

Increasing Production and Decreasing Cost in Putting Up Piece Goods

How One Finishing Plant Has Reorganized for Quality Production and Increased Quantity

By REYNOLDS LONGFIELD

About three years ago, a firm of cotton goods converters had at their disposal an order for a million yards of cloth to be finished according to certain specifications. Determined to obtain a high grade article, they decided to let several finishing companies compete for the contract without their knowledge that such a contest was being conducted. Accordingly, five responsible concerns with a reputation for handling that particular grade of cloth were selected and to each was sent a thousand yards of goods in the grey with identical instructions. When the five finished products were received, they were placed side by side that judgment might best be passed as to which company was deserving of the order. All were good, but the choice narrowed to two which seemed to be on a par as to appearance and feel. Finally, the contract was awarded to one company, the deciding feature being the Put-up.

Criticisms of Put-up are often heard and frequently, these criticisms seem unnecessary and even out of order, but no better concrete example can be had than this actual case showing what it meant in dollars and cents to this firm. The company always had been proud of their product, and of their reputation in the trade. "Quality," was their slogan! Frequently had they been

complimented, not for the finish alone, but for how it appeared upon the shelf. This reputation had been gained as a result of great painstaking when the plant was small, and Put-up was emphasized. During its rapid growth, in order to maintain this feature, the efficiency of the operation was not taken into consideration. They had started with a small unit and with each increment in business, an additional unit was added.

Under these conditions, it had been considered inadvisable to interfere with the operation in any way, but finally the point was reached where three deciding factors made it necessary that something be done.

Congested Conditions

Floor space had become limited. There was no opportunity for expansion. The room had become extremely congested, resulting in considerable confusion. Lots were frequently lost or overlooked, causing many annoyances and much dissatisfaction.

To relieve the conditions, a more efficient organization must be developed and a scheme for handling the work put into effect that lots might be completed more quickly and in the order desired. With this end in view, plans were immediately laid to make a survey of conditions, in order to determine the course of action.

When this was suggested to the forewoman, she could arrive at but one conclusion. Increased production could be obtained only by requiring the individual to work faster, and with increased speed, poor quality only would result. The forewoman had developed this department into its present size. Credit for the high standards of quality was due to her efforts. She had realized what ills had come with its growth, but felt powerless to cure them. In fact, she questioned if they could be corrected and very skeptically acquiesced to the starting of the work. She was willing to cooperate in every way to improve conditions, but if the operatives were to be buried in their work, she would not be responsible for the quality of workmanship.

No one felt any less than did the forewoman that the high standards developed and maintained over a period of years should in any way be let down. There was no doubt that changes of any kind would tend to confuse and cause bad work as well as mistakes, but relief of some kind must be afforded and it could be had only through carefully laid plans as carefully carried out. With proper cooperation, confusion would be only temporary and the number of mistakes should not mount above those usual under normal conditions.

A brief survey of conditions in general was immediately started for the purpose of determining a modus operandi.

The Put-up department shared one large room with the Doubling Department. See Fig. 1. About three quarters of one side was confined to doubling, and the remaining quarter reserved for special put-up. Half of the other side was devoted to double and roll and the other half to longfold put-up. The operation of folding remnants which was considered one of the duties of the Put-up Department, was performed at one end of the room, while the forewoman maintained her office and headquarters at the other end.

Coincident with the delivery of an order to the gray room for processing, the Put-up Department received theirs which carried with it the folding instructions. From this, the order clerk wrote the put-up order, and passed it without delay to the supply girls, where tickets and special bands were prepared, placed in a tote box together with the put-up order and stored until needed.

There was no planning unless the forewoman had made note of some special order which had come to her attention, and in such a case, she would request that it be the next

lot worked upon. When a unit was ready for a new lot, the senior supervisor authorized the trucker to deliver the next load which was usually the material most conveniently located.

