

## LENO ATTACHMENTS

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# LENO ATTACHMENTS

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## INTRODUCTION

1. When weaving fabrics in which any warp thread is caused to turn partly around another thread or threads while in the loom, it becomes necessary to attach special appliances to the loom in order to give this turn to the warp ends. The word **leno** has become, during recent years, a general term applied to all classes of such cross-weaving.

In such cloths, the ends, and consequently the picks, instead of lying in parallel lines, are twisted and pulled out of a straight course. This is caused by some of the ends being under the control of 2 harnesses, which can lift them to the right or to the left of one or more other ends, thus producing a crossing of the ends. Crossing the ends on one pick and not crossing them on another is the means whereby such fabrics are produced.

2. A pure, or plain, gauze fabric, the production of which will be considered, is one in which an end of the warp is brought upon one side of a separate end on one pick, and on the next pick is brought up on the other side of the same end, whereas in the ordinary plain weave the warp ends lie parallel to each other and are alternately raised over and depressed under the picks of filling. The gauze plan of interweaving may be said to be the firmest that it is possible to adopt when the amount of material used is considered. It is impossible to make a close fabric by this method, and frequently the gauze method of interweaving is used to obtain in the cloth an open effect that will give to it a very light appearance. In order to weave such fabrics, it is

necessary to attach special appliances to the loom; and it is the object of this Section to deal only with these appliances in so far as they may be considered from a mechanical standpoint, and not to consider the designing of the many different and elaborate leno effects that may be obtained.

Fig. 1 shows the manner in which the ends interlace in gauze weaving;  $a, a_1$  represent the 2 warp ends, while each pick is marked in its order of interlacing. It will be

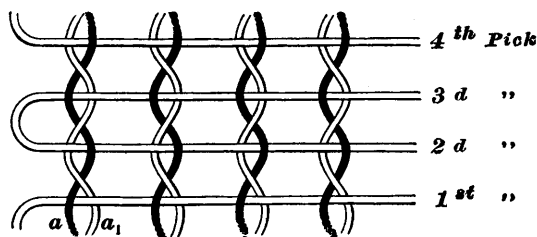


FIG. 1

noticed that the end  $a$  is always over the pick of filling but under the other warp end  $a_1$ , where these ends cross each other; while the end  $a_1$  is always under the pick but over the end  $a$  between the picks, also that on the first pick  $a$  is on the left of  $a_1$ , and on the second pick on the right.

A pure gauze weave, such as is shown in Fig. 1, always repeats on 2 ends and 2 picks, since all the even-numbered picks are alike and all the odd-numbered are alike, the same being true with regard to the ends.

**3. Doup and Ground Ends.**—The end  $a$  is known as the **doup**, **douping**, **crossing** or **whip end**, while the end  $a_1$  is known as the **ground end**. When examining a piece of cloth constructed with the pure gauze weave, it is impossible to distinguish definitely which are the ground ends and which the doup ends; nor is it possible to distinguish the face of the cloth from the back, since the interlacings of the doup and ground ends of a pure gauze fabric are similar, and the ground end has the same appearance if viewed on the back of the cloth as the doup end when observed on the face, and vice versa.

## LENO WEAVING ON SINGLE-LIFT, OR CLOSE-SHED, DOBBIES

### BOTTOM DOUPS

**4. Harnesses.**—In the production of gauze fabrics, two sets of harnesses are required—one for the ground ends and the other for the doup ends. The harnesses for the ground ends are of ordinary construction and the ends are drawn through them in the ordinary manner, but a special arrangement of harnesses is provided for the doup ends. These ends are required to be lifted on both sides of the ground ends and are first drawn through the eyes of an ordinary harness at the back, passed beneath the ground ends, and then drawn through what are known as *doups*, which are connected to a *doup harness*. In this Section, when referring to doups, those known as *bottom doups* and described in Art. 7, should always be understood unless otherwise mentioned.

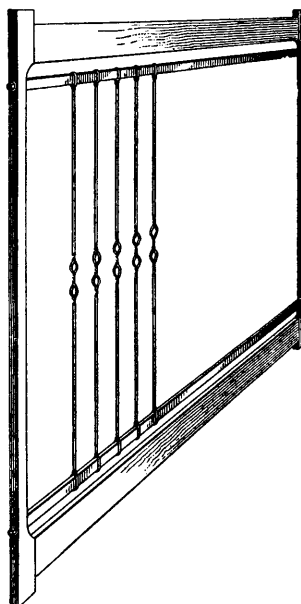


FIG. 2

**5. The Standard Harness.** Fig. 2 is an illustration of the harness known as the **standard harness**. The frame of this harness is similar to those on ordinary harnesses, but the heddle is of a somewhat different construction. The standard heddle, as shown in the illustration, contains two eyes. In some cases these

eyes are both of the same length, while at other times one eye will be found to be considerably longer, this being a matter of choice, but a heddle with one eye longer than the other will not chafe the yarn forming the doup as much as when both eyes are of the same size. When the heddles used have eyes of unequal length, the longer eye is uppermost in the case of bottom doups and is below the smaller eye when using top doups.

**6. The Doup Harness.**—Fig. 3 is an illustration of a bottom-doup harness frame with several doups attached.

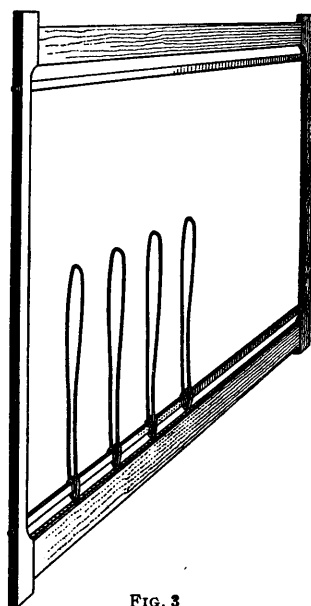


FIG. 3

The frame is similar to that found on an ordinary harness, the difference being that it carries no heddles. The doup-harness frame is the one to which certain loops of worsted thread are attached, and it is used in connection with the standard harness through the heddles of which these loops are passed. A cord is stretched tightly across the lower part of the doup-harness frame; this is shown, in Fig. 3 and other figures, between the heddle bar and the bottom part of the harness frame and close to the latter. It is not essential that the cord be placed in the exact position shown; it may be higher up and nearer to the

heddle bar, or it may be about  $\frac{1}{4}$  inch above the heddle bar; in fact, the latter position is often adopted. It is secured at each side either by being passed through holes in the side pieces of the harness frame and tied there, or by being passed over hooks fixed on the inside of each side piece of the harness frame. Sometimes the doups are merely passed around the heddle bar and no cord is used.

Threads, or *doups*, as they are known, are sewed to this cord in the exact position they should occupy. When for a fancy leno, they are spaced off in such positions as are required by the pattern. This thread, or doup, is generally made of worsted on account of the elasticity and wearing qualities of that material.

