put more tool work into the loom parts than any other builder we know. Our foundry castings have a world-wide reputation and our tool equipment for the manufacture of looms is entirely modern. While the prices we charge for our product may seem high, the additional expenses of manufacture must be taken into account, as well as the extra mechanism which we supply.

WASTE.

We have no very recent figures on this subject. The filling waste in a Northrop loom print mill, as averaged from several weeks' test, showed .14 lbs. per loom per week on bobbin filling.

LOOM EQUIPMENT.

The usual common loom, as sold to the trade, includes no extras in the way of parts not secured to the loom, except the *beams*, 1 1-2 being figured to each loom. Our Northrop loom, on the contrary, is furnished with *one shuttle per loom*, *check stands*, *shuttle guard*, *filling fork*, and *one loom seat* to every eight looms. We also furnish *steel heddles* or *warp stop detectors* in quantities as ordered and supply our own *temples* of whatever pattern desired, at regular prices. The following list specifies the extras which are usually purchased from supply dealers, although we can furnish sample lots, if required, at their prices: *Lug straps*, *lease rods*, *jack sticks for cotton harness*, *strapping*, *cotton harness*, *reeds*, *lease rod holders*. We can supply *thin place preventers* on order and also sell *extra pick gears*, *auxiliary shaft with gears* for 3, 4, or 5-shade work, *selvage motions*, etc., at extra cost.

DOUBLE PICK CLOTH.

In view of the many attempts at introduction of weaving novelties that produce cloth with two threads in a shade, we might call attention to the fact that such cloth is easily woven on our Northrop loom by *winding two threads on a bobbin*. With this system double production is assured, but the cloth is not of the regular trade standard. We mention this not to suggest adoption, but merely to prevent waste of time on experiment with *double bobbin shuttles*, *needle looms*, etc.

CLOTH DEFECTS.

Cloth as woven is usually inspected for imperfections, such as *thick* and *thin places*, *cracks*, *oil stains*, *scratch-ups*, *thread runs*, *wrong draws*, *too many threads* in a harness eye or reed dent, *overshots*, *skips*, *kinks*, *loops*, *unevenness*, *bareness*, *reediness*, *lack of weight*, or *narrow width*. Thick and thin places are usually caused by imperfect action of the let-off or take-up and on the Northrop loom by the filling fork being out of order. Cracks or slight thin places are caused by the loom stopping and being started, especially if the weaver turns the loom over while mending in warp or placing the shuttle. Our latest take-ups are arranged so that they will not operate *unless the shuttle is picked*. Excessive looseness of parts in the loom may also cause cracks when stopping or starting. Our *double fork* will cure thick and thin places and we expect to produce a take-up that will absolutely avoid cracks. Oil stains usually result from carelessness. Care should be taken, for instance, in *oiling the hopper stud* on a Northrop loom not to let any excess of oil drip on the filling bobbins. If bobbins are allowed to drop on the floor they may get dirty and show streaks in the cloth. Scratch-ups and thread runs are practically obsolete where Northrop looms are used, for the warp stop-motion, if kept in order, will prevent either one. Wrong draws and extra threads should be detected by the weaver. Overshots are greatly reduced on our loom, especially with our steel harness motion. Of course, overshots are possible if the harnesses and pick motion are not properly timed. Skips are also caused by improper adjustment of the harness or pick, or if the picker is not in proper position. Kinks result from filling not being properly conditioned and also from weaving goods too narrow for the width of the loom. Also by using a *too heavy fork*, or *not sufficient friction* in the shuttle. Too much power in the pick will also cause them. Loops are almost always caused by the harness not shading properly, especially on five-harness goods. Uneven cloth is usually made when the let-off or take-up is not working right, although uneven filling will also give the goods a similar appearance. The faults in the surface appearance of the cloth are determined from the standard set by the buyer, and this may vary so that a fault on one class of goods would not be detected on another. Weight and width must be kept right. We believe our *Draper-Roper let-off* will produce more even goods than any other in the market, and our high-roll take-up principle will also assist in keeping the width uniform. Of course, the weight will vary if the take-up is not absolutely uniform and positive in action. Our iron take-up roll is also of assistance in keeping the picks uniform. Another defect, not always classed as a defect, is the mispick, or lack of thread in a shade or double thread in a shade. With ordinary two-harness weaving the presence or absence of threads is hardly apparent except on close examination. When goods are *napped*, it is highly important that mispicks should be avoided. In common loom weaving the weaver is personally responsible for a mispick, as he can find the pick by turning the loom over and taking care to make a proper jointure. Some weavers escape mispicks on common looms by stopping the loom just before the filling weaves off in the shuttle. Our feeler mechanism copies this method by changing the filling just before it is woven off. It has been found that the Northrop Loom on three-shade weaving makes less mispicks than the common loom as run in the ordinary manner, for the usual lapse of time between the detection by the fork and the operation at the hopper brings the new thread into the proper shade a good part of the time. The usual weaving expert has more to say about cover on the cloth than any other special feature. Cover is a quality appealing to the eye by evenness and to the feel by softness. Evenness can be positively produced by using reeds having a *dent for each thread* and may also be apparently produced by weaving with the upper shed slack so that the unevenness is disguised. A *soft feel* is produced in a similar manner and can also be given by use of soft twisted filling. Cop filling undoubtedly has advantages over bobbin filling in this respect, although it is possible that bobbin filling may some day be spun with slacker twist if desired. Slackness in shed is produced by the relative positions of the breast beam and whip roll, or by the angle of the lay when beating up. Heavy drop wires may take some of the slackness out of the top shed, but we have never found this objection important. Bare cloth is also due to the harness cams not being suitable. Sometimes cloth or warp is soiled by dirt falling through belt holes in the floor above. All mills should be thoroughly equipped with belt hole guards to prevent such difficulty. Sometimes oil from the shafting above the loom will drip on to the cloth or warp. Of course, as cloth is woven from yarn made in other departments, its defects may be due to conditions outside the weave room. If the filling yarn is poorly wound, rings of yarn will slip of, making double filling in the cloth. If not properly moistened it will kink. Yarn may be made from dirty roving or with too much twist. Of course, the slashing of the warp affects the weaving and the goods woven. All the departments of a mill should work harmoniously to produce the necessary result, and the management in charge of all departments is directly responsible for such a result.

COTTON MILL PRODUCTS, 1900.

(From Census Bulletin, No. 215.)

ARRANGED IN ORDER OF YARDS WOVEN.

	Square Yards.	Rough Percentage.	Value.	Number of Looms
Total	4,509,750,616	100	$243,218,155	450,682
Prints and converters cloths	1,581,613,827	36	57,780,940	125,000*
Not finer than No. 28 warp	1,056,278,952		35,616,575	
Finer than No. 28 warp	525,334,875		22,164,365	
Sheetings and shirtings	1,212,403,048	27	55,513,032	100,000
Ginghams	278,392,708	6	16,179,200	25,000*
Napped fabrics	268,852,716	6	18,231,044	44,227*
Fancy woven fabrics	237,841,603	5	21,066,310	45,686
Drills	237,206,549	5	11,862,794	30,000*
Twills and satteens	235,860,518	5	14,301,302	28,839*
Ticks, denims and stripes	171,800,853	4	16,446,633	18,000*
Duck, total	129,234,076	3	14,263,008	15,000*
Duck, sail	11,750,151		2,216,371	
Duck, other	117,483,925		12,046,637	
Upholstery goods	50,334,609	1	8,670,384	5,000*
Mosquito and other netting	41,885,023	1	875,868	4,500*
Bags and bagging	30,039,616		2,554,192	4,421
Cottonades	26,323,947		2,791,431	2,500*
Corduroy, cotton, velvet and plush	7,961,523		2,682,017	800*
Yarns, sewing cotton twine, tape, and other products			89,588,001	1,709
Total value of all products, including above			332,806,156	

* Estimated by writer. (The report only separates out the looms on certain lines.)

In referring to the goods which it is now possible to weave on the Northrop looms, it might be simpler to mention those which can not be woven, for the Northrop loom has been successfully used on the greater majority. We weave all classes of prints, sheetings and shirting, a large line of napped fabrics, drills, twills and satteens, ticks, denims and striped goods; in fact practically the whole field covered by looms that weave with one shuttle, no matter whether they use plain harness motions, dobbies or jacquards. Our looms have been specially successful on corduroys. They are also weaving bags, window shade cloth, towels, etc. Quite a number of mills are using our regular loom on goods made with silk warp and cotton filling. We have woven worsted goods by using a wooden skewer to hold the ordinary worsted bobbin. We see no reason why the Northrop principle should be restricted to cotton looms.

"We have been running twenty-six of your Northrop looms for a little over a year and it has occurred to me that you might be interested in results obtained. Our percentage of seconds for the last three months from these looms, for all causes, such as thin places, button hole selvedges, oil cords in filling, etc., is only 2.07 per cent. Goods weigh 2.85 yards to the pound, 18s warp, 15s filling. I believe this is a low figure, especially as these goods are all bleached and the bleachery reports that our grading of first quality is strict so that they have practically nothing to say to us except to hold the goods up to our standard. Conservative figures show that the looms are producing about 93½ per cent. of theoretical production figured on our actual running time. We do not run them over time at all, as some mills do. Some mills may show a larger percentage than we get, but as the goods must bear rigid inspection I think the results produced are fair. . . . . The looms give us little if any trouble in fixing, and repair account for them is very light. We are running them 170 picks, which is somewhat higher than you recommend for 45″ reed space looms, but they give us no trouble in that respect."—[*Letter received from customer Sept.* 28, 1900.

"They say they have never had any complaint from the selling house in regard to the quality of their cloth, and some of the goods they are weaving in 6-cuts rolls, and sending it out even without inspecting it at the mill"—[*Expert's Report of Dec.* 12, 1903.

PRICES AND PROFITS.

The price demanded for a new machine should bear a pertinent relation to the profits to be derived from its use. The machine itself may be absolutely efficient, accomplishing all that its promoters claim, and yet demand a price prohibitive by reason of the capital required. On the other hand, a new machine may be sold so cheaply as to give little encouragement to the builders to continue its improvement, through the only possible channels; namely, expensive experiment. Contrary to a popular fallacy, inventors rarely devote their time and energy entirely for the good of the world at large. Those who develop and introduce the inventions are certainly not so impractically altruistic. There is no reason why the customer should not pay a proper price for value received; and yet, in the general introduction of inventions, it is necessary to give the customer the lion's share of profit, in order to secure his approbation. The value of our spindle improvements has recently been estimated at considerably over one hundred million dollars; and yet the return in price paid for the actual spindles themselves, sold within the period referred to, would be under twenty million dollars, which payment must cover the cost of the spindles themselves, the cost of the patents, the cost of expensive litigation, and all the experiments, advertising, and general expense connected with the industry.