Former Organization

The working force was composed of operating units, each one of which was headed by a supervisor. The number of these units varied during the year, depending upon the season and the volume of work going through. At this time, the organization was as follows:

An Assistant forewoman

An Auxiliary group composed of eight:

2 Order Clerks writing put-up instructions

4 Supply girls preparing tickets and supplies

1 Trucker

1 Ironing woman

A Double and Roll group consisting of twenty, in five units, each unit composed of

1 Supervisor

1 Ticket-hanger

2 Bundlers

A Longfold group consisting of fifteen in three units, each unit composed of:

1 Supervisor

2 Paperers

2 Tapers

A miscellaneous Put-up group of five, composed of:

1 Supervisor

4 Put-up girls

A Remnant group of four:

4 Folders (girls)

Samples and Swatches:

2 Girls.

The units in themselves were industrious but inefficient. Waits were numerous, work poorly placed, and material unnecessarily handled. There were, however, very creditable features, such as the carefulness with which the goods were handled and the strict attention paid to quality. One thing significant in reference to this and worthy of note here, was the inspection required of the backer. As she opened the piece to turn back the end, she was required to scan quickly, but carefully, the exposed cloth as a check on the inspection of the doubler. If the piece appeared stained, damaged, creased or imperfect in any way, she cast it aside for the supervisor to examine. Of course, it was but a small portion of the cloth that received this inspection, but it

was indicative of the quality of the rest of the piece, and the frequency with which imperfections were brought to light at this point was surprising. It was felt that this feature should be emphasized in any changes contemplated.

In proceeding with work of this nature where complete overhauling of methods and personnel are desired, the usual way is to start with planning and control, develop the organization necessary to carry it on, and lastly standardize the individual operations, teaching the operatives how to work. Although, this problem required that a complete revision be made from the ground up, because of the nature of the forewoman and those connected with her, that they might not feel that a radical change was being made, it was decided to approach it contrary to general practice. Although studying the problem from the usual viewpoint, the actual installation should proceed from the opposite angle, believing that less confusion would result.

General Plan

The general plan then briefly stated was:

First. Lay out on paper the organization considered necessary to properly control the work and supply the operatives.

Second. Select one individual from an operating group, train her carefully under scientific methods until she was able to work skilfully and satisfactorily.

Third. Using this trained operative as a nucleus, develop around her the organization as laid out on paper, drawing one at a time from the old organization.

In order to correctly lay out on paper an organization for properly controlling the work and supplying the operatives, according to the first part of the general scheme, it was necessary to take each function, consider all work in connection with it and reclassify the duties from the viewpoint of eliminating duplication, improving methods, and developing more specialized jobs. Bearing in mind these cardinal principles, the investigations were started at the point where the order was received in the department.

These were two order clerks writing Put-up instructions. After dividing the incoming lot sheets between them, they each referred to the file of standard Put-up instructions, transferred to the lot sheet any data that were lacking, and proceeded to write the Put-up order which was to convey information to all operatives who were to work on that particular lot. In the first

place, the Put-up order was poorly designed. There was no definite place for specific information, not only making it difficult for the order clerk not to omit anything from the order, but also making it necessary for each operative handling it to read it thoroughly that they might be sure that nothing was overlooked. A new order form was immediately designed with allotted space for all instructions that every one using the forms knew exactly where to look for any desired information. This also made it possible to use symbols and words where formerly whole sentences were required. There was but one typewriter in the department and that was used by one of the order clerks. The other order clerk wrote everything in long hand. The forewoman had made several requests for an extra machine, but it had never been approved by the management. On the face of it this request was out of place for it all data obtained by one of the two, the other could easily type the information with much time to spare.

The Put-up order as soon as typed was forwarded to the supply girls. The one in charge drew from her stores all special bands, tapes and tickets necessary to fill the order. These were put into a tote box together with the Put-up order and passed to one of the three girls stamping tickets. After the tickets had been stamped, they were returned to the tote box together with the Put-up order, and placed in a rack designed to hold possibly a hundred or more of these boxes. The organization of this group was satisfactory, but the operation itself was inefficient and showed possibilities of a future task.