**7. Right- and Left-Hand Doups.**—Fig. 4 shows the way, or manner, in which the standard and doup harnesses are placed when combined in the loom, the doup harness being in front of the standard harness. One end of the doup is fastened to the cord near the bottom frame of the doup harness, while the other end is passed around the heddle bar, through the bottom eye of the standard heddle from one side, then back through the upper eye and, after being passed around both the cord and the heddle bar, is fastened to the cord at the same place that the first end was fastened. In Fig. 3 the proper method of passing the doups around the heddle bar of the doup-harness frame is shown; in Fig. 4

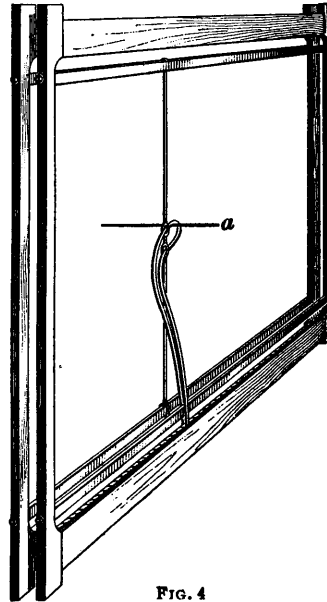


FIG. 4

and other figures, the doup is simply indicated as being attached to the cord. In case the loop formed by drawing the doup through the standard heddle comes at the right of the standard heddle, as in Fig. 4, the doup is known as a **right-hand doup**. When it is formed at the left of the standard heddle, the doup is known as a **left-hand doup**. No ends are drawn through the heddle on the standard harness, but the ends *a*, known as the doup ends, are drawn through the loop that is

formed by the doup passing through the standard heddle, as shown in Fig. 4.

A few very important points should be noted in connection with the manner in which these 2 harnesses are joined. Each harness, whether doup or standard, has its own set of harness straps and its own set of levers. The doup harness may be lifted while the standard is down, but on the other hand, if the standard is lifted, the doup harness must also be

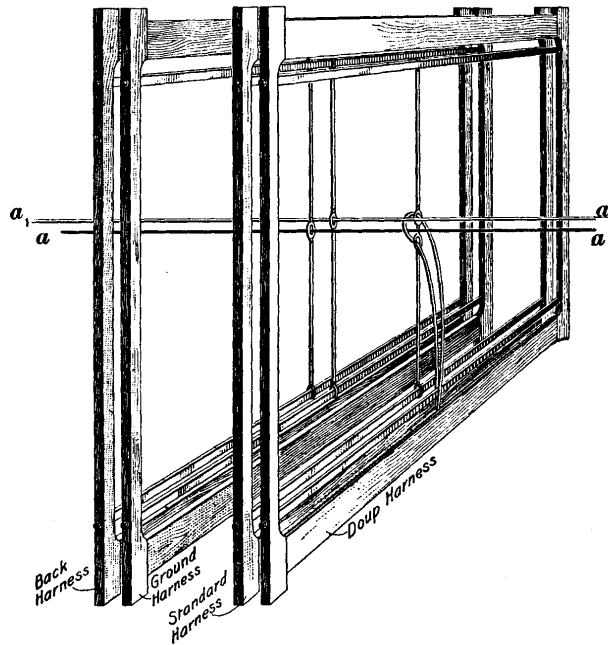


FIG. 5

raised on account of the doup part of the harness passing through the two eyes of the standard heddle. If the standard should be raised without also raising the doup harness, the doups will be strained or broken. These points should be constantly kept in mind when studying the workings of the leno motion.

**8. Drawing in the Ends.**—The next point to be considered is the manner in which the ends are drawn through

the harnesses when producing a pure gauze weave, reference being made to Fig. 5, which shows a left-hand doup. The doup end  $a$  is drawn through the back harness and then passed through the doup, while the ground end  $a_1$  is drawn through the third harness and crossed over the doup end; thus, while it is on the right of the heddle on the back harness, through which the doup end is drawn, it is on the left of the doup. It is necessary to draw the doup end  $a$  through the heddle of a separate harness, as shown in this illustration, in order to lift the end when the doup harness rises and the standard remains down. In this Section the doup harness will be considered as the first, the standard harness the second, the harness through which the ground end is drawn the third, and the harness at the back the fourth harness.

**9. Drawing-In Draft.**—Fig. 6 illustrates the method that is generally adopted to show on paper the manner of drawing in the ends for a leno weave, and is often used in the mills. The standard and doup harnesses are shown together. The harness through which the doup end is drawn at the back is marked fourth harness, while the harness through which the ground end is drawn is marked third harness. The crosses show that the ends connected to them are drawn through those harnesses, the ends being shown by lines. The end  $a$  is to be drawn through the fourth harness and then through the doup, while the end  $a_1$  is to be drawn through the third harness and crossed over the end  $a$ . This method of drawing in the ends will give the same order as that shown in Fig. 5.

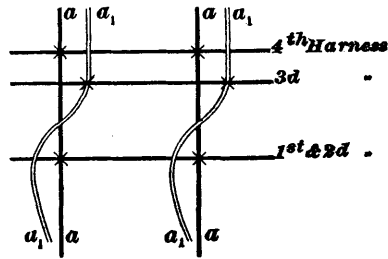


FIG. 6

If a left-hand doup is used, the doup end  $a$  must be on the left-hand side of the standard heddle, and if



a right-hand doup, on the right-hand side of the standard heddle.

**10. Reeding the Ends.**—When drawing in the ends for weaves of this class, the crossing end and the end around which it crosses should always be drawn through the same

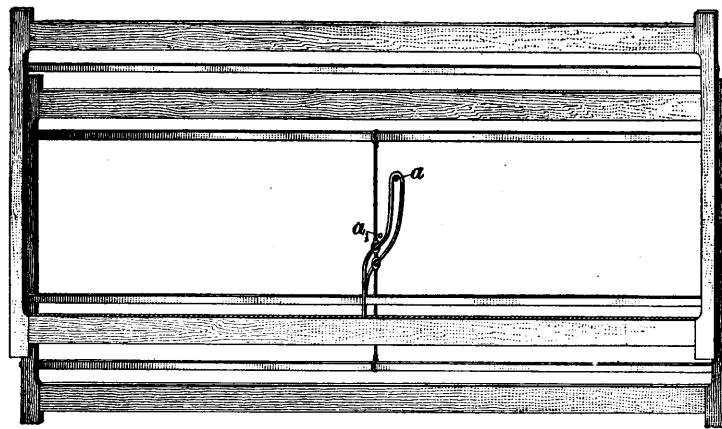


FIG. 7

dent, since this crossing is produced between the standard harness and the last pick inserted in the cloth rendering it