The introduction of the spindle was comparatively easy compared with the introduction of the loom, for the early price of new spinning with high speed spindles was actually less for a given product than the slow running frames, while with our loom the price is nearly three times the price of the competing loom, so far as the amount of product is concerned. There is always a protest against higher prices, no matter what the advantages may be.

Looking at the introducer's side, it is evident that, having but seventeen years of patent protection, several years of which are usually used up before actual sales are made, he must make enough out of this limited period to repay all of his expenditure involved in perfecting, protecting, and introducing his idea, as well as a fair bonus to repay for the risk of attempting to improve in the first place. The profits must also cover the expense of hundreds of useless experiments, thousands of disused patterns, possible litigation, extensive advertising, replacement by improved parts, etc. It may be easily demonstrated that if it had been possible to sell all the possible customers all the looms they could use at a uniform price, none of them would derive appreciable profit from the operation; for the competition amongst themselves would reduce the profits till the general public received all the advantages of the new economies. The earlier purchasers of our looms would, therefore, prefer to see our introduction gradual, and it would hardly be fair to them to reduce prices in favor of those who were not so willing to assist by patronage in the early years of trial. We have no doubt but that we could have sold a great many more looms, had we set our price lower in the first place. We might even have made as much profit; perhaps even more. It would have been necessary, however, to have still further enlarged our plant for such a purpose, and after filling the more numerous orders given to replace old machinery, we might easily have found ourselves over equipped for the regular business of supplying new mills for the future.

The possible profits of the Northrop loom are based on the actual fact that with them a weaver can produce at least twice as much cloth as formerly, often three times as much, and in special instances even more, by tending a much greater number of looms. It is also found that the Northrop looms will produce more cloth per loom, as they generally run for a greater percentage of the time and in many mills are allowed to gain still more by running during the noon hour. The quality of the cloth is often better for certain purposes, but we do not claim yet that the improvement in quality actually increases the price at which the cloth can be sold. We do believe it is enough better to give a preference and we believe that with certain of our later devices, employed in large quantity, **we shall actually create a new and better grade of cloth which the common loom does not produce.** The weavers on Northrop looms, having actually less work to do, even while tending three times as many looms as formerly, have been allowed to share somewhat in the profits by being allowed a price per cut at which they can make better wages. The average piece price for goods woven on Northrop looms is probably a little less than half the former weaving rate. To offset this gain we have an increased cost of the loom itself, with loss of interest on the extra investment money, and a very slight increase in repairs and fixing, although there are mills which claim that their expenses in this line are actually less with the Northrop loom. Roughly figured, the gross profit on the loom should run from $20 per year per loom upward. It varies with the scale of wages paid, and the number of common looms formerly tended; for instance, Northrop loom weavers are paid six cents per cut in Southern mills on goods where they might earn nine cents in the North. The weaver that changes from four common looms to twelve Northrop will show a greater gain than one who changes from eight to twenty. There are many incidental advantages in the lessening of the number of operatives required. When we take half the help out of the main department of a mill we greatly lessen the number of tenements necessary, lessen the cost of bookkeeping and paying off, and less personal attention is required from the supervisors. Our loom being automatic in character, requires much less skill and training from the operative, for it is easy to learn to run Northrop looms; in fact, green help become accomplished weavers in a much shorter period than with common looms. As the loom is automatic and therefore more responsible for errors, there is less chance for trouble with the weavers over bad work and fines. Some of these matters may seem small in themselves, but they amount to considerable in the aggregate.

We have labored very hard to overcome traditions in weaving that have grown up out of the long ascendency of the common loom, and we believe that the possibilities of automatic weaving are still hampered by customs originating with common loom practice. When a weaver was limited to four, six or eight looms, it was more or less a matter of pride to keep them running, and if the weaver could not keep a certain number continuously operating he was forced to use a less number. This bred the instinctive horror of a stopped loom, which prevails now that the Northrop loom allows a much greater number to the operator; yet economy actually demands that a weaver with automatic looms should have enough under his charge so that some stopped looms would be more or less of a necessity. It is quite common in Northrop loom weaving to have production run as high as 95 per cent. of the possible production without counting in the extra gain by running noon hours. It is a common thing to see a Northrop loom weaver with all of the hoppers full and no single loom stopped for any purpose. Such a state of affairs simply proves that the same weaver could be given a greater number of looms if it would be possible to educate him into a state of mind that would not look on the stopping of several looms at a time as a terrible error. It can be easily proved that it would be much more economical for weavers to get 80 per cent. off of 30 looms rather than 90 per cent. off of 20 looms, or 95 per cent. off of 16 looms, provided the pay of the weaver were regulated to the product in proper proportion. We believe it for the best interests of the loom, the help and the management as well, for the Northrop loom weavers to be relieved of the work of cleaning and oiling their looms.

No labor-saving device attains its full efficiency in the first few years of use. Our later large hopper looms have certainly enlarged the scope of the weaver, and continual improvement will gradually reduce warp breakage and other loom stops due to various other causes.

The problem of how to increase earnings is often solved by enlarging the plant, but less money applied to the improvement of a present plant may sometimes give far greater returns with much less inconvenience. The change from common to Northrop looms requires no addition to floor space. As above noted, it greatly decreases the number of operatives, and therefore solves a most perplexing problem in localities where weavers are scarce. If the old mills will not appreciate these facts they must face the competition of the new mills, which start with more modern equipment. We are frank to say that the hesitation of many of the older mills has been distinctly disappointing, for we should like to see them share in the benefits of our new ideas on account of the friendship founded on long and intimate associations. Failing to induce them to take the majority of our products, however, we must in justice to ourselves encourage the building of new plants. We should, if necessary, place our looms, even if we had to build and operate mills ourselves in which they were used; for we are absolutely convinced that the mills with our machinery can make profits in straight competitive lines at prices which will drive the older, poorly equipped mills, out of business. If there is demand enough to make a profit for all, the mills with our machinery will make the greater part of it; and when there is no profit at all for the older mill, the newer mills can at least keep a balance on the right side of the ledger.

According to the census reports there were in 1900 about 450,000 cotton looms running in this country alone. In 1904 there are certainly over 500,000. Out of this number there are probably at least 75,000 looms running on tapes or narrow wares and with box motions or other devices that practically take them out of the field of filling changing mechanisms. These looms, however, offer an opportunity for warp stop-motions which we have already accepted to a considerable extent. Taking out the Northrop looms already delivered and running, there remains a field of about 330,000 looms for us to replace, as this number of common looms is still used on goods which we are perfectly capable of weaving. With our present plant, even before recent additions, we attained an output of 2,000 looms per month. With our new foundry facilities and a proper increase in tools for which we have space already saved, we could undoubtedly deliver 40,000 looms a year. In view of the looms sold to new mills it is therefore somewhat doubtful as to whether we could entirely replace the old looms in 10 years' time, especially as we should be foolish to increase our capacity to an extent not warranted by the normal future demand after the old looms are replaced. The trade can therefore be assured that those who have purchased looms now will have at least 10 years' advantage over those who delay. The earlier purchasers of our looms have long since paid for them by their profits, and these profits are practically guaranteed so long as there remains any appreciable number of common looms in use.

During the last few years the trade has noticed many periods of curtailment by large numbers of mills running on certain standard lines of goods. It has also been noticed that other mills on these lines of goods have not only run full time, but even kept running during the night hours in spite of the disadvantages of such a practice. **The main difference between these mills has been that one class run common looms and the other Northrop looms.**

It is not to be supposed that the introduction of a revolutionary machine like the Northrop loom is effected without difficulty, annoyance and delay. Those who use common looms and have not immediate chance for replacing them are naturally anxious that their competitors should not adopt advantageous improvements. Those who sell common looms are adverse to acknowledge the merits of their competitors and the influence of a large body of manufacturers with their salesmen and personal friends is of acknowledged weight and importance. There is also a limited class who have made unsuccessful experiments with certain lines of weaving with the new devices and who are not disposed to admit that the other mills can be more successful than themselves. All of these opposing elements together create a certain atmosphere of doubt and a disinclination to accept facts, which can only react to their own disadvantage.

Apart from the profit derived from the sale of our looms there is a distinct personal satisfaction in overcoming the antagonism of these varied elements and proving the truth of our earliest contentions. It has always been held to be a difficult matter to convince a man against his will, but difficulties in the undertaking make success so much the sweeter.

Many have read the series of letters that were written to the Manchester Guardian by their special correspondent who visited this country with the delegation that inspected our cotton industry. Nothing recently published gives an equally clear and comprehensive view of the trade situation from North to South by an outside, and therefore unprejudiced, party. The following quotation is but one of many which refer to the paramount advantages of our loom :

"The mill contains, at present, 25,000 ring spindles and 800 Northrop looms. All the cloth manufactured is for export, and consists of two kinds only, namely—China drills and sheetings or shirtings. Drills are 30 inches wide, weigh 3 yards to the pound, and have 68 ends and 48 picks to the inch. The sheetings are 36 inches wide, are of the same weight as the drills, and have 48 ends and 48 picks to the inch. In both cases the yarns are 13.65s twist and 13.80s weft, the cuts are 120 yards long, and the piece rate for weaving is 13 cents a cut. The rate for weaving similar drills in Maine, I had found but a few days before, to be 58 1-2 cents for 120 yards, and that was less than the Lancashire rate. Here, the cheapness of the Southern labor and the use of the Northrop loom had enabled the superintendent to undercut the Maine weaving price by 75 per cent. One man who was running 24 looms told me that he could earn $1.35 per day: two other men were also running 24 looms each, and said they could make $1.50. . . . the tacklers tend 100 looms each."

The writer also refers to a statement made to him in Massachusetts to the effect that the Northrop loom is so easily managed that an inexperienced girl learned to run 14 of them within a week.