The supervisor of a Put-up unit, when ready to start a new lot, went to the rack and withdrew the tote box corresponding to the lot which she desired. Then after giving orders to the truckers to remove her finished work and bring in the new, the location of which being indicated to him, she gave instructions to the operatives and supervised the Put-ups and was responsible for accuracy, industry, and workmanship. She repaired or rejected pieces laid aside by the backers as doubtful, assorted when necessary, counted the pieces when finished, and entered in the lot book the amount of work completed against this lot.

This work was entirely too diversified for any one individual to perform in the best manner. To improve operations, responsibility should be so divided that an individual would be expected to perform only one or two of these duties. She could then

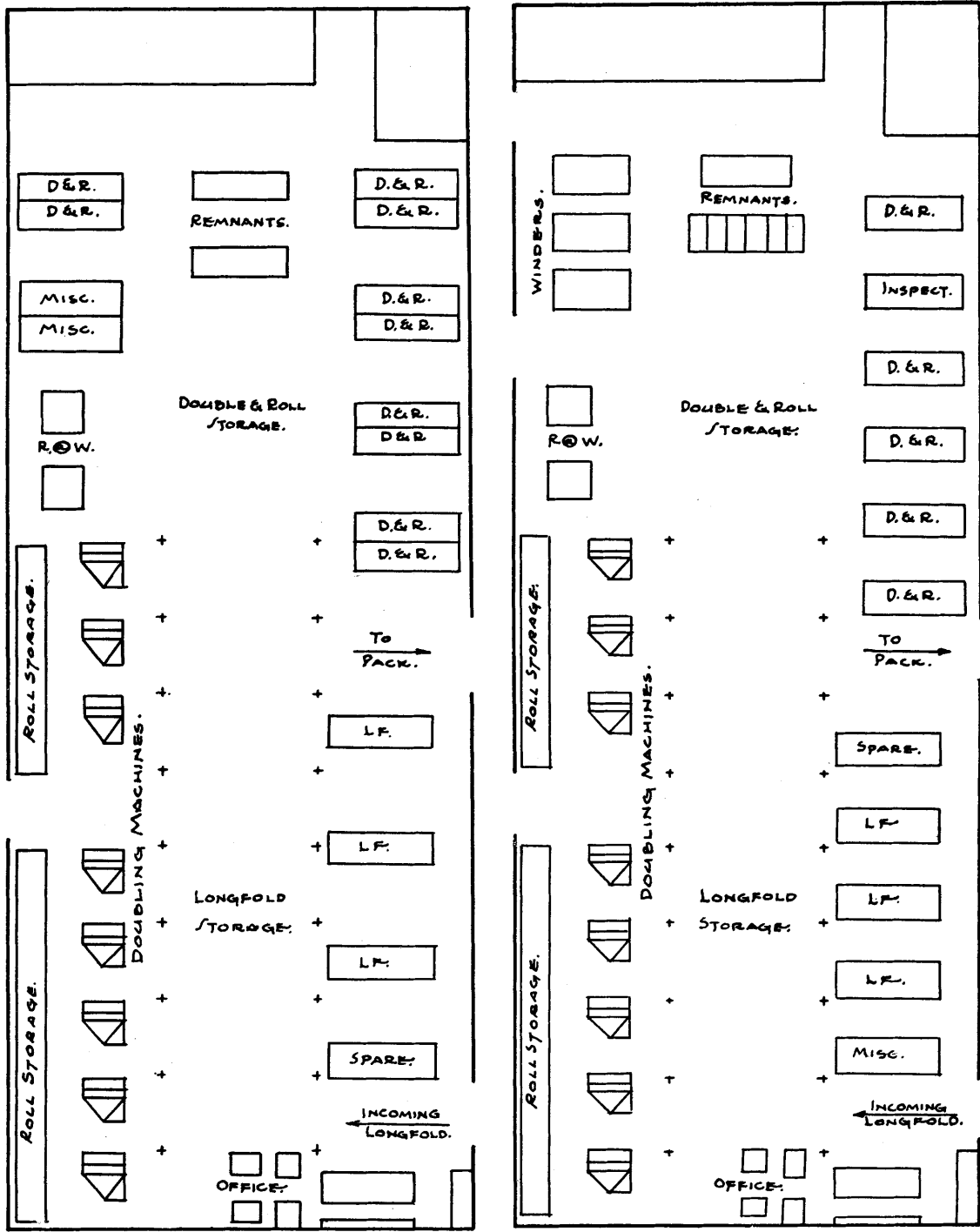


Fig. 1

ORIGINAL LAYOUT OF ROOM

FINAL LAYOUT OF ROOM

Number of tables reduced from 18 to 12. Put-up confined to one side of room thereby releasing other side entirely for machines.