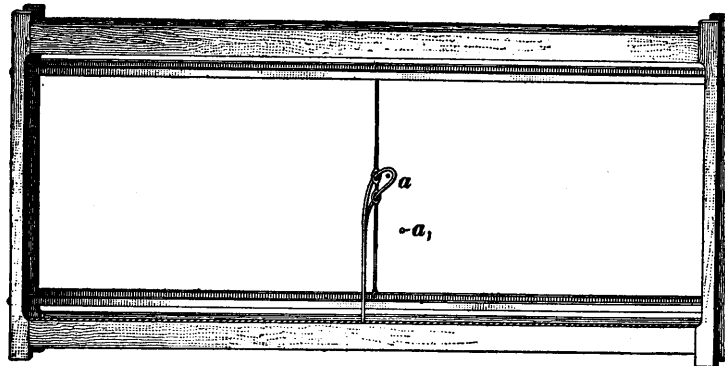


FIG. 8

impossible for the ends to be crossed in front of the reed if drawn through separate dents. The reed, therefore, would prevent the formation of the shed, and the ends of the warp

would be broken. In order to permit more space for these ends when the crossing takes place, since the ends are also crossed between the standard harness and the harnesses through which the ends are drawn at the back, the 2 back harnesses are generally placed as far back as possible, while the doup and standard harnesses are placed as far front as

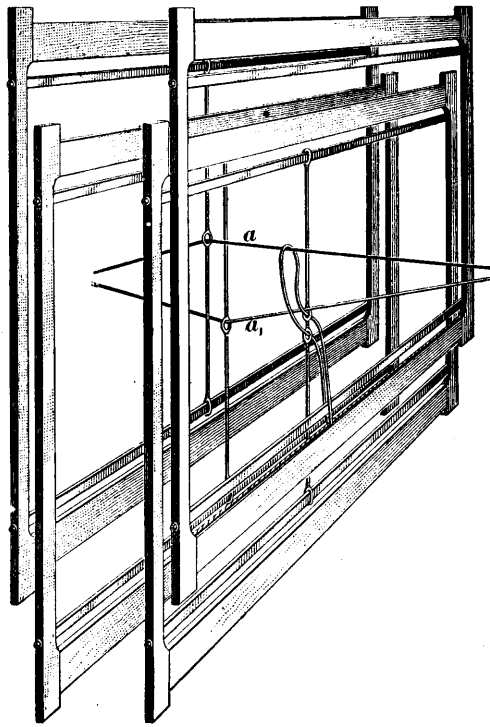


FIG. 9

possible; that is, the doup and standard harnesses are operated by the front levers of the dobby, while the other harnesses are operated by levers near the back of the dobby.

**11. Operation of Harnesses.**—Figs. 7 and 8, which show two views of a standard and doup harness with a right-hand doup, will serve to illustrate the method of operating these harnesses when producing the crossing of the warp

ends. In Fig. 7, which may be said to represent the first pick of the weave, the standard remains down, while the doup harness is raised. The doup end is raised by a harness not shown in this figure but shown as the fourth harness in Fig. 6. On this pick the doup end  $a$  is brought up on the right-hand side of the ground end  $a_1$ , which is drawn through

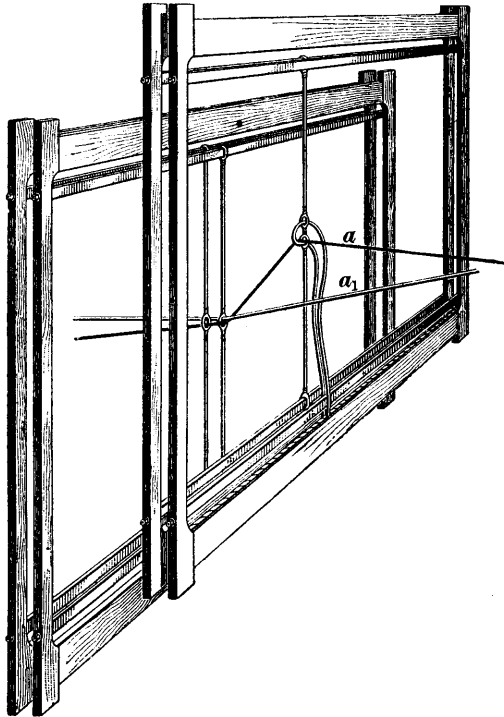


FIG. 10

a harness not shown in this figure but shown as the third harness in Fig. 6.

In the other view, Fig. 8, which represents the next pick of the weave, the standard and doup harnesses are both raised, and as a result the end  $a$  that is drawn through the doup harness is brought up on the left-hand side of the ground end  $a_1$ , and thus a crossing of the ends in the warp takes place. By this means the doup end  $a$  will always be above,

while the ground end  $a$ , will always be below, the picks of filling.

Figs. 9 and 10 show two other views of the manner of operating the harnesses; in this case the doups shown are left-hand, since the doup end passes on the left of the standard heddle.

In Fig. 9, the fourth harness, through which the doup end is drawn at the back, is shown raised, thus raising the doup end. When, however, this harness is raised, the doup harness is also lifted, permitting the end  $a$  to be raised and to bring with it the doup of the doup harness, which slips through the eyes of the standard heddle. In this case the doup end  $a$  is brought up on the left of the ground end  $a_1$ .

In Fig. 10, which represents the positions at the next pick of the weave, the standard and doup harnesses are both raised, while the fourth harness is lowered, thus causing the doup end  $a$  to be brought up on the right of the ground end  $a_1$ . In this manner the turn is made in the warp ends, and, as a result, the ends and picks will lie in the cloth in a manner similar to that illustrated in Fig. 1.

**12.** In all these illustrations, the harness through which the ground end  $a$ , is drawn always remains at the bottom, and in order to make the turn in the ends, it is necessary for the doup end  $a$  to come down to the ground end  $a_1$  at each pick. This is the manner of operating the ends that takes place in a single-lift dobby, where all the warp ends are brought to the bottom of the shed at each pick. This part of the operation will be further spoken of when dealing with the mechanism that operates the harnesses.

The principal form of shedding mechanism used for weaving lenos is the dobby. Dobbies are spoken of either as single-lift or double-lift machines, the general acceptance of the term single-lift dobby being one with but one lifting knife, or blade, the term double-lift dobby generally being applied to a dobby equipped with two lifting knives. There is some difference of opinion as to the exact meaning of these terms but the explanation given is the one usually accepted.

A single-lift dobby forms a close shed since all the ends are lowered to the bottom of the shed between each 2 picks.

Double-lift dobbies, as ordinarily constructed and used in textile mills, especially cotton mills, form an open shed since certain ends may remain up while the shed is being changed in preparation for the next pick. However, by the application of special mechanism or by making other changes the ordinary double-lift dobby can be caused to make a shed other than an open shed.

A close-shed dobby is therefore usually understood to be a single-lift dobby and an open-shed dobby generally infers a double-lift dobby. In the consideration of shedding mechanisms for weaving leno fabrics, it is the difference in the sheds, whether close or open or any other style of shed, that is of importance, the question of single or double lift being immaterial except so far as it means, or causes a closed or an open shed. Therefore, throughout this Section the terms close shed and open shed will be used in considering the shedding mechanism, rather than the terms single- and double-lift.