It is not often that a manufacturer will personally admit the extent of his profits by use of the Northrop loom. Recently, however, it became necessary for such a manufacturer to file an affidavit, which, being a matter of public record, we quote in part, although witholding the name for the present. In referring to a large number of looms running with Northrop attachments, the affidavit states as follows:

"This mill is one of the most modern in this country so far as equipment is concerned. The average pay of the weavers who attend to these looms (common) that weave such goods is nine dollars a week. Each weaver takes care of four looms. The average production of each of these looms is twenty-four yards or twelve pounds of such goods per day. This would be one hundred and forty-four yards or seventy-two pounds per loom a week, making five hundred and seventy-six yards or two hundred and eighty-eight pounds of such goods a week for the four looms taken care of by each weaver. This is the only mill of which I have knowledge where the weaver can take care on an average of as many as four looms." (On this style of goods.)

"The cost of manufacture of such goods for the wages of the weaver only is about 3.12 cents per pound. With less improved looms for producing such goods, of which many are in use, the cost is greater as a weaver cannot take care of so many looms."

The affidavit then states that the use of our devices on these goods increases the production to 38 yards per loom, or 19 pounds of such goods a day. As a weaver attends six looms of the new style, the production per day per weaver is 228 yards, or 114 pounds of such goods. The cost per pound is about 1.31 cents, or a saving per loom per year of over $100 each. The affidavit states that the profits from such looms will be about 9 per cent. on the entire cost of the plant, including carding and spinning machinery, and if the plant were to consist solely of looms, the saving would pay a dividend of about 19 per cent. on the cost. The affidavit also calls attention to the greater product per loom as requiring less looms, less floor space, etc. In fact 100 looms at this ratio of product would do the work of 158 common looms. On this basis the saving in number of looms and floor space would possibly pay for the entire cost of the attachments, as these are one of the most expensive type of loom built.

Of course, it is evident that this is a pecular class of weaving, inasmuch as the weaver only changes from four looms to six; yet the greatly increased product shows that the weavers on six looms are producing more than twice as much cloth per weaver compared with the common loom product. This affidavit was not made with the intent of aiding us in any way by its information; in fact, we only ran across it by accident.

We recently learned from an Indian cotton manufacturer, now in this country, that in India his weavers run two looms each and earn $7.50 per month. This seems a very low price, but as a matter of fact it is $3.25 per loom per month, or $39 per loom per year. There are plenty of Northrop loom mills in the United States where the wages are under $20 per loom per year, although the American weaver may be earning five times as much money. Of course, it is probable that Northrop looms may invade India itself and the coolie may run four, or eight, or sixteen, instead of two common looms. Theoretically, all manufacturing could be done cheaper in such countries as China and India—but practically the high wage countries hold their own.

Yet the only reason they do hold their own is because they take prompt advantage of economical methods and devices. The mills that defer using Northrop looms until India is equipped, will have to face a serious proposition. But why should they wait?

We were recently permitted to see a record from the books of a large Northern mill using both Northrop and common looms. The figures were based on a low scale of weaving wages for the common loom. The figures showed an actual difference of $23.52 per loom per year in favor of the Northrop loom above all extra expense for supplies, fixing, cleaning, etc. The weavers on the Northrop loom also earned $55.12 each, per year, above the earnings of the common loom weavers. This record is based on sixteen Northrop looms to the weaver. Some mills already run twenty-six Northrop looms to the weaver.

Recently noting a broker's list of Southern cotton mill stocks for sale, with prices bid and asked, the writer, as a matter of curiosity, separated out the mills which had bought Northrop looms, and figured a comparison in the value of the stock as quoted. The price *asked* was taken in each case, the price bid being added in only where there was no asking price. The total result showed that 28 mills *without* Northrop looms averaged a stock value, as thus figured, of $102 a share. The 37 other mills, having Northrop looms, averaged on the same basis, $114 per share.

Prices of looms vary somewhat with cost of materials and equipment desired. They should properly vary in proportion to the expense and utility of new attachments. We do not, however, add to the price of our loom when improving its fundamental features. It has been estimated that we have actually added $15 of cost per loom to our complete machine since its earlier stages. We are glad to estimate on whatever looms are desired and specified. Old common looms are taken in exchange at fair allowance under certain conditions.

Our policy of smashing up old common looms taken as part payment for new Northrop looms has awakened a certain amount of comment, the visiting Englishmen being particularly impressed. Of course, some of these old looms have outrun their utility and are fit only for junk in any event. Many looms thus replaced, however, have been comparatively new and certainly efficient so far as common looms may be efficient.

One of the frequent English visitors to our country published a comparative criticism of the Northrop loom on his return home, that endeavored to show how little actual saving was possible. In view of the wide circulation of the article, as copied by various trade journals, we thought best to issue an answer at some length, taking up the various comparisons in detail and explaining the falsities on which the final figures were based. We were rather embarrassed in replying by the fact that while the Northrop loom mill was well known to all, the common loom mill selected by comparison was not named, and the assertions of speeds, wages, etc., relating to that mill, could not be verified. Without repeating our argument, we might say that we found several reasons to criticise the assumptions made, and if any expert who cares to venture further in this line will give us detailed information as to the source of his facts, we will be glad to enter into a further discussion. The comparison of one mill in one definite locality, with another mill several hundred miles away, is not necessarily convincing. The best comparison possible is that of Northrop looms and common looms running in the same mill, under the same conditions. Our best customers include the mills that have made this experiment for themselves, and we are ready to contend that these mills are perfectly capable of figuring cost and appreciating conditions.

"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, 64x64, 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. . . . .

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.*

"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 97½ per cent. of the full possible production of the loom."—[*Mr. Mercer, N. Y. Journal of Commerce.*

"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 yards to cut, which is 50 35-100 yards per loom; speed of loom 180, 64x64 goods, which makes 97 86-100 of production. How is that for running Northrop Draper looms?"—[*Textile Excelsior, Feb.* 18, 1899.

"There can be no doubt that the enormous expansion of the American cotton industry during recent years has been very largely owing to the Northrop loom, and the conviction is steadily gaining ground in this country that only by the general adoption of the Northrop loom can our cotton trade be put once more upon a thoroughly sound basis."—[*Letter from London correspondent to The Indian Textile Journal, printed September*, 1903.

One of the cloths made here very largely in the 40-inch looms is 32 inches wide and has 68 ends and 112 picks to the inch of 42's twist and 36's weft. It is woven in 62 yard cuts, and the price paid to the weavers is 27¼ cents per cut for the Northrop loom and 56 cents per cut for the ordinary loom. The latter is, I believe, 10 per cent. less than the rate paid in Lancashire, but the ordinary eight loom weaver here can earn $9 a week and the weaver who runs twenty Northrop looms $10.50 to $11.—[*Correspondent of Manchester Guardian.*

For the 2000 Northrop looms there are 134 weavers—a number which I verified by counting the names in the overseer's wage-book. Some of the weavers are running 20 40-in. Northrop looms each, others 16, and a number of learners have 12 each, the average for the whole of the 2000 looms being a fraction less than 15. . . .—[*Correspondent of Manchester Guardian.*

"Called at the ——— Mills; found them exceedingly pleased with the Northrop looms. They are getting an average of between 26 and 27 yards per day, which is more than two yards more than they get from their common looms. They are weaving 78x80 goods, 40″ wide, 52 yards, and pay 20 cents a cut against 42 cents. The weavers are running 20 looms; there are two fixers on 204 looms, and the only extra help in the room is two boys for cleaning and oiling."—[*Salesman's Report, Oct.* 10, 1903.

"Their weaving is running extremely well, and they have on 1182 looms, which they have been running an average of about 19½ looms per weaver, and Mr. ——— is sure they will be able to bring it down to an average of 22 looms to the weaver throughout."—[*Expert's Report of Nov.* 14, 1903.

"Mr. ——— said the only fault he can find with the Northrop looms today is that they use too much filling. Since he came here he had had to put two extra spinning frames on to spinning filling for these looms, and now he has just put on the third."

(In another mill). "Mr. ————, the overseer of weaving, says they are getting 93 per cent. product from the Northrop looms, 26 looms to a weaver, 163 picks per minute."—[*Extract from Expert's Report, Dec.* 12, 1903.

"The work at this mill is running very nicely indeed. They now have some weavers running 30 looms each, and with all their looms running—1292 I understand—they have only 59 weavers at the present time, and expect to spread the weavers further the coming week."—[*From Expert's Report of Jan.* 16, 1904.

"The weavers are still running 20 looms each here, but it is hardly enough for them. There was less than 5 per cent. of the looms stopped, and the overseer thought I had made a mistake in count, as he said he was weaving 98 per cent. right along."—[*From Expert's Report of March* 26, 1904.

"On their print looms, the weavers are running from 16 to 28 looms. Most of the weavers, however, are running 20, 24, and 26. They pay for weaving $5\frac{1}{2}$ cents per cut of 52 yards."—[*From Expert's Report of April* 16, 1904.

"In No. 1 mill I saw one room with 216 looms in it being run by six weavers. These weavers run 36 looms each, cotton harness and double-thread stop-motion. The goods are 80x88 25s warp 33s filling. Four boys fill the batteries for this room, and they are getting as much product as when the weavers ran 24 looms each and filled their own batteries. The overseer says he expects to get a larger product than before. The weavers like this arrangement better than the former one. The overseer told me that the weavers tell him that filling the batteries is more than half of their work."—[*Expert's Report, April*, 1904.

"They have an average of about 18 looms to the weaver, and are making prints 64x60, paying $6\frac{1}{4}$ cents a cut for 54 yards."—[*From Expert's Report of May* 7, 1904.

In order that this volume shall be complete, we refer again to the change in price of our Northrop loom shuttles. On December 1, 1903, we sent a letter to all of our loom customers, stating that while our former charge was $1 each for new shuttles sold for repairs, with an allowance of 35 cents for equal number of old shuttles returned, customer paying freight, our standard price from the above date would be 75 cents each, we no longer asking for any old shuttles to be returned, leaving the mill to use parts of old shuttles for their own repairs when advisable, no allowance whatever to be made in future for old parts, as we do not care to have them returned to us. When our original allowance of 35 cents was first voted, we expected to use such good parts as were serviceable in the old shuttles, but finding such repairing inadvisable, we sent out regular new shuttles on such orders. Our customers were put to considerable annoyance and expense in saving the old shuttles, and paying boxing and freight charges. We believe our new arrangement will be much more satisfactory to all parties concerned.

Although our shuttle is made under some of our most important patents, the new price only gives us a small manufacturer's profit, without royalty charge. Our shuttles are much more expensive than the common loom shuttles, and our methods of manufacture include a high standard of care and precision.