become expert in the few details and have them extended to cover the entire department, rather than a small unit, thus improving operation through centralized control. The supervisor's work then should be broken up into four distinct jobs, each of which should be rounded out considerably to give better control and follow up of material. These four new jobs were designed as follows:

A. DISPATCHER. One girl responsible for handing out the material in the proper order. To take record of all lots coming into the department, note position of material on the floor, secure tote box with supplies and Put-up order, assort if necessary, require that it be put up in sequence planned, and point it out to the trucker, when giving orders for its delivery to a specified table.

B. A RECORD CLERK. In charge of the lot books for the purpose of making entries for all work completed, who could quickly hand out information concerning the status of lots. Such a plan was very badly needed, for entries were being made by so many individuals and in such helter skelter manner that it required the proverbial Philadelphia lawyer to intelligently interpret the information there entered. The location of the lot book also was quite a trysting place, for at almost any time during the day at least one or two girls could be seen waiting their turn to make an entry. Anticipating this alteration, a new lot sheet form was designed and ordered preparatory to initiating the job. This new form had an allotted space for recording location, condition, and date of each movement of the material from the frames to and including packing. In conjunction with this, another form was designed and printed in many colors, each color representing a distinct operation to be used by the supervisors in submitting to the record clerk, data to be entered.

C. AN INSPECTOR (for Double and Roll Put-up) especially skilled in what should be rejected and how best to repair bad work, if possible. Work for examination would be delivered to her, and she should repair, with the assistance of the ironing woman, all work thrown aside by the backers.

D. ONE SUPERVISOR. For all backers and bundlers, one for longfold and one for special Put-up should be able to shoulder the responsibilities of training new employees, interpreting Put-up instructions and requiring industry and high class workmanship from the operatives. Each should check the amount of work done by their subordinates and deliver these data to the

record clerk on the specially designed cards of the proper color representing her particular operation.

The trucker would be required to deliver all work according to instructions from the dispatcher and remove completed work at the request of the supervisor.

The ironing woman should work in conjunction with the inspector and at the same table, ironing and repairing such work as the inspector might designate.

This covered all duties, necessary for the supporting organization, and incidently completed the first part of the general scheme.

With the superintendent's approval of the plan, the three designated forms including the Lot Sheet, the Put-up order and the Work Completed Card were ordered and immediately put into use. These could not interfere with the operation in any way and the sooner that various ones became accustomed to their use, the easier could the other desired changes be affected. The forewoman was also requested to delegate the senior and more responsible order clerk the job of accumulating all information necessary for the Put-up and to check all Put-up orders after being typed by the other order clerk who was to act as typist. This not only eliminated the need of a new typewriter, but increased accuracy by means of a clerk, and resulted in a more efficient operation.

Second Step of Plan

The second step of the general plan was to study the operating groups, the method of approach being to isolate a selected operative, study her operation in detail and train her scientifically in the one best way. It was realized from the original survey that greatest congestion was centered around the double and roll work. Inefficiencies in the long-fold group were just as evident, but due to the fact that less labor was required per piece, and considerably less detail, flow of work was faster and there was much less confusion. Although a general course of action was necessary for the department as a whole, first aid was required for the double and roll and it was around these that attention was centered.

In looking among the operatives, one girl was noticed who, although working in the same manner as the others, worked remarkably easily and with no apparent effort. Fortunately she was industrious, willing, and of a quiet nature. One would have gone far to find another as well adapted for the purpose. A table was selected in a

corner of the room beside which a load of doubled and rolled pieces, having been previously backed and ticketed, was deposited. The selected operative was placed at this table and asked to bundle pieces in the usual manner. A motion study man then proceeded to study the work in detail for the purpose of obtaining a careful analysis of the cycle of motions in order to determine what movements were useless or could be improved upon.