**13. Weaving Plain Cloth.**—With the ends drawn through the harnesses in the manner shown in Figs. 9 and 10, it is possible to weave ordinary plain cloth. Although the most practical method of weaving plain cloth is the ordinary one in which the ends of the warp are drawn alternately through two harnesses, each end being controlled by only 1 harness, the possibility of weaving plain cloth with the ends drawn through the harnesses in the manner required for weaving plain gauze is a very important advantage, since in many fancy gauze fabrics the pattern is formed by alternately weaving plain cloth and plain gauze as desired. Fig. 9 shows the doup end raised by means of raising the doup and fourth harnesses, while the ground end is lowered; this may be considered as the first pick of a plain weave. On the next pick, the doup, standard, and fourth harnesses will remain down, while the third harness, through which the ground end is drawn will be raised, thus causing that end to

float over the pick of filling. The position of the harnesses for this pick is shown in Fig. 11, where  $a$  shows the position of the doup end and  $a_1$  shows the position of the ground end. On the next pick, the harnesses resume the position shown in Fig. 9 and the doup end floats over the pick of fill-

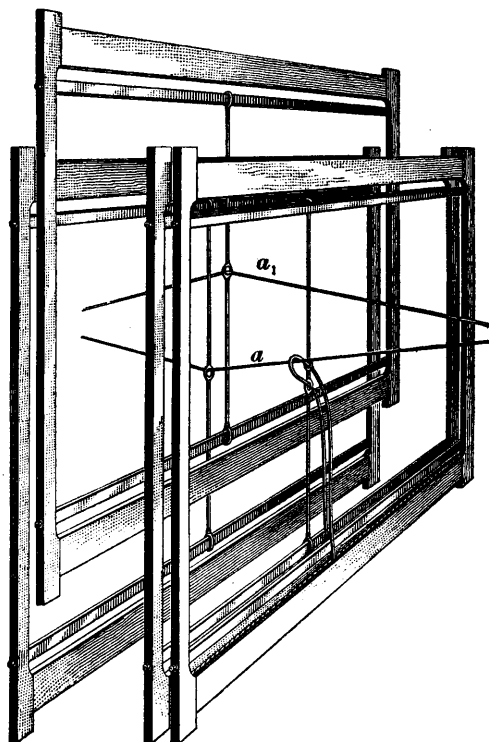


FIG. 11

ing, while the ground end is underneath. The next, or fourth, pick is similar to the second, shown in Fig. 11; consequently, plain cloth will thus be woven.

Plain cloth may also be produced by raising the harnesses as shown in Fig. 10 on one pick, and on the next pick raising them as shown in Fig. 11. This method of lifting the harnesses will produce plain cloth, but is not as satisfactory as the former, due to the additional strain brought on the ends

when raised as shown in Fig. 10. On this account, when doup ends are used in weaving plain cloth, the first method explained is always employed.

**14. The Slackener.**—When the standard and doup harnesses are both raised and the harness through which the doup end is drawn at the back remains down, as shown in Fig. 10, considerable strain is brought on the doup end. This will be perfectly clear from studying the illustration. Consequently, to prevent the breaking of the ends, some arrangement must be employed to ease the doup end and at the same time keep it tight enough to prevent any slack yarn.

This is generally accomplished by using an attachment known as a **slackener** or **easer**, which contains a rod over which all the doup ends pass. Such an arrangement is shown in Fig. 12; the ground ends  $a$ , pass from the warp beam  $c$  over the whip roll  $c_1$  of the loom, while the doup ends  $a$  pass from the beam over a rod  $d$  supported at each end by an arm  $d_2$ , attached to the shaft  $d_3$  to which a lever  $d_1$ , is also attached. Connected to the end of this lever is a harness strap  $d_4$ , fastened to the back lever of the dobbie and consequently raised by that lever, while the spring  $d_5$  serves to pull the lever back into position when it is released by the action of the harness lever.

The operation of this mechanism is as follows: Whenever the doup and standard harnesses are raised and the harness at the back, through which the doup end is drawn, remains down, that lever of the dobbie to which the slackener is connected must be raised, thus raising the lever  $d_1$ . When this lever is raised, the rod  $d$  will be drawn in, thus permitting the doup ends to become slack; but it must be understood that this looseness of the ends must be no more than what will be taken up by the action of the doup and standard harnesses rising together. This will be further considered when dealing with the settings of the dobbie for leno work.

In most cases when weaving leno fabrics, it is necessary to place all the doup ends on a separate beam on account of