"Mr. ——— said the last time the treasurer was there he wanted to go in and see the Northrop looms. Every loom was running and the weavers sitting down. The treasurer said that was enough, he did not care to see the rest of the weaving. The overseer told the agent in my presence that it is hard work to get weavers for his common looms, as they all want the Northrop."—[*From Expert's Report of March* 26, 1904.

THE LABOR QUESTION.

While there have been a few cases of labor difficulty in adjusting the new conditions introduced by our Northrop looms, they have really been most surprisingly infrequent, considering the radical changes introduced. A mill that changes from common to Northrop looms necessarily discharges half its weaving force, but the scarcity of good weavers is proverbial and the surplus thus produced is easily assimilated. In the adjustment of wages to the new conditions disputes have not prevented the further adoption of our looms, or reduced its advantages to a minimum. The general policy followed by the purchasers of our looms has been to allow weavers to earn more pay in tending them than they formerly received on the common looms. In many cases this extra wage has been very liberal indeed, considering the fact that the weavers really had less work to do, and a less irritating series of operations. There is no difficulty involved in changing from the common to the Northrop style of weaving. Weavers should certainly credit us with the relief from sucking filling, for prior to our introduction of the Northrop loom, it is doubtful if any appreciable per cent. of shuttles in use on common looms had hand-threading or self-threading devices. Since the advent of our loom, more hand-threaded shuttles have come into use, but their proportionate number is still quite small. The sucking of filling is naturally attended by many physical evils, especially where the filling is colored. Common loom weavers are a short-lived class, as a rule, their lungs becoming packed with cotton fibre inhaled when sucking filling. Another curious danger inherent in common loom practice comes from the changing around of weavers on different sections of looms. We have heard of an actual case in which three weavers are said to have caught consumption from using the shuttles of a consumptive weaver; and other objectionable diseases are transferred by the same application of the lips to shuttles used by infected parties.

More hand-threaded shuttles would undoubtely be used if the ordinary hand-threaded shuttle was as efficient as the closed-eye shuttle for general weaving. It has taken us a great many years to develop an efficient open eye for our own purpose, and our patents undoubtedly control the better forms of eye for either hand-threading or self-threading. We have been asked frequently to fit our eyes to common shuttles, but do not care to confuse our systems or encourage the retention of uneconomical machinery.

The advantages of automatic weaving have raised a curious question, certain interested parties contending that, as there are labor laws restricting the hours of labor, these same laws apply to the machinery, so that Northrop looms should not be allowed to run without attention during the noon hour, or at other periods. The mill managements naturally claim that it is immaterial whether automatic machinery runs overtime or not if no help is in attendance. The opposition might as pertinently object to the continuous operation of the solar system. It is interesting to note that the very antagonism directed against the Northrop loom is a sure evidence of its superiority. The very fact that **it does produce cloth with economy of labor,** suggests the mistaken notion that it is therefore worthy of opposition by the laborers themselves. As a matter of fact, however, there are more weavers given employment to-day than there were before the Northrop loom was introduced. The introduction of a labor-saving machine is so gradual, of necessity, that it rarely causes any real commotion and change of immediate conditions. In progress there must be continual readjustments. It is only in countries like China, that do not progress, that conditions are stable.

The general question of labor displacement by automatic machinery is so well considered in the following extract that we take pleasure in its reproduction:

"But our problem in this nation is of to-day, and if we do our duty of to-day the nation will find those who can take our places to-morrow. All that is now happening is in accord with the nature of things. Displacing the old with the new is never without its complications and minor evils, which correct themselves in due time. All good progress, even that which is undoubted, has its temporary sorrows. One example, which takes innumerable forms, of this temporary sorrow which may be employed to illustrate the idea, is the invention and use of labor-saving machinery. Upon such invention and use depends the whole material progress of the world. Nothing else could give us the abundance which characterizes our age. Yet, when any new labor-saving invention comes into use the first thing it does is to deserve its name by lessening the number of men who can work. Labor saved is, temporarily, labor lost. Men are discharged: the machine does what they used to do. Do you wonder, then, that men should resent this intrusion upon their sustenance and support? Some are too old to learn new trades, and for them there is no consolation. Yet, in the long run, new occasions spring up which employ this discharged labor, and the world has all it used to have and much beside.—[*Thomas B. Reed.*

An overseer recently called attention to a Northrop loom weaver, saying:—"You see that woman! She has gained forty pounds since going on those looms and her last winter's clothes won't fit her." Investigation showed that she formerly ran four common looms (No. 4s filling, 17 warp) and now ran twelve Northrop on the same goods. She was making better wages with less work, though ascribing some of the betterment in health to relief from sucking filling.

"Mr. ——— told me that at first they had a great deal of trouble with their weavers, but he cleaned them all out and started in with a new set that never saw a loom before. Now he has no trouble at all." —[*Extract from Report of Travelling Expert, Nov. 15, 1902.*

We print above a photo of a ticket of membership in one of the old Scotch Weaving Guilds. It dates back to the days of the hand loom and its owner very probably lived through the period when the power loom started its slow and halting progress. The original was kindly furnished us by Mr. Elias Richards of the Maginnis Mills, New Orleans.

One of the very best overseers of weaving in the country running Northrop looms made a casual observation to one of our representatives recently, which impresses us as being important. We quote from the report of our representative:

"I spent considerable time in going through the looms that have been running the longest, and find them running as well, if not better, than ever before. The overseer tells me they are getting about 94 per cent. of the product, and his help is all family help. He also stated that if one of his weavers goes away to work on the common loom he is not gone more than a month before he wants to get back. I find this to be so in other places also. Once let a good weaver get used to Northrop looms and he never wants to run common looms again."

"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.*

We are properly proud of the high grade and splendid efficiency of American laborers, but we must not forget that other races are awakening under the stimulus of American examples. Some years ago we sent several hundred Northrop looms to Japan. They were shipped in pieces and put together by Japanese, we not even sending one man to supervise the job. One of the purchasers wrote us that they were giving "satisfaction in every respect."

ATTEMPTS AT COMPETITION.

It is clearly in evidence that we are the only concern that has ever successfully introduced filling-changing looms. When we say "success," we do not intend to permit reference to the sale of small lots of automatic looms which are tried in various mills, with trained mechanics standing over them, the whole number in use after years of effort not equalling that sometimes shipped from our plant as a week's production. Under this head of filling-changing looms, we are perfectly willing to include the shuttle-changing devices on which so much expense and energy have been exhausted. We know something about shuttle-changing looms, for we spent considerable time in testing them ourselves. The experience of many inventors has practically demonstrated the fact that the shuttle-changing principle is fundamentally wrong. The shuttle, which is a square, wooden box, cannot be shifted into position in a complicated receptacle in the short time allowed for the change, without chance for breakage, especially when the necessity for ejecting the spent shuttle is present. A large number of shuttles cannot remain uniform in weight and width so they will pick uniformly. The shuttle-changer primarily does not save enough of the weavers' labor, for they must still go through the motions of taking out the spent filling carriers, putting in new ones, and threading the shuttles. The difficulty of substituting one shuttle for another is emphasized by the confessions of the patents taken out, which allow for a slowing up of speed while making the transfer. These motions often stop the weaving part of the loom absolutely while the transfer is being made. To say nothing of the loss of time which this process necessitates, it is evident that a weaver must be continually annoyed by the stopping of looms for this purpose; for looms naturally only stop for faults, and the first thought of the weaver naturally concludes that a fault is present.

There is no comparison whatever as to simplicity. A Northrop loom, with its revolving hopper and filling-fork connection, using one shuttle, must be far easier to understand and keep in order than a complicated arrangement of shifting shuttle boxes, many shuttles, and intermittent cam movements.

The persistent attempts at perfecting the shuttle-changing principle are surprisingly uniform in their claims, and a review of recent trade literature in this line might prove of interest. Since our last catalogue on the Northrop loom was issued in 1900, articles have appeared in print from which the following brief quotations are made:

"THE AMERICAN LOOM COMPANY.

The Company to Build the Harriman Loom.

This Company, recently organized, embraces all of the patents of the Universal Loom Company, and also all the property and business of the Readville Machine Works, at Readville, Mass. The new company will own all the patents of H. I. Harriman for the new automatic shuttle changing looms now being built by the Readville Machine Works. . . . . . The advantages of the Harriman loom over all other looms are high weaving speed and low magazine speed, simplicity and strength of construction, cheapness of supplies and fine quality of cloth."—[*Journal of Commerce, March* 10, 1900.

"SELF-CHANGING SHUTTLE LOOM.

Mr. H. R. Ross, Durham Street Mills, Belfast."

The inventor has the loom working at the Durham Street Mills, in Belfast, where he invites inspection from persons desiring further information regarding it. . . ."—[*From the Textile Mercury, June* 9, 1900.

"ATHERTON BOOM

Many Inspected the Busy Machine Shop

That Turns Out the Perham Loom

An Increasing Demand for This New Invention

As the reporter approached the plant he met a local real estate dealer, who had been conducting two business acquaintances over the Perham loom, and said it was bound to be in demand in every cotton mill in the country.

"I look to see a big demand for this loom, for the simple reason that once it is installed in a mill, competition will compel other manufacturers to place them in their mills."—[*From the Lowell Sun, May* 14, 1901.

"Two English inventions are now attracting attention, that of Messrs. Hattersley, of Keighley, and that of Mr. Bernard Crossley, of Burnley, in Lancashire."—[*From English paper, Oct.* 21, 1901.

"I do not know when I shall come to the end of the new self-shuttling looms which are being pushed forward, for since writing last two or three new ones have come to light. One is being made on commission by Mather and Platt of Salford. . . ." —[*Correspondent to Textile Manufacturers' Journal of England, May* 17, 1902.

"Other automatic looms are the Crossley, Hattersley, the Ross loom (which is of a circular-box type), and Messrs. Harling and Starkie's. A week or two ago I saw two of the last-named looms working at Livingstone Mill, Burnley-lane, Burnley. . . ."—[*From Northern Daily Telegraph, Aug.* 11, 1902.

"Recently, a new automatic loom—or, rather an attachment which converts the ordinary loom into an automatic loom—was shown to a number of pressmen at Messrs. William Dickson & Son's Phoenix Iron Works, Bank Top, Blackburn, by the patentees, Messrs. Rossetter and Talbot."—[*Quoted from English journal by "Southern Manufacturer," Oct.* 15, 1902.