The report of the motion-study man describing the operations in details was as follows:

Note No. 1. All supplies are centrally located within approximately 50 feet of all tables, and each operative serves herself.

Note No. 2. The supervisor gives necessary instructions concerning put-up when operative is ready to start a new lot.

- A. *Get supply paper:* Operative goes to storage, secures supply of wrapping paper, returns to table and deposits the paper upon the table directly in front of where she is to work.
- B. *Get supply tissue:* Operative goes to storage, secures a supply of tissue paper, returns to her table and deposits it just to the left of the wrapping paper.
- C. *Get supply cord:* Operative gets a spool of wrapping cord from storage, returns with it, places stool in holder and threads the end through eye of the holder.
- D. *Place tissue liner:* Reaching to pile of tissue paper with the left hand, she takes one and places squarely upon the wrapping paper which is on the table in front of her.
- E. *Crease edge:* The top sheet of wrapping paper (including the tissue liner just placed) is pulled closer to the operative in order to reach the far edge. This is doubled over approximately three inches and creased for the purpose of re-enforcing the paper. Paper is then pushed back to its original position.
- F. *Take D R piece:* Turning to truck directly in back, she picks up one doubled and rolled piece and places it squarely upon the paper.
- G. *Fold paper around:* She then takes the near and far edges of the paper and folds it around the doubled and rolled piece, placing a weight upon it to hold paper in position.
- H. *Turn in right end:* Turns in the paper at right end of piece. (This immediately opens as soon as released by hand and of course is a useless motion.)

- I. *Turns in left end:* Turns in paper at left end of piece. (This also opens as soon as released.)
- J. *Tie first knot:* She then reaches for the wrapping cord and ties a two inch loop in the end. Pulling the cord through this loop, she forms a noose which she slips around the doubled and rolled piece and draws tight.
- K. *Repeat right end:* She turns in the right end once more and carries the cord around and under the piece.
- L. *Repeat left end:* Turns in the left end once more and brings the cord up and over the piece.
- M. *Cut cord:* Holding cord tight with left hand, she picks up scissors with right, cuts the cord, drops scissors and removes the weight from the piece.
- N. *Tie final knot.*
- O. *Dispose:* Deposits finished piece upon the truck.

Slight Changes Helped

With this analysis complete, each detail was studied individually as well as in conjunction with the rest. By altering some motions and changing the rotation of others, an entirely new cycle was developed which shortened some movements and entirely eliminated others. A drawer without its front and large enough for tissue paper was built into the table at the place where the operative worked. When empty it could be pulled out far enough to fill, and when pushed back into place, one piece of tissue at a time could be easily removed. This made the movement of getting tissue much easier and quicker. A ring with cutter attached for cutting cord was furnished to be worn on the little finger of right hand (See Fig. No. 2). Also an improved holder for the spool of cord was placed on the table and a shelf built beneath for holding an advance supply of paper and cord.

After these additions were completed the operative was asked to work under the instructions of the motion-study man and she was taught to perfect the new cycle in accordance with the changes as follows: (Capital letters show sequence of motions as performed formerly and small letters show sequence after revision.)

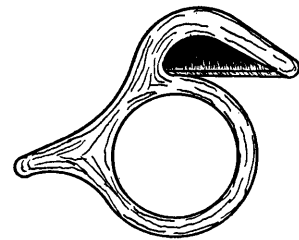


Fig. 2
Ring for cutting wrapping cord worn on little finger of right hand.