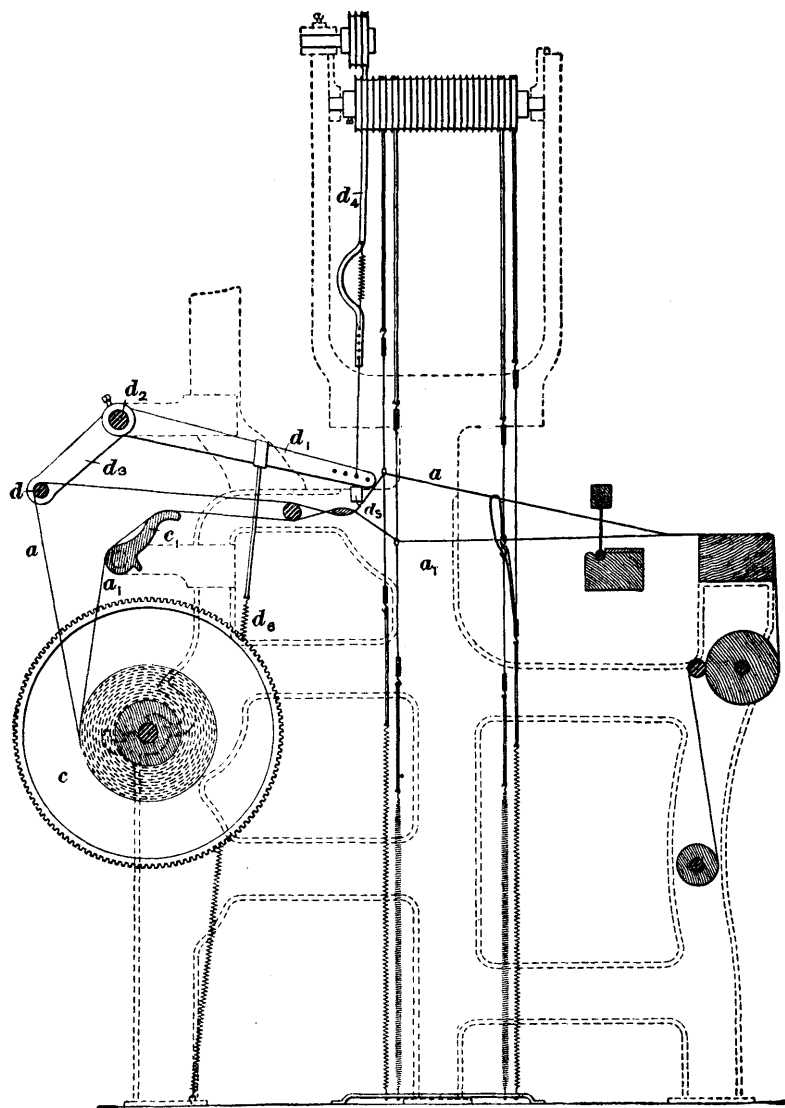


FIG. 12



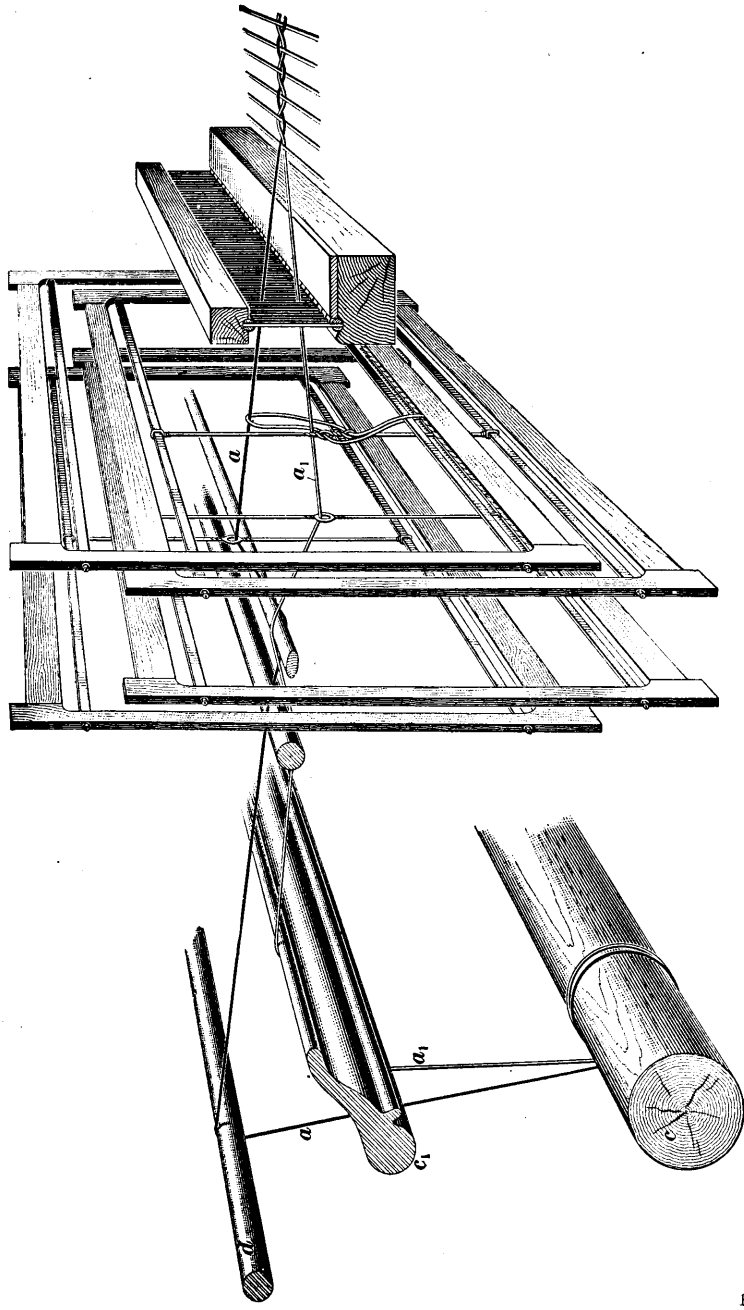


FIG. 13

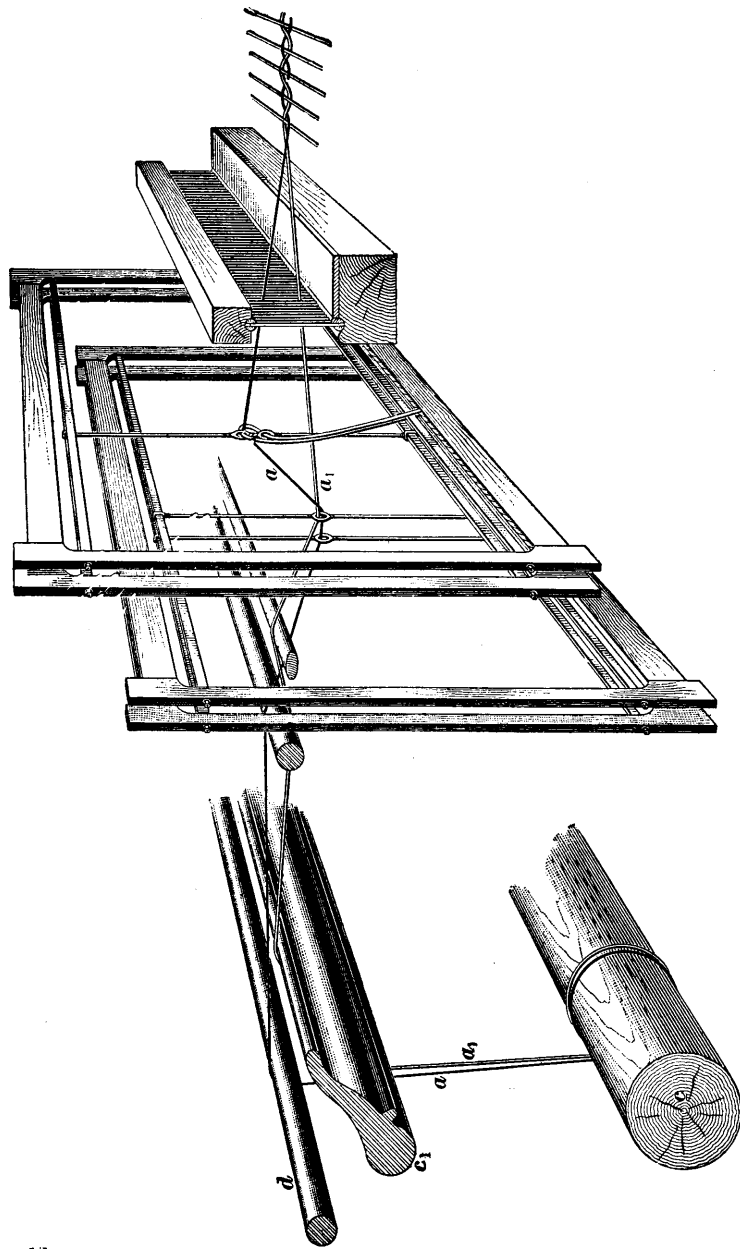


FIG. 12

the greater contraction of these ends due to their being pulled out of a straight line, but in a pure gauze consisting of but two ends, the contraction of both will be about equal; consequently, only one beam is necessary, although even in this case it is advisable to place the doup ends on a separate beam in order to reduce as much as possible the strain and wear on both the doups and the doup ends.