" . . . the following English firms all hold patents and make automatic looms: Messrs. Hattersley, of Keighley; Sowden & Sons, and George Hodgson, Ltd., Bradford; Hutchinson, Hollingworth &

Co., Ltd., Dobcross: Robert Hall & Sons, Ltd., and William Hacking, of Bury: Butterworth and Dickenson, Dugdales, and Harling & Todd, of Burnley: William Dickenson & Sons, and Willan & Mills (the Blackburn Loom & Weaving Machinery Co., Ltd.), Blackburn: Atherton Bros., and Gregson & Monk, of Preston, and others.

This list clearly indicates that English loom makers do not intend to be behind in the race, and as all of the devices made by them deal with the automatic supply of charged shuttles in contradistinction to the automatic supply of cops to a common shuttle, we are likely to see some interesting developments ere long."—[*From English letter to American Wool & Cotton Reporter, Dec.* 4, 1902.

"A RADCLIFFE INVENTOR.

The Latest Automatic Loom.

Mr. James Cowburn of Parrin-lane, Monton, has invented certain attachments applicable to existing looms, which textile experts agree, have all the essentials of successful automatic shuttling. . . ."
—[*From Bury Gazette, May* 23, 1903.

"An appliance, which has just been invented by Mr. Harry C. Howarth, a member of the firm who own Meadow Mills, at Failsworth, is being very highly spoken of in textile circles in Lancashire, and manufacturers who have been wanting an automatic shuttle-changing loom, which would cheapen the cost of production and make perfect textile goods, will be inclined to acknowledge. . . ."—[*From The Textile Journal, Aug.* 7, 1903.

" Shuttle-changers are built upon most diverse lines. . . . Others eject a spent shuttle and insert a full one without any reduction of speed. These include the Crossley No. 1, the Ross, the Baker-Kip, the Cowburn, the Walker, the Gregson and Monk, the Harling and Todd, the Manchester automatic and many other looms."—[*T. W. Fox in Manchester Guardian, Dec.* 3, 1903.

These continuous references are certainly worthy of careful study when the associating facts are disclosed. In spite of all this flow of human energy and waste of brain tissue, the number of shuttle-changing looms in actual operation is probably under one per cent. of our total output, and the greater part of this number are new looms on trial that will probably be discarded like all that have gone before.

LONG BOBBIN EXPERIMENTS.

Certain mills are making an interesting trial of warp stop-motions on common looms used in connection with longer bobbins in their shuttles.

In the more noticeable efforts in this line, the traverse on the filling bobbin has been increased from 5 1-2 to 8 inches, the looms being reduced also in speed. The change to the long bobbin necessarily requires changes in the spinning room, if the best results are to be obtained, and the spinning must be done at a greater inconvenience, if not expense, for no spinner will claim that the spinning of filling yarn on a traverse 8-inch length is as easy or as cheap as on a length of 5 1-2 inches. With this change, there is evidently 2 1-2 more inches of yarn on the bobbin, or less than 50 per cent. increase. It is absolutely impossible, therefore, for such a bobbin to run twice as long, as many claim, unless the loom is run at a less proportion of time, or less speed, or both combined, sufficiently to account for the result.

Now suppose we assume for easy figuring, that the new bobbins will hold 50 per cent. more yarn, and suppose we compare with the former common loom conditions. A weaver with eight common looms on prints, or similar goods, will have a duty at least once per minute. That is, the replenishing of filling, or filling breakage, mending of warp and taking off cloth, will make about 600 separate acts necessary per day. This might be sub-divided as follows: There would be four operations of taking off cloth from the eight looms, as it is common practice to wait until two cuts have been wound up before removal. The eight looms might stop about 28 times for broken filling in the shuttle; that is 3 1-2 times per loom, and would need 480 replenishments of filling, or 60 per loom. As to the warp breakage, it would amount to 11 per loom per day at a very moderate estimate, making 75 duties per loom or 600 for the eight looms, as before noted. Now, if the long bobbin looms were run at the same speed and with the same production, we would have 33 1-3 per cent. less replenishment of filling, or 40 per loom in all. There would certainly be as many filling breaks, or 3 1-2 per loom, as much cloth removal, or one-half operation per loom, and as many warp breaks, or 55 operations per loom in all. If 600 operations shall still constitute a day's work, this weaver could run 11 looms, and no more. Now, suppose the looms are run so as to average twice as long for the filling to run, we shall produce 25 per cent. less in cloth. At this rate, we should have 30 replacements of filling, about 3 duties for broken filling and cloth removal, and eight warp breaks or 41 per loom in all. Divide this into 600, and we find the possible number of looms run nearly 14 1-2; but these looms are producing but 75 per cent. of what the other looms figure, so that the apparent increase is practically cancelled. When we hear, therefore, of weavers tending 16 looms with large bobbins and warp stop-motions, we know that they are either losing in production, or doing more work. There is no escape from this, —no possible evasion of the plain facts. It may be possible to get more work out of a weaver temporarily than before, without proportionate increase of pay, but **we doubt very much whether such conditions will continue.**

As to comparison with the Northrop loom, it must be remembered that our looms do not require filling replenishment at regular intervals, as they will run until the hoppers are emptied. As there are 24 bobbins in our hoppers, it is evident that they need filling only 2 1-2 times a day. Add to this the 11 warp breaks, as figured before, and the 1-2 operation for taking off cloth, and we have but 14 duties per loom per day. Allow that the work of filling the hopper is equivalent to several duties on the common loom; 3, for instance, and we would have 19 duties as a whole. This would show a capacity of over 30 looms to a weaver at six hundred operations per day; and, as a matter of fact, this record has been attained. We believe there are as many weavers capable of running 30 Northrop looms as there are who can run 12 common looms with the long bobbin and produce at the same rate per loom.

Now there is, of course, no reason why the Northrop loom cannot use the large bobbin also, providing it is proved that there is no additional trouble, either in spinning or weaving off, as its adherents claim. This would take 33 1-3 per cent. of the labor in filling hoppers away. Very possibly, with improvements yet to be introduced, the Northrop loom weavers will be relieved entirely of the labor of filling hoppers, so that they shall do nothing but mend in warp threads and take cloth off the looms. Under such conditions, 50 looms per weaver may yet be the accepted rule on print goods.

The recent introduction of the Northrop loom in England has aroused curious phases of criticism from the conservatives who have argued against the Northrop devices by raising objections which are easily answered by the proof of those thousands of looms already running in this country. As a matter of fact, the possibilities of the Northrop loom in a country like England, where four looms has been the maximum, are much greater than in a country like ours, where common loom weavers have run as high as 10 looms. The English trade is used to certain practices introduced by the domination of the Trades Unions, who have prevented a weaver from tending more than four looms and often demanding the assistance of a helper at that. Under these conditions the manufacturers have been forced to speed their looms up so that comparison with the lower speed recommended for the Northrop loom suggests immediate cause for comment. Now there is no reason why the Northrop loom cannot run at high speed so far as the mechanism itself is concerned. All cotton weavers know, however, that increase of speed, increases the tendency toward warp breakage. In automatic weaving it is desirable to minimize the faults which cause a loom to stop so far as possible, and it can be easily figured that there is more profit in spreading a weaver over a large number of looms run at a comparatively low speed rather than give a weaver less looms with more work per loom by reason of the extra breakage. Another curious contention from our English critics asserts that the Northrop looms require better yarn. If they stated that the Northrop loom *ought to have* better yarn it would be a fairer way to present the case. There is nothing in the mechanism of the Northrop loom itself to require better yarn or stronger yarn. The Northrop loom, and every other loom for that matter, will break warp and filling threads oftener if the yarn is poor. With the English system of four looms to a weaver it may pay the manufacturer to force the weaver to weave poor yarn, but considering that the good weaver with good yarn could easily run 20 and probably 24 Northrop looms instead of 4 common English looms, it will be found that the gain is more than sufficient to compensate for any slight increase in the grade of cotton used.

"For six months running on 8-oz. ticking—3284 pieces—they have one cut of seconds; 4-oz. ticking—22,917 pieces—they have 3 cuts of seconds; 4½-oz. denims—9684 pieces—they have 36 cuts of seconds. These seconds were caused mostly by bad filling. The total amount of seconds made on the Draper looms for the six months is 11-100 of one per cent."—[*From Expert's Report of March* 19, 1904.

SPEED RECOMMENDED FOR DRAPER LOOMS FOR MEDIUM WEIGHT GOODS.

28″	190 to 195	60″	128 to 132
30″	185 to 190	64″	124 to 128
32″	180 to 185	68″	120 to 124
34″	175 to 180	72″	116 to 120
36″	170 to 175	76″	112 to 116
38″	165 to 170	80″	108 to 112
40″	160 to 165	84″	104 to 108
42″	154 to 158	88″	100 to 104
44″	148 to 152	92″	96 to 100
46″	144 to 148	96″	94 to 96
48″	140 to 144	100″	90 to 94
52″	136 to 140	104″	88 to 90
56″	132 to 136	108″	86 to 88

There is no reason why our loom cannot run at any speed attained by common looms of the same capacity. We never advocate extremes in this direction. In fact, on heavy goods we would consider the above table too high.

In order to correct certain natural errors, recently published, it may be well to state that the Draper Company is not directly interested in the new corporation recently organized in England, as it never owned any rights in foreign loom patents. The Northrop Loom Company, organized in 1892, sold its United States rights to the Draper Company in 1897, but retained its outside business. It still retains many Foreign rights; in fact receives royalty from shops in Canada, France, Germany, Switzerland and Austria.

The new British company is capitalized at £150,000, the stock being fully subscribed and the control remaining with the Draper family. Its headquarters are at Blackburn. The American directors are William F. Draper, George A. Draper, Eben S. Draper and Alfred M. Coates. The English directors are all prominent manufacturers.

PATENT INFRINGEMENT.

While we have been remarkably free from competition in our loom introduction, it is not our intention that any substantial infringement of our patent claims shall be allowed, even where the financial damage is immaterial. We have a suit now running in the United States Court against the American Loom Company, who exploit the "Harriman Loom," so called, for infringement of several of our earlier patents, especially those taken out on the shuttle-changing looms which we ourselves developed. Curiously enough, we were ourselves sued for infringement of some patents on hand-threaded shuttles, owned by one Henry M. Hewes. The suit was promptly decided in our favor, when it came to a hearing.