- A. a *Get supply of paper*: performed by trucker.
- B. b *Get supply of tissue*: performed by trucker.
- C. c *Get supply of cord*: performed by trucker.
- D. d *Place tissue liner*: Remove one tissue from drawer and place properly upon wrapping paper.
- F. e *Take DR piece*: Place doubled and rolled piece squarely upon the paper but with hang ticket at right instead of at left hand.
- E. f *Crease edge*: Crease near edge of paper (rather than far edge of paper as formerly. This is permissible because piece is now placed with hang ticket at right.) By creasing the near edge, it is not necessary to move the paper, the movement is easier and the hand is in position to proceed with the next motion without letting go of the paper.
- G. g *Fold paper around*: Fold near and far edges of paper around the doubled and rolled piece. Eliminate use of weight by holding paper in position with the little finger of left hand.
- J. h *Tie first knot*: Reach for wrapping cord with right hand, place the end between the thumb and forefinger of left hand (still holding paper in place with little finger of left hand), carry the string under and around the piece with right hand. In this position, tie a slip knot with thumb and forefinger of left hand (Fig. 3) and then draw
- paper at the right end of piece. Carry the string around this end and down under the piece so that the string will hold the paper as turned in.
- I. j *Turn in Left end*: Turn in paper at left end of piece. Carry the cord around this end and up over the piece so that the string will hold the paper as turned in. Simultaneously with the pulling tight of the cord at the end of this motion, cut the cord by means of the ring with cutter attached.
- K. k *Repeat Right end*: This operation has been eliminated.
- L. l *Repeat Left end*: Eliminated.
- M. m *Cut Cord*: Performed simultaneously with turn in left end.
- N. n *Tie final knot*.
- O. o *Dispose*: Deposit finished piece upon truck.

Working according to the new method, considerable saving in time was evident. The operative was not hurried, but left alone a large part of the time so that the method would become natural and easy. Frequently her work was examined to check workmanship, and constructive criticism was offered in an encouraging manner. The only way in which the new piece differed from the old in appearance was in the knot which, as a matter of fact, was an improvement, being smaller and less bulky.

New Method A Time Saver

Being familiar with what was required in the way of quality, and skilful with her

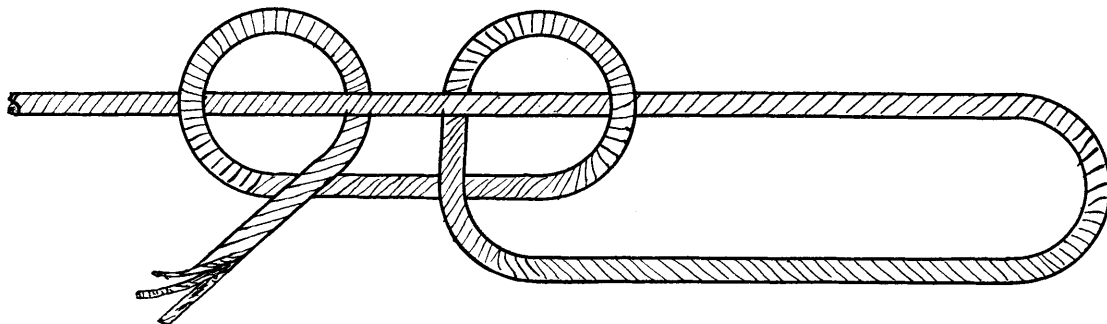


Fig. 3

the string taut to hold the paper securely. This change in sequence of motions and new method of tying the knot not only eliminated the weight, but also shortened the time of the operation considerably.

- H. i *Turn in Right end*: Turn in the

fingers, she was able to develop remarkable speed in less than two weeks. It was then a detailed time study was taken, the result of which is tabulated below, together with time studies taken under old conditions. The figures given are in minutes and decimals thereof. Capital letters show

sequence of operations under the old method and small letters under the new.