Figs. 13 and 14 illustrate two successive picks of a pure gauze weave, showing the beam, together with the whip roll and slackener rod, also the position of the slackener during both picks. In these figures, *c* is the beam from which the ground end *a*, passes over the whip roll *c*, and through the third harness. The doup end *a* passes from the beam *c* over the slackener rod *d*, through the back harness, and then through the doup. The lease rods are shown in these figures, but, as they do not affect the weave, they will not be considered.

In Fig. 13, the doup harness and the back harness, through which the doup end is drawn, are both raised, thus bringing the doup end up on the right of the ground end *a*, this being a right-hand doup. In this case the slackener rod *d* is some distance back, this being its ordinary position.

On the next pick, as shown in Fig. 14, the doup and standard are both raised, while the harness at the back, through which the doup end is drawn, remains down. In this case a longer length of the doup end is required, and, consequently, the slackener rod *d* is moved in, as shown in the illustration, thus permitting this operation of the harnesses to take place without any undue strain being brought to bear on the warp ends. The manner of thus bringing the slackener rod in closer to the loom was explained in connection with Fig. 12.

**15. The Harness Chain.**—Before building a harness chain that will produce a pure gauze weave, the following points should be considered: (1) When the doup harness is raised and the standard is lowered, the back harness, through which the doup end is drawn, must always be raised, in order

to bring up the doup end. (2) When the doup and standard are both raised, the back harness, through which the doup end is drawn, must always be lowered, in order to permit the crossing of the ends. (3) The harness through which the ground end is drawn is never raised. (4) When the doup and standard are both raised, the lever that actuates the slackener rod must always be lifted, in order to relieve the doup ends. It should be remembered that these points refer to a pure gauze weave on a close-shed dobby, using bottom doups. Exceptions to these will be noted later.

Fig. 15 shows the harness-chain draft that would be used to produce a pure gauze weave with the ends drawn in as shown in Figs. 13 and 14. Four picks of the weave are shown, although the weave repeats on 2 picks, since the third pick is exactly like the first and the fourth like the second. The picks are marked in their order, and it is clearly shown which harness each row of pegs operates. The filled-in squares represent levers raised and, consequently, harnesses and ends raised, while blanks represent levers, harnesses, and, consequently, ends lowered.

<i>1st Pick</i>	■						
<i>2d "</i>		■					■
<i>3d "</i>	■						■
<i>4th "</i>		■					■
	<i>Doup</i>	<i>Standard</i>			<i>Ground</i>	<i>Back</i>	<i>Slackener</i>

FIG. 15

By comparing the first and second picks of the harness chain, or Fig. 15 with Figs. 13 and 14, they will be found to correspond. In Fig. 13, the doup and back harnesses are raised, while the others are down; therefore, in Fig. 15, on the first pick, marks are placed in the squares representing the doup and back harnesses, while the others are left blank. In this instance the slackener is not raised; consequently, the lever of the dobby that actuates the lever of the slackener will remain down and the square will be left blank, as is the case in Fig. 15.

On the next pick, the doup and standard harnesses are raised, the other harnesses remaining down; consequently, in Fig. 15, on the second pick, marks are placed in the squares that correspond to the standard and doup harnesses, the others being left blank.

When the standard and doup harnesses are both raised, it is necessary also to raise the slackener; consequently, a mark is placed in the square that corresponds to the slackener for that pick. This completes the weave, since the third and fourth picks are simply repeats of the first and second. Thus, with Fig. 15 as a harness-chain draft, and with the ends drawn in the harnesses as shown in Figs. 13 and 14, a pure gauze cloth similar to Fig. 1 will be woven.

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#### TOP DOUPS

##### 16. Distinction Between Top and Bottom Doups.

Two methods of weaving with doup harnesses are in common use in producing leno fabrics. When the doup is placed at the bottom of the harness frame, similar to those previously illustrated, it is known as a **bottom doup**; frequently, however, it is placed at the top of the harness frame, in which case it is known as a **top doup**. When bottom doups are used, the cloth will be woven with the wrong side uppermost in the loom, the right side of the cloth being uppermost when top doups are used. This is only noticeable in lenos other than pure gauze, since both sides of this cloth are alike. Although bottom doups are in general use, the top doups possess some advantages, the principal ones being that the cloth is right side up when being woven and any defects in the weaving can easily be detected. Broken top doups are also much easier to repair than broken bottom doups.

When weaving a pure gauze cloth, bottom doups are almost always used, since both sides of the cloth are similar. In certain forms of leno, however, better results are obtained by using top doups, and, since a somewhat different arrangement must be adopted in these cases a short description of weaving with this method is given.

With bottom doups, it is possible to raise the doup harness without lifting the standard, but when the standard is raised, it is necessary also to raise the doup harness. With the **top doup**, however, this condition is reversed; that is,

the standard harness may be lifted without raising the doup harness, but it is not possible to raise the doup harness without at the same time lifting the standard harness. Again it will be noticed that with the bottom doup, the ground end was crossed over the doup end in being drawn through the harnesses, whereas in the case of the top doup, the ground end is crossed under the doup end.

When dealing with top doups it is necessary to keep in

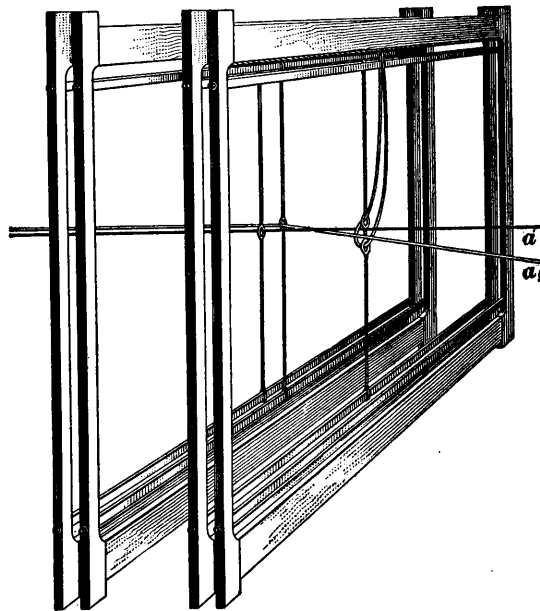


FIG. 16

mind the following important points, a pure gauze weave being understood in this case as well as in all former cases: (1) The ground end is lifted at each pick. (2) When the standard harness is lifted, the doup and back harnesses remain at the bottom. (3) When the doup and standard harnesses both remain down, the back harness through which the doup end is drawn, is lifted. (4) When the harnesses are lifted in the manner described in (3), the harness chain must always be pegged to work the slackener.