In order to warn the unsuspecting from infringing our present patent rights, we call attention to our hundreds of patents, applying to nearly every motion of the loom, including the Filling-Changing devices, the Warp Stop-Motions, the Thread-Cutting devices, the Feelers, the Shuttle Position Detectors, the Shuttles, the Bobbins, the Cop Skewers, the Take-Up, the Shedding Motion, the Let-Off, the Filling-Fork, the Crank Arms, the method of making cranks, the Checks, the Beam Locks, the Brakes, and also other devices not mentioned, too numerous for detailed enumeration. While we have not engaged in this branch of business long enough to allow any of our patents to expire, we call special attention to the fact that expiration of earlier patents will not allow use of our attachments in their present form, and in their present utility, the improvements being covered by later patents of unquestioned validity.

We call special attention to the fact that we have acquired by direct assignments patent formerly owned by Malcolm G.

Chace, and many patents formerly owned by William H. Baker and Frederic E. Kip, covering a large field of filling-changing devices for automatic looms, including various electrical connections, and special adaptation of mechanism for special problems, particularly relating to changing of filling before exhaustion. This control does not include patents of Baker and Kip relative to warp-stop devices. We expect to enforce our rights over infringers of these various patents as fully as with regard to any other patents owned and controlled by us.

We also call attention to the fact that on Nov. 21, 1899, there issued to Joseph Coldwell and Christopher Giles Gildard a patent, No. 637,234, covering certain elements of warp-stop mechanism. On July 30, 1901, there issued a reissue of the above patent, No. 11,923, in which twelve additional claims were granted, covering the suspension of detectors from single threads, so that each thread is normally out of contact from the detectors suspended from the adjacent threads. We have acquired the sole and exclusive right to make, use and sell mechanical warp stop-motions containing the claims of said reissued letters patent, and are authorized and empowered to bring suit in the name of the patentees against any person who shall infringe said reissued letters patent.

PATENT CONTROL.

It is not wise for owners of important patents to express their opinion regarding priority, or importance, for the courts may not coincide with their judgment, and evidence may develop unappreciated circumstances. We think it safe to say, however, that to James H. Northrop belongs the credit of inventing the original filling-changing loom and its most important original details. General Draper conceived the idea of combining a warp stop-motion with the filling-changer, and the earlier practical devices in this line were developed by Mr. Charles F. Roper. Our feeler devices are controlled by patents of George Otis Draper. These three distinct lines of novelty have been further developed by continued contributions of these same inventors, as will be seen by our table of inventions, and also by a long list of Hopedale experts, such as Mr. Edward S. Stimpson and Mr. Jonas Northrop, whose entire time is devoted to loom improvement. Outside inventors have often given us valuable ideas; the majority of which, however, have received considerable modification by our own inventors before being included in our regular loom output.

It is, of course, our intention to so continually improve our loom as to prevent competition from our own inventions after their seventeen-year expiration. We believe the 50-loom weaver a coming possibility, and we intend to improve the quality of the goods produced as an associate feature of our loom introduction.

In thus detailing our intentions with regard to the protection of our property, we do not wish it assumed that we take any "dog in the manger" position. We believe we control all the feasible means for making practical automatic looms, and we are willing and ready to accept orders for these looms, fitted for their intended purposes according to the best of our judgment and experience. We have not always been ready to furnish looms according to terms specified by customers, especially when they ask for combinations or elimination of devices which we considered impractical for the purposes desired. We have no wish to see our looms run at a disadvantage, having a pride in their success and a reputation which we cherish. Neither have we any intention to decry the merits of any of our competitors' productions. We shall certainly point out any disadvantages inherent in their devices if they compete with machinery produced by us which we consider more efficient and more satisfactory to the customer.

In presenting a list of our Northrop loom patents we do not make it exhaustive, for the simple reason that we do not care to expose our control of a great number of patents which may not stand in our name as of record. We are protected by use of large numbers of patents for purposes of litigation, which are at present in others' direct ownership.

Our principal inventors, however, include the following, having assigned to us the patents as noted in the period from Jan. 1, 1886, to July 1, 1904: (Plain temple patents not included.)

Adkins, A. B.	1	Bartlett, E. E.	1
Allen, W. E.	4	Beardsell, A. W.	3
Ambler, G. B.	2	Benson, A. E.	2
Armstead, M. J.	1	Bevil, S. H.	1
Arnold, C. H.	1	Bigelow, M. J.	3
Aumann, L. A.	2	Bolton, J. B.	1
Austin, B. F. S.	3	Bracken, H. W.	2
		Brooks, J. C.	9
Bailey, S. C.	1	Broomhead, W. H.	1
Bailey, W. H.	1	Brown, L. H.	1
Baker, W. H.	31	Brunette, L.	1
Barber, W.	1	Burgess, R.	1
Barnes, L. E.	1	Burton, J. L.	2

Tomlinson, H.	2	Welch, W.	1
Trombly, W. C.	1	Whiting, C. D.	1
Tubby, W. W.	1	Whitmore, F. A.	1
		Wolger, J. H.	1
Vickerman, J.	1	Wood, E. S.	6
Ward, N.	1		
Warren, C. H.	2		613

While several patents are figured twice as belonging to more than one inventor, our interests in other patents not included will more than balance them.

"I happened to question a weaver as to his earnings and the number of looms he was minding. He answered me he had 23 looms weaving drills, and he stood talking to me fully ten minutes, and during that time not a single loom came to a standstill. By the way, he was a Blackburn man, and he also told me that he used to think he had a lot of work when he had four looms in England, but that he preferred to run 23 under his present conditions."—[*Blackburn Daily Telegraph, Oct. 24, 1902.*

"He has just got his sample awnings out, something heavier than they have ever made in this mill before. He made them on the Northrop looms, and the vice president of the company pronounced them superior in quality to the sample given him to make them by."—[*From Expert's Report of Nov.* 14, 1903.

SALES.

Although we print a complete record of sales to the nearest possible date, a casual reading of the same will hardly give the information which the facts warrant. Sales of improved machinery really prove nothing until the machines themselves have demonstrated their capacity. The real proof of merit is shown **when the original trials produce further orders.** The greater part of the Northrop looms sold have been on repeat orders, or from parties who had carefully investigated the actual running of the looms in others' mills.

We first began to ship looms from our plant in 1895. It may be interesting to go back and examine the results attained from the very first looms that we sent out.

Taking this first year to 1896, we find that we then sold the Tucapau Mills 320 looms. They have since bought 1439 more, total	1759
We sold the Queen City Cotton Company 792 looms, and they have since bought 516 more, total	1308
Our next order was from the Pacific Mills, 100 looms. They have since bought 2183 more, total	2283
The Merrimack order for 100 looms was entered about the same time. They have recently wanted 2048 more, total	2148
The Amory Mfg. Co. ordered 100 looms. They have since increased, making a total of	688
The Lawrence Company took 216 looms. The mill in which they were running was bought entire by the Tremont & Suffolk Company, who afterward bought 1761 more, total	1977

The Grosvenor Dale Company placed an early order for 335 looms. They kept ordering and ordering at various times: 3282 more in all, total 3617

The Social Company had 196 looms to start with. Other orders increase to a total of 556

Every one of our first eight customers has therefore not only increased their orders, but increased largely. They would hardly continue their patronage had the looms not proved profitable.

And we had other customers at this early period, who have since continued their patronage. For instance:

	First Order.		Total Orders.
The Pelzer Company	1000 looms.		2702 looms.
Lockhart Company	800 "		1550 "
Gaffney Mfg. Company	1040 "		1401 "
Massachusetts Cotton Mills	100 "	both mills	2415 "
Lonsdale Company	12 "		2035 "
Newmarket Mfg. Co.	100 "		371 "
Spartan Mills	1280 "		1880 "
Dwight Mfg. Co.	16 "		681 "

We could, of course, add largely to this list, if we referred to more recent examples. We believe those quoted, however, are more pertinent, as it was from the results of our earliest looms that these proofs of satisfaction were derived. We build better looms to-day. Their use would give still better satisfaction.

It may be noted that the mills quoted cover several states, both North and South. They also cover a wide variety in goods. Their reputation is unquestioned. Their example is certainly worthy of consideration.

It may be interesting to note the comparison of the sales of spindles in the early days with our loom for the same period. Taking the first nine years of spindle sales, we note the mills that had then purchased in lots of 20,000 or more, and in parallel column find that the same mills, with few exceptions, have also been pioneers with the Northrop loom.

	Spindles Purchased in First Nine Years.	Northrop Looms Purchased in Nine Years.	Attachments put on Old Looms.
Lonsdale Co.	103.234	**2095**	
Merrimack Mfg. Co.	97,031	**2148**	**1**
Lawrence Mfg. Co.	69.420	***216**	
Boott Cotton Mills	63.905	**1132**	
Harmony Mills	55.042		
Tremont & Suffolk Mills	51.702	**1977**	**304**
Social Mfg. Co.	48.960	**556**	
Cocheco Mfg. Co.	48.438	**116**	
Amoskeag Mfg. Co.	40.465	**1261**	**10,555**
Union Cotton Mfg. Co.	39.728		
Hamilton Mfg. Co.	37,768	**108**	
B. B. & R. Knight	37.160		
Grosvenor Dale Co.	33.982	**3617**	
Wampanoag Mills	32,956		
Stark Mills	32.480	**190**	**2**
Atlantic Mills, Providence	29,528		**1**
Lancaster Mills	26.192	**50**	**2288**
Pocasset Mfg. Co	25.764		
Chicopee Mfg. Co.	25.472	**126**	
Hill Mfg. Co.	24.706	**142**	
Amory Mfg. Co.	23.192	**688**	
Appleton Co.	22.300	**310**	

*Sold to Tremont & Suffolk Mills.

The Northrop loom has won recognition outside of the United States in spite of the difficulties of foreign introduction. A complete new shop was built, equipped and run by the Northrop Loom Company of Canada (now Northrop Iron Works, Limited), established at Valleyfield, Province of Quebec. The Societe Alsacienne de Constructions Méchaniques, of Mulhouse, Germany, and Belfort, France, are building on large orders at both of their establishments. The Ateliers de Construction Ruti, of Ruti, Switzerland, are manufacturing on various foreign orders for Switzerland, Italy, etc., and the firm of Isaac Mautner & Sons of Vienna manufacture for Austria and Hungary.

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

LIST OF NORTHROP LOOMS SOLD TO JULY 1, 1904.