	<i>Old</i>	<i>New</i>
	<i>Method</i>	<i>Method</i>
A. a	Get supply paper..	—
B. b	Get supply tissue..	—
C. c	Get supply cord...	—
D. d	Place tissue liner..	.06
E. f	Crease edge.....	.11
F. e	Take DR piece....	.05
G. g	Fold paper around.	.08
H. i	Turn in Rt. end...	.11
I. j	Turn in Lt. end....	.11
J. h	Tie first knot.....	:33
K. k	Repeat Rt. end....	.09
L. l	Repeat Lt. end....	.09
M. m	Cut Cord.....	.08
N. n	Tie final knot.....	.05
O. o	Dispose05
	<hr/>	<hr/>
	Total time in minutes	1.21 0.76

Here is shown a reduction in the total time of the operation of from 1.21 minutes to 0.76 minutes, equivalent to an increase in production of 59 percent. This difference did not result from increased speed, for the same amount of effort is involved. The difference was the result of a practical application of decisions reached by proper and scientific analysis of detail motion studies. Time required in furnishing wrapping paper, tissue and cord has not been included for this work was shifted to the trucker in order to show a further increase in production for the bundler. Such a maneuver of course did not result in an increase per man hour for the department, but did permit an increase in production per square foot of table space, which in this department and at this time, was highly important.

The resulting increase in production, afforded the opportunity of a higher wage to the workers without increasing the unit cost of the operation and without extra effort. The new product was regarded very much askance by various ones in the department, for it was somewhat different from what the old timers had been accustomed to, but those in authority accepted it as being as good as the regular article and it was necessary to at least maintain it as such.

Quality Never Forgotten

Emphasizing quality, then, the regular Gantt Task and Bonus wage incentive was initiated. This plan consisted of simply converting the quantity of pieces produced into standard hours known as the time allowed.

The task required that the work be completed within the time allowed, and this being done, the operative was paid for the total standard hours of work completed at her regular hourly wage increased by 20 per cent. If, on the contrary, it took longer than the time allowed by the standards, the task was not considered as being accomplished and the operative received only the regular hourly rate. In offering this method of remuneration, it was definitely stated that the bonus was paid only on quality of workmanship and the supervisor was charged with the responsibility of seeing that it was maintained.

The bundler working under these conditions, was encouraged in her efforts and not permitted to work too fast, but sufficiently so that she might comfortably accomplish the task. Partially because of the revised methods and partially because of the fact that she stayed more closely on the job, her output was considerably higher than that of any other operative on the same class of work. This was apparent to others in the department who attributed the increase to excess speed. One or two individuals concerned themselves with this, together with the fact that the bonus received by the bundler gave her considerably more than what the rest were getting, attempting first, to discourage the operative and then to arouse resentment among the others. Judgment used in making the selection however, proved sound and she continued in her work unruffled.

Such interference may frequently be incurred, and although it seldom amounts to much, yet it must be considered. In this particular case, the next step was hastened somewhat, that of allowing another operative to follow through on what had been started. The experimental operative was so peculiarly adaptable for new work that it was desired to use her on further developments, but it would have been unwise to remove her until a new recruit had been trained. So another was selected, one whose term of service was considerably longer and who was recognized as the most skilled in the work. She had regarded the bonus with envy and was glad of the opportunity, being flattered that she had been selected because of her skill. She was trained similarly to the first operative and just as thoroughly until every movement had been perfected. The time in learning was considerably shortened, since the experimental stage was passed, and she was soon accomplishing the task. The operation now

had the advantage of having one with a reputation for skill, accuracy and neatness, who from the start was able to produce work beyond criticism.

In the meantime, a detail analysis of both backing and hanging tickets was made. Of these two operations, the former was fairly efficient, but the latter did not require enough effort to permit either continuous or fast work. It was not a quality job, and speed not only could be permitted but should be required. Following backing as it did, however, the ticket hanger naturally could not do more pieces than the backer. Because of the poor distribution of labor between these two operations, they were studied in conjunction with the intention of combining them into one job as the most proper and efficient method.

The report of the motion study man describing this work in detail, was as follows:

Note: The supervisor secures the tote box containing put-up order, stamped tickets and supplies which have been prepared in advance by the supply girls. After having located the lot on the floor and having given orders to the trucker for its delivery to her table, she interprets the put-up instructions and supervises the unit as it works.

Backer:

A.—*Take DR Piece.* The operative takes a doubled and rolled piece from the truck at her left and places it upon the table directly in front.

B.—*Write Yards.* Reads yards as written by the doubler on the cloth, writes the yards on a stock ticket and places it upon the gum jar.