**17. Drawing In.**—Figs. 16, 17, and 18 give three views of a left-hand top-doup arrangement. The doup end is drawn through the fourth, or back, harness and passes through the loop of the doup harness, while the ground end passes to the right of the heddle of the back harness, crosses beneath the doup end, and then passes to the left of the standard heddle, these two ends being then drawn in the same dent.

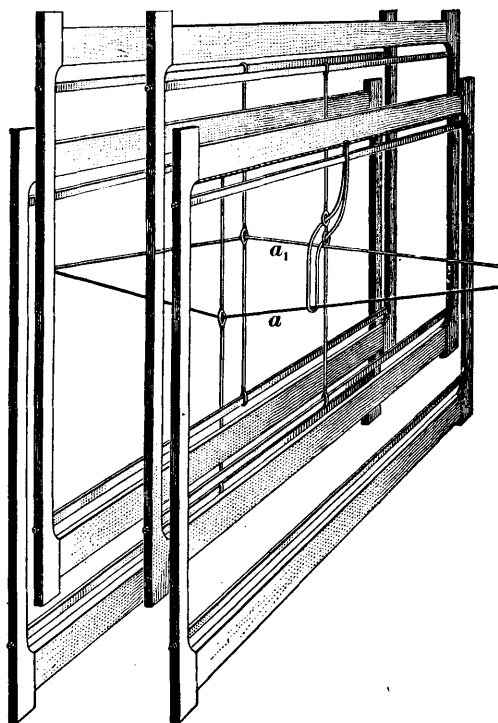


FIG. 17

Fig. 17 shows a view of the first pick of a gauze weave, top doups being used; in this instance the ground harness together with the standard is lifted, while the doup and back harnesses remain lowered. On the next pick, shown in Fig. 18, the back harness, together with the ground harness, is raised, while the doup and standard harnesses remain

down, thus making a crossing of the ends, as is shown in the illustration. On this last pick, the slackener rod should be brought in, thus relieving the yarn and permitting the crossing of the ends without any undue strain.

**18. The Harness Chain.**—Fig. 19 shows the harness-chain draft required to operate the harnesses in the manner

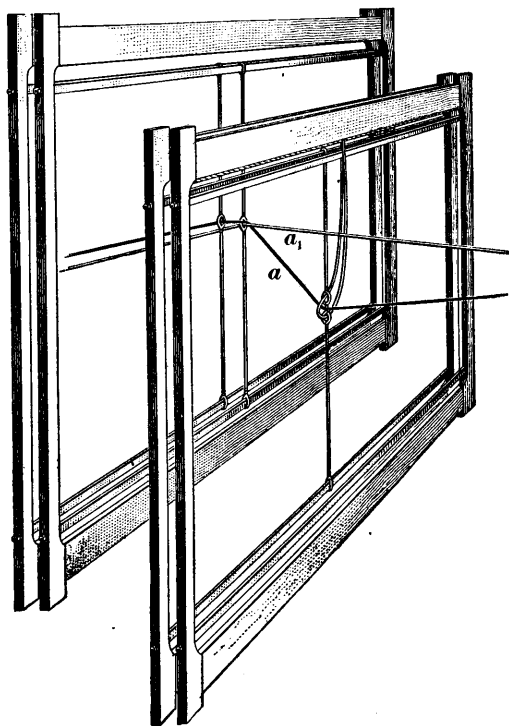


FIG. 18

shown in Figs. 17 and 18. With the harness chain built in this manner, the standard and ground harnesses will be lifted on the first pick, since the filled blanks represent harnesses lifted; this corresponds with Fig. 17, which represents the first pick of the weave. On the second pick, as shown in Fig. 19, the ground and back harnesses are lifted together with the lever operating the slackener; this corresponds to



Fig. 18, which shows the arrangement of the harnesses for the second pick.

By comparing Fig. 15, which shows the chain draft when using bottom doups, with Fig. 19, which is the chain draft for top doups, it will be noticed that the harnesses that are lifted on any pick in Fig. 15 are lowered on that pick in Fig. 19, the lowering and raising of the harnesses being exactly opposite to each other. The lever of the slackener, however, is lifted on the same pick in both cases, it being necessary thus to relieve the yarn whenever the crossing of the ends takes place.

<i>1st Pick</i>		■				■		
<i>2d "</i>						■		
<i>3d "</i>		■						
<i>4th "</i>						■		
		<i>Doup</i>	<i>Standard</i>			<i>Ground</i>	<i>Back</i>	<i>Slackener</i>

FIG. 19

#### SETTINGS

19. In all cases so far referred to, the references have been to harnesses operated by a single-lift dobby. It will not be out of place to make a few references to the timing and adjustment settings of the harnesses necessary to obtain good results when weaving a pure gauze fabric.

The lifting of every harness and also the slackener must be timed accurately in order that one may work in harmony with the other. The slackener must be lifted just high enough to let off the required amount of warp at the time of crossing and exactly on time with the standard and doup. The standard and doup must be kept well together in order to prevent the doup from doubling up into the warp, which is liable to result in the ends being broken in addition to producing bad shedding and rapidly wearing out the doups.

With bottom doups, the doups must be kept well down, a little below the eyes of the ordinary harnesses, while with the top doups, they should be a little higher than the eyes on the rest of the harnesses. When bottom doups are being used, they should not lift any higher than is absolutely necessary; otherwise, they will become entangled in the warp ends.

Care should be taken to have both the doup and standard harnesses level and so set that the loop will not be too tight nor too slack at the point where it passes through the heddle eyes on the standard harness.

If the harnesses are set so that the bottom doups lift higher than the standard when both are raised, the doups will be pulled through the eyes of the standard. On the other hand, if the harnesses are so set that the doup harness does not lift as high as the standard, there will be an undue strain on the doups, which will be very liable to result in their breaking.

Care should be taken that the slackener does not allow the doup ends to become looser than is necessary to prevent too great a strain being placed on the yarn.

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### LENO WEAVING ON DOUBLE-LIFT, OR OPEN-SHED, DOBBIES

**20.** In order that the ends of the warp may make a turn such as is required in weaving gauze, it is absolutely necessary that those ends that are to make the turn shall become level before the crossing takes place. When weaving gauze fabrics on a close-shed dobby, this of course does not need to be considered, since after each pick all the warp ends are brought level at the bottom shed. When, however, the cloth is to be woven on an open-shed dobby, this point becomes more important, since on this style of dobby only those ends are lowered from the top shed that are required to be at the bottom on the next pick, while only those ends are raised that were at the bottom and are required to form a part of the top shed on the next pick.

Thus, in weaving a pure gauze fabric on an open-shed dobby, there will be found this difficulty to overcome; namely, two sets of ends, one being at the top and the other at the bottom, which must be made to meet after each pick of filling is inserted and then resume their former positions. Moreover, this must be accomplished on a loom in which

only those ends are moved from the top and bottom sheds that are required to change their positions on that pick.