NAME.	PLACE.	QUANTITY.
Abbeville Cotton Mills	Abbeville, S. C.	940
Acushnet Mill Corp.	New Bedford, Mass.	417
Adams Mfg. Co.	North Scituate, R. I	24
Aiken Mfg. Co.	Bath, S. C.	38
American Linen Co.	Fall River, Mass.	100
American Pad & Textile Co.	Cartersville, Ga.	572
American Spinning Co.	Greenville, S. C.	758
Amory Mfg. Co.	Manchester, N. H.	688
Amoskeag Mfg. Co.	Manchester, N. H.	1261
Anderson Cotton Mills	Anderson, S. C.	724
Androscoggin Mills	Lewiston, Me.	205
Appleton Company	Lowell, Mass.	310
Aragon Mills	Aragon, Ga.	20
Arcadia Mills	Spartanburg, S. C.	344
Asheville Cotton Mills	Asheville, N. C.	30
Ashland Company	Ashland, R. I.	20
Atlantic Cotton Mills	Lawrence, Mass	561

NAME.	PLACE.	QUANTITY.
Atlas Linen Company	Meredith, N. H.	25
Attawaugan Mills	Killingly, Conn.	48
Augusta Factory	Augusta, Ga.	32
Aurora Cotton Mills	Aurora, Ill	96
Barker Cotton Mills Co.	Mobile, Ala.	325
Barker Mills	Auburn, Me.	16
Bates Mfg. Co.	Lewiston, Me.	2
Beaumont Mfg. Co.	Spartanburg, S. C.	144
Belton Mills	Belton, S. C.	1240
Bemis Bros. Bag Co.	Jackson, Tenn.	812
Bennett Spinning Co.	New Bedford, Mass.	1
Berkeley Company	Berkeley, R. I.	256
Blackstone Mfg. Co.	Blackstone, Mass.	1032
Boott Cotton Mills	Lowell, Mass.	1132
Borden Mfg. Co., Richard	Fall River, Mass.	252
Botany Worsted Mills	Passaic, N. J.	14
Bourne Mills	Fall River, Mass.	2000
Bradford Durfee Textile School	Fall River, Mass.	3
Brandon Mills	Greenville, S. C.	972
Bristol Mfg. Corp.	New Bedford, Mass.	1
Brogon Cotton Mills	Anderson, S. C.	366
Brookside Mills	Knoxville, Tenn.	650
Brower & Love Bros.	Indianapolis, Ind.	2
Cabarrus Cotton Mills	Concord, N. C.	542
Cabot Mfg. Co.	Brunswick, Me.	204
Cannon Mfg. Company	Concord, N. C.	426
Capital City Mills	Columbia, S. C.	216
Centreville Cotton Mills	Centreville, R. I.	16
Chadwick Mfg. Co.	Charlotte, N. C.	300
Chewalla Cotton Mills	Eufaula, Ala.	40

NAME.	PLACE.	QUANTITY.
Chicopee Mfg. Co.	Chicopee Falls, Mass.	126
Chicora Cotton Mills	Rock Hill, S. C.	1
China Mfg. Company	Suncock, N. H.	89
Chiquola Mfg. Company	Honea Path, S. C.	1000
Clemson College	Calhoun Station, S. C.	2
Clifton Mfg. Co.	Clifton, S. C.	1000
Cocheco Mfg. Company	Dover, N. H.	116
Columbia Mfg. Company	Ramseur, N. C.	69
Columbian Mfg. Company	Greenville, N. H.	80
Columbus Mfg. Co.	Columbus, Ga.	784
Continental Mills	Lewiston, Me.	122
Converse Co., D. E.	Glendale, S. C.	550
Cooleemee Cotton Mills	Cooleemee, N. C.	1296
Cordis Mills	Millbury, Mass.	61
Coventry Company	Anthony, R. I.	2
Crompton Company	Crompton, R. I.	2
Dallas Mfg. Company	Huntsville, Ala.	544
Darlington Mfg. Co.	Darlington, S. C.	592
Dunbarton Flax Spinning Co.	Greenwich, N. Y.	1
Durham Cotton Mfg. Co.	West Durham, N. C.	300
Dwight Mfg. Co.	Chicopee, Mass.	681
Eagle & Phenix Mills	Columbus, Ga.	328
Eagle Mills	Woonsocket, R. I.	2
Easley Cotton Mills	Easley, S. C.	800
Edwards Mfg. Co.	Augusta, Me.	709
Erwin Cotton Mills	West Durham, N. C.	457
Eufaula Cotton Mills	Eufaula, Ala.	32
Everett Mills	Lawrence, Mass.	452
Exeter Mfg. Co.	Exeter, N. H.	100
Exposition Cotton Mills	Atlanta, Ga.	142

NAME.	PLACE.	QUANTITY.
Fairfield Cotton Mills	Winnsboro, S. C.	190
Falls Company	Norwich, Conn.	61
Farnum & Co., John	Lancaster, Penn.	12
Farwell Mills	Lisbon, Me.	132
Florence Mills	Forest City, N. C.	200
Fulton Bag & Cotton Mills	Atlanta, Ga.	1088
Gaffney Mfg. Co.	Gaffney, S. C.	1401
Gainesville Cotton Mills	Gainesville, Ga.	1000
Gary, James S. & Son	Baltimore, Md.	1
Georgia School of Technology	Atlanta, Ga.	6
Gibson Mfg. Co.	Concord, N. C.	6
Glenn-Lowry Mfg. Co.	Whitmire, S. C.	800
Glen Raven Cotton Mills	Burlington, N. C.	100
Gosnold Mills Corp.	New Bedford, Mass.	800
Granby Cotton Mills	Columbia, S. C.	1014
Graniteville Mfg. Co.	Vaucluse, S. C.	362
Graniteville Mfg. Co.	Graniteville, S. C.	592
Great Falls Mfg. Co.	Somersworth, N. H.	638
Great Falls Mfg. Co.	Rockingham, N. C.	172
Grendel Mills	Greenwood, S. C.	498
Grinnell Mfg. Corp	New Bedford, Mass.	341
Grosvenor-Dale Co.	No. Grosvenor-Dale, Ct.	3617
Hamilton Mfg. Co.	Lowell, Mass.	108
Hamlet Textile Co.	Woonsocket, R. I.	56
Harmony Grove Mills	Harmony Grove, Ga.	180
Hartsville Cotton Mills	Hartsville, S. C.	650
Hathaway Mfg. Co.	New Bedford, Mass.	401
Henderson Cotton Mills	Henderson, N. C.	84
Henrietta Mills	Henrietta, N. C.	101
Hill Mfg. Co.	Lewiston, Me.	142

NAME.	PLACE.	QUANTITY.
Hope Co., Phoenix Mill	Hope, R. I.	800
Hoskins Mills	Charlotte, N. C.	580
Indian Head Mills of Alabama	Cordova, Ala.	200
Jackson Co.	Nashua, N. H.	253
Johnson & Johnson	New Brunswick, N. J.	387
Keasbey & Mattison	Ambler, Pa.	2
Kesler Mfg. Co.	Salisbury, N. C.	268
King Mfg. Co., J. P.	Augusta, Ga.	600
King Philip Mills	Fall River, Mass.	12
Knowles Loom Works	Worcester, Mass	2
Lancaster Mills	Clinton, Mass.	50
Lane Mills	New Orleans, La.	1034
Lanett Cotton Mills	West Point, Ga.	672
Laurens Cotton Mills	Laurens, S. C.	522
Lawrence Duck Co.	Lawrence, Mass.	2
Limestone Mills	Gaffney, S. C.	350
Lockhart Mills	Lockhart, S. C.	1550
Lockwood Co.	Waterville, Me	1427
Lonsdale Co.	Lonsdale, R. I.	2095
Loray Mills	Gastonia, N. C.	1580
Lorraine Mfg. Co.	Saylesville, R. I.	3
Louise Mills	Charlotte, N. C.	152
Lowell Textile School	Lowell, Mass.	3
Lyman Mills	Holyoke, Mass.	24
Lynchburg Cotton Mills	Lynchburg, Va.	1
Maginnis Cotton Mills	New Orleans, La.	50
Manchester Mills	Manchester, N. H.	5

NAME.	PLACE.	QUANTITY.
Manville Co.	Manville, R. I.	48
Massachusetts Cotton Mills	Lowell, Mass.	1123
Massachusetts Mills in Georgia	Lindale, Ga.	1292
Mass. Institute of Technology	Boston, Mass.	2
May's Landing W. Power Co.	May's Landing, N. J.	1
Meridian Cotton Mills	Meridian, Miss.	148
Merrimack Mfg. Co.	Lowell, Mass.	430
Merrimack Mfg. Co.	Huntsville, Ala.	1718
Methuen Co.	Methuen, Mass.	26
Mills Mfg. Co.	Greenville, S. C.	484
Millville Mfg. Co.	Millville, N. J.	313
Mississippi Agr'l College	Agr'l College, Miss.	2
Mississippi Mills	Wesson, Miss.	49
Mohawk Valley Cotton Mills	Utica, N. Y.	1
Mollohon Mfg. Co.	Newberry, S. C.	352
Monaghan Mills	Greenville, S. C.	1262
Monarch Cotton Mills	Union, S. C.	940
Nantucket Mills	Spray, N. C.	32
Nashua Mfg. Co.	Nashua, N. H.	51
Naumkeag Steam Cotton Co.	Salem, Mass.	248
Neuse River Mills	Raleigh, N. C.	150
New Bedford Textile School	New Bedford, Mass.	2
Newberry Cotton Mills	Newberry, S. C.	26
Newmarket Mfg. Co.	Newmarket, N. H.	371
New York Mills	New York Mills, N. Y.	52
Nightingale Mills	Putnam, Conn.	14
Ninety-six Cotton Mills	Ninety-six, S. C.	300
Nockege Mills	Fitchburg, Mass.	1
Nokomis Cotton Mills	Lexington, N. C.	320
N. C. Col. of Agr'l & Mech. Arts.	West Raleigh, N. C.	3