C.—*First Fold.* She then unrolls piece at least four half turns and scans cloth for imperfections as she holds end with both hands. The end is then carried back to the rolled piece, thus giving a first fold to the doubled piece.

D.—*Second Fold.* Taking the folded end, she scans again for imperfections and then turns the once folded end back to the rolled piece, making a second fold.

E.—*Complete Back.* The operative then passes her hand over the twice folded cloth to be sure there is no wrinkle. She then rolls the piece over on to the twice folded cloth, completing the "Back," piece face down. With a twist of the wrist, she spins the piece around 180°.

F.—*First Band.* Reaching to pile of bands, she takes one, moistens the end with paste from the gum jar, carries it

under the piece with a motion from the body and then around over the top, pressing the ends together, thus gluing them in place.

G.—*Second Band.* Reaching to pile of bands, she takes a second band, moistens end with paste and puts it around the piece, gluing it in place with the same motions used for the first band.

H.—*Stock Ticket.* After turning piece face up, she takes the stock ticket which reposes on the gum jar, and sticks it upon the cloth just within the selvage and under the cloth near the crease of the second fold.

I.—*Place Aside.* She then piles the pieces on table at right within reach of the girl hanging tickets.

Ticket Hanger:

J.—*Take Piece.* The Ticket Hanger reaches to pile of backed pieces, takes one and places on table directly in front.

K.—*Stamp Yards.* Turns lap back in order to read yards written on stock ticket by backer, takes numbering machine, sets it and stamps the yards on a hang ticket.

L.—*Thread Needle.* Then taking needle, she threads it with hang string, and taking scissors, cuts string to proper length. (One threading of needle hangs an average of five tickets.)

M.—*Hang Tickets.* Running needle through selvage of cloth and through hole in the ticket just stamped, she pulls the string until proper length is left.

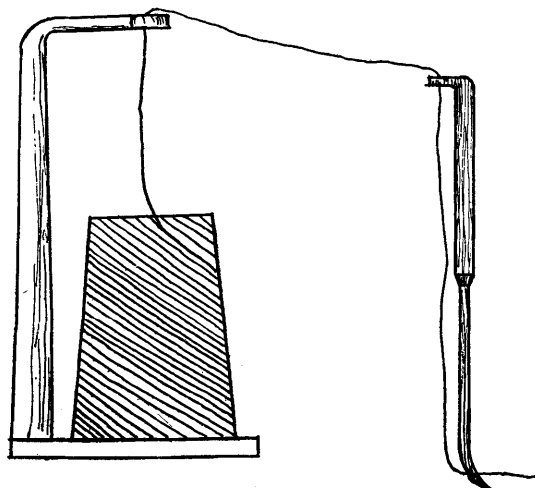


Fig. 4

Devised needle which does not require rethreading. Used for hanging tickets.

After tying a knot with ticket inside the loop, she takes scissors, cuts the string and replaces scissors on the table.

N.—*Dispose*. She then piles the backed and ticketed piece across the table within reach of the bundler.

Studying each of the above details individually as was done in the case of bundling, a revised cycle of motions and methods was devised, eliminating unnecessary movements. Other conditions also which were considered improper and improved upon were: (1.) Tickets, scissors, pencils, etc., were piled promiscuously upon the table in a confused and untidy pile. A tray was made for holding these in a neat and convenient manner. (2.) Spools of tape were placed at the side of the backer and when

tape was used, it twisted as it was drawn from the spool, requiring definite time to straighten. Tape holders were designed and installed which delivered tape without twists. (3.) For hanging tickets, the idea was conceived of using a needle with the eye in the point (Fig. 4) making it unnecessary to pull the needle entirely through the cloth, but sufficiently so to push the hang string far enough to grasp it from the other side. This device, not only eliminated threading the needle, except at the start as in the case of a sewing machine, but also did not require long, awkward lengths of string which frequently tangled. (4.) The ring with cutter attached (Fig. 2) went hand in hand with the new needle, very much facilitating its use.

(To be continued)