NAME.	PLACE.	QUANTITY.
Odell Mfg. Co.	Concord, N. C.	40
Olympia Cotton Mills	Columbia, S. C.	2250
Orangeburg Mfg. Co.,	Orangeburg, S. C.	392
Orr Cotton Mills	Anderson, S. C.	1504
Ossipee Cotton Mills	Elon College, N. C.	104
Pacific Mills	Lawrence, Mass.	2283
Pacolet Mfg. Co.	Pacolet, S. C.	222
Pacolet Mfg. Co.	Gainesville, Ga.	1764
Palmer Mills	Three Rivers, Mass.	2
Parkhill Mfg. Co.	Fitchburg, Mass	13
Patterson Mfg. Co.	China Grove, N. C.	200
Peabody Mills	Newburyport, Mass.	16
Pell City Mfg. Co.	Pell City, Ala.	640
Pelzer Mfg. Co.	Pelzer, S. C.	2702
Pemberton Co.	Lawrence, Mass.	52
Pepperell Mfg. Co.	Biddeford, Me.	809
Philadelphia Textile School	Philadelphia, Pa.	2
Piedmont Mfg. Co.	Piedmont, S. C.	640
Poe Mfg. Co., F. W.	Greenville, S. C.	12
Portland Silk Co	Middletown, Conn.	1
Potomska Mills Corporation	New Bedford, Mass.	1
Proximity Mfg. Co.	Greensboro, N. C.	395
Putnam Mfg. Co.	Putnam, Conn	252
Queen City Cotton Co.	Burlington, Vt.	1308
Quidnick Mfg. Co.	Quidnick, R. I.	17
Quinebaug Co.	Danielson, Conn.	206
Reedy River Mfg. Co.	Greenville, S. C.	153
Revolution Cotton Mills	Greensboro, N. C.	389
Rhode Island School of Design	Providence, R. I.	1

NAME.	PLACE.	QUANTITY.
Roanoke Mills Co.	Roanoke Rapids, N. C.	120
Rosemary Mfg. Co.	Roanoke Rapids, N. C.	258
Royal Bag & Yarn Mfg. Co.	Charleston, S. C.	74
Royal Cotton Mills	Wake Forest, N. C.	186
Salmon Falls Mfg. Co.	Salmon Falls, N. H.	1
Salt's Textile Mfg. Co.	Bridgeport, Conn.	20
Samoset Co.	Valley Falls, R. I.	80
Saxon Mills	Spartanburg, S. C.	320
Scottdale Mills	Atlanta, Ga.	320
Shetucket Co.	Norwich, Conn.	70
Slater Cotton Mills	Pawtucket, R. I.	1
Slater Mills, H. N.	Webster, Mass.	250
Social Mfg. Co.	Woonsocket, R. I.	556
Spartan Mills	Spartanburg, S. C.	1880
Star & Crescent Mills	Philadelphia, Pa.	44
Stark Mills	Manchester, N. H.	190
Steele's Mills	Rockingham, N. C.	600
Stevens Mfg. Co.	Fall River, Mass.	1
Stirling Silk Co.	Stirling, N. J.	2
Strickland Cotton Mills	Valdosta, Ga.	20
Susquehanna Silk Mills	Sunbury, Pa.	2
Tarboro Cotton Factory	Tarboro, N. C.	200
Texas Mechanical College	College Station, Tex.	2
Thistle Mill Co.	Ilchester, Md.	4
Thompson, Jas. & Co.	Valley Falls, N. Y.	12
Thorndike Co.	Thorndike, Mass.	2
Toxaway Mill	Anderson, S. C.	352
Tremont & Suffolk Mills	Lowell, Mass.	1977
Trion Mfg. Co.	Trion Factory, Ga.	664
Tucapau Mills	Tucapau, S. C.	1759

NAME.	PLACE.	QUANTITY.
United States Cotton Co.	Central Falls, R. I.	1487
Utica Cotton Co.	Capron, N. Y.	1
Utica Steam Cotton Mills	Utica, N. Y.	13
Victor Mfg. Co.	Greers, S. C.	1309
Wachuset Mills	Worcester, Mass.	1
Walhalla Cotton Mills	Walhalla, S. C.	120
Warren Cotton Mills	West Warren, Mass.	64
Warren Mfg. Co.	Warrenville, S. C.	1000
White & Son, N. D.	Winch'ndonSpr'gs.Mass.	1
Whitman Mills	New Bedford, Mass.	829
Whitney Mfg. Co.	Whitney, S. C.	394
Whittenton Mfg. Co.	Taunton, Mass.	1
Williamson, Jas. N. & W. H.	Raleigh, N. C.	120
Wilmington Cotton Mills	Wilmington, N. C.	60
Woodruff Cotton Mills	Woodruff, S. C.	880
York Mfg. Co.	Saco, Me.	365
		98,737

LIST OF ATTACHMENTS APPLIED TO OR ORDERED FOR OTHER MAKES OF LOOMS TO JULY 1, 1904.

NAME.	PLACE.	Filling Changer.	Warp Stop-Motion.
Aiken Mfg. Co.	Bath, S. C.	13	13
Albion Co.	Valley Falls, R. I.	1	1
Amoskeag Mfg. Co.	Manchester, N. H.		10,555
Androscoggin Mills	Lewiston, Mass.	53	53
Arlington Mills	Lawrence, Mass.	1	13
Atlantic Cotton Mills	Lawrence, Mass.	9	9
Atlantic Mills	Providence, R. I.		1
Bates Mfg. Co.	Lewiston, Me.		24
Boston Mfg. Co.	Waltham, Mass.		300
Botany Worsted Mills	Passaic, N. J.		1
Cawthon Cotton Mills Co.	Selma, Ala.	16	16
China Mfg. Co.	Suncook, N. H.	14	14
Dallas Mfg. Co.	Huntsville, Ala.	3	3
Davol Mills	Fall River, Mass.	82	82
Eagle & Phoenix Mills	Columbus, Ga.		102
Everett Mills	Lawrence, Mass.		774
Exposition Cotton Mills	Atlanta, Ga.	1	1
Fulton Bag & Cotton Mills	Atlanta, Ga.	502	502
Gibson Mfg. Co.	Concord, N. C.	100	

NAME.	PLACE.	Filling Changer.	Warp Stop-Motion.
Globe Mill	Woonsocket, R. I.		43
Gosnold Mills Corp.	New Bedford, Mass.		780
Grinnell Mfg. Corp.	New Bedford, Mass.		2
Hargraves Mills	Fall River, Mass.	45	21
Hathaway Mfg. Co.	New Bedford, Mass.		432
King Philip Mills	Fall River, Mass.	142	6
Lancaster Mills	Clinton, Mass.		2,288
Lockwood Co.	Waterville, Me.	803	803
Lorraine Mfg. Co.	Pawtucket, R. I.		2
Manville Co.	Manville, R. I.		557
Manville Co., Social Mill	Woonsocket, R. I.		409
Mass. Cotton Mills	Lowell, Mass.	112	113
Mass. Mills in Georgia	Lindale, Ga.	6	6
Mechanics Mills	Fall River, Mass.		1
Merrimack Mfg. Co.	Lowell, Mass.	1	1
Methuen Co.	Methuen, Mass.	1	1
Nashua Mfg. Co.	Nashua, N. H.	2	
Naumk'g Steam Cotton Co.	Salem, Mass.	1	1
New York Mills	New York Mills, N. Y.		1
Otis Co.	Ware, Mass.		6
Pacific Mills	Lawrence, Mass.		1
Parker Mills	Warren, R. I.	1	
Parkhill Mfg. Co.	Fitchburg, Mass.		29
Peabody Mfg. Co.	Newburyport, Mass.	1	1
Pemberton Co.	Lawrence, Mass.		60

NAME.	PLACE.	Filling Changer.	Warp Stop-Motion.
Pierce Mfg. Corp.	New Bedford, Mass.		1
Poe Mfg. Co., F. W.	Greenville, S. C.	13	13
Salt's Textile Mfg. Co.	Bridgeport, Conn.	8	
Shetucket Co.	Norwich, Conn.		1
Stark Mills	Manchester, N. H.		2
Stevens Mfg. Co.	Fall River, Mass.	111	
Stonewall Cotton Mills	Stonewall, Miss.	12	12
Susquehanna Silk Mills	Sunbury, Pa.	7	
Tecumseh Mills	Fall River, Mass.	1	1
Trainer&SonsMfg.Co.,D.	Trainer, Pa.		1
Tremont & Suffolk Mills	Lowell, Mass.		304
Utica Steam & Mohawk Valley Cotton Mills	Utica, N. Y.	1	1
Webster Mfg. Co.	Suncook, N. H.	1	1
West Boylston Mfg. Co.	Easthampton, Mass.		2
Whittenton Mfg. Co.	Taunton, Mass.	4	16
York Mfg. Co.	Saco, Me.	1	69
		2,069	18,452

ALSO

Complete looms, not on list, shipped to foreign countries or agents, etc.	1,802
Extra Filling Changers	121
Extra Warp Stop-Motions	45

TOTALS.

Complete Northrop Looms sold to date,	**102,653**
Number of Filling Changers applied,	**102,729**
Number of Warp Stop-motions applied,	**119,036**
Plain Looms made at or ordered from Hopedale Works,	**2,319**

The looms changed over include looms made by our licensees in the United States and furnished to mills also in the United States.

These figures do **not** include the many thousand looms made under license in Canada, England, France, Germany, Switzerland, Austria and Hungary.

This volume is intended to contain all the general information necessary regarding our looms, including all the information previously published in other catalogues or circulars that is pertinent. We are sometimes asked by overseers or second-hands, to send them books containing numbers and description of our various loom parts in detail. We have such printed lists and are glad to furnish them to the mills which purchase our looms, but they are too expensive in character to be generally distributed. Any overseer, or other operative, can probably have access to this list in the mill office, if necessary.

While starting to print in April, the unavoidable delays have extended the preparation of this volume to the first of July, 1904, the last tables being made up to that date. While intended to be practically complete, we cannot, of course, detail the improvements now being developed which have not yet secured patent protection. Our customers may be sure, however, that the looms which we shall sell them are even further advanced than those illustrated herein.

As soon as this present edition is exhausted, we shall follow with a second edition in which the newer devices will be exploited. Any further information regarding looms, or any of our other products, will be cheerfully furnished on application. To those not fully informed as to the general scope of our business, we will say that while the Northrop looms are our chief product, we have been introducing cotton machinery improvements since 1816, our line of manufacture before taking up the Northrop loom being devoted to the introduction of High Speed Spindles for spinning frames, Spinning Rings, Spinning Frame Separators, Loom Temples, Warpers, Twisters, Spoolers, Reels, Banding Machines, Balling Machines, etc., etc. We have other literature relating to these products which we will be glad to send on application.

DRAPER COMPANY,

Hopedale, Mass.

July 1, 1904.

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Date Due

Labor-saving looms