Formerly it was thought impossible to weave a pure gauze on an open-shed machine, and, in fact, the more complicated leno weaves will be found to weave better on a close-shed dobby; yet, during recent years, motions have been applied to the double-lift dobby by means of which very intricate patterns may be woven successfully on a loom with this kind of a shedding motion. In describing this mechanism, bottom doups will be understood as being used.

As previously stated, there are two sets of ends that must be dealt with when considering a gauze weave on an open-shed dobby, these being as follows: (1) The ends that are drawn through one of the back harnesses and known as the ground ends; these are the ends that are always under the filling. (2) The ends that are drawn through the doups and known as the doup ends; these are the ends that are always over the filling.

The manner in which these ends are operated on an open-shed dobby is to bring the ground ends from the bottom almost to the center of the shed and back again to the bottom while the doup ends are brought from the top to the center of the shed and back again to the top, this operation being performed in the same period of time that it takes an end to move from the bottom to the top shed or vice versa. With this arrangement, the crossing of the ends will take place when the ends are near the center of the shed instead of at the bottom as is the case in a single-lift dobby.

**21. The Jumper.**—Two mechanisms are applied to the double-lift dobby in order to accomplish this result, one of which operates the harness through which the ground ends are drawn, while the other operates the doup harness. The mechanism operating the ground harness is known as a **jumper**. Its object is to bring the ground ends from the bottom to the center of the shed, where the turn is made, and then to allow the harness again to resume its position at the bottom, this operation taking place in the same

length of time that it takes the dobbie to form the shed. There are several motions that will accomplish this object,

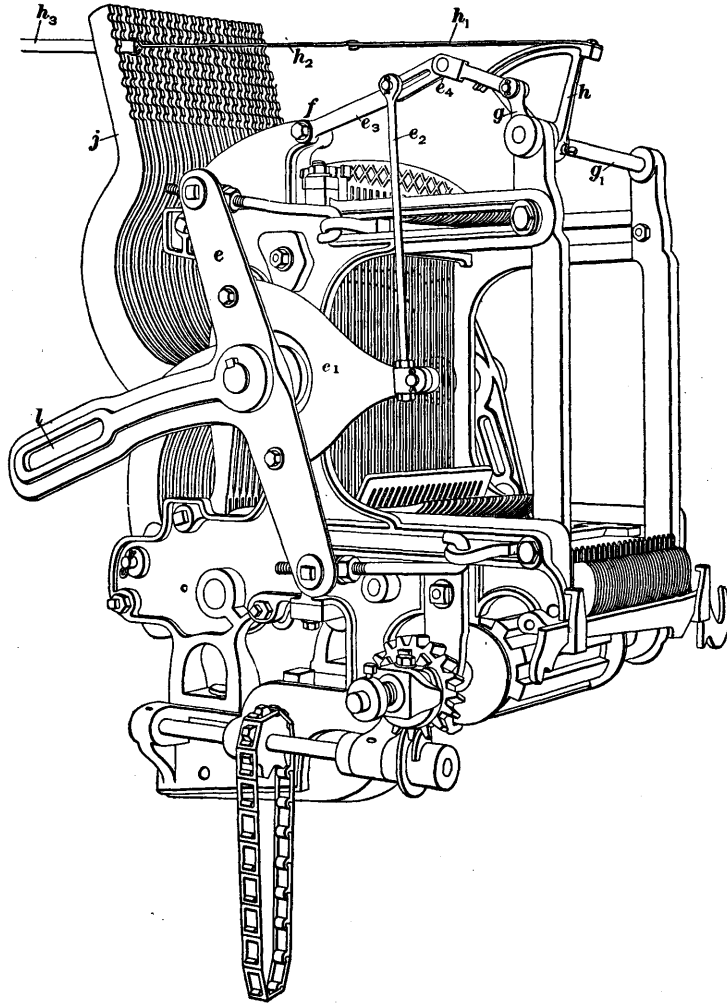


FIG. 20

one of which is described here. Fig. 20 is an illustration of a dobbie with a jumper arrangement attached, while Fig. 21

shows the jumper, together with the dobby lever to which the ground harness is attached.

Referring to these figures,  $e$  is the dobby rocker, to which is attached an arm  $e_1$ . Connected to this arm is a rod  $e_2$  that, at its other end, is connected to a togglejoint  $e_3$  hinged at  $e_4$ . This togglejoint is connected to the frame of the dobby at  $f$ , while at its other end it is connected to an arm  $g$  attached

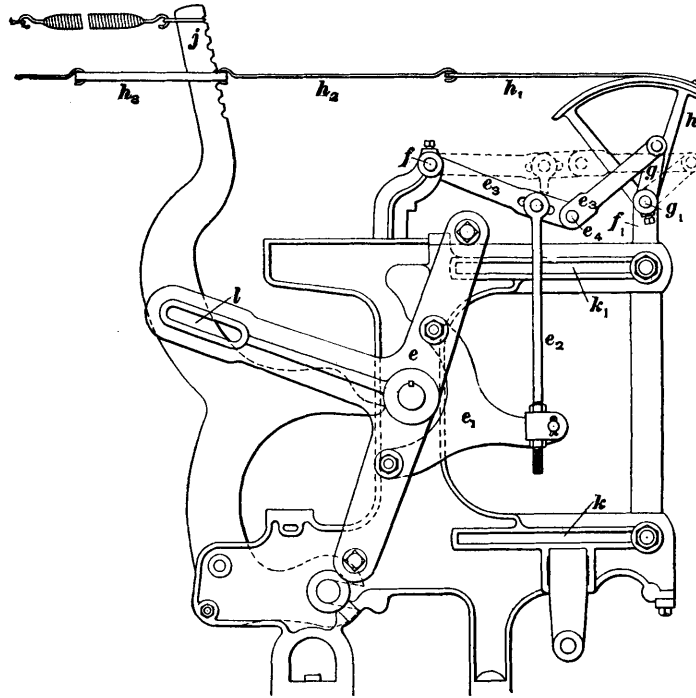


FIG. 21

to the shaft  $g_1$ . Fastened to this shaft, by means of a setscrew, is the segment  $h$ . Fastened to the top of the segment, by means of a screw, is a strap  $h_1$ , that is connected to a wire rod  $h_2$  attached to a loop  $h_3$ , through which the dobby lever  $j$  passes. The loop must be at least half as long as the depth of the shed formed by the dobby, although it may be longer than this distance without in any way

interfering with its proper action. When gauze is being woven, the dobbie lever does not act on the harness in any manner, but the segment, acting through the loop, performs the lifting of the harness, the slot in the loop allowing this to be done without interfering with the lever. Sometimes, as shown in Fig. 21, a spring is attached at one end to the dobbie lever  $j$  and to the upper part of the loom framing at the other end by means of a cord or strap. This keeps the dobbie lever in place when the jumper is in operation.

**22.** The action of the whole mechanism is as follows: Motion is given to the dobbie rocker  $e$  by means of a connecting-rod, which connects with the rocker at the point  $l$ , this motion being such that the top arm of the rocker will be out on one pick, while at the next pick the bottom arm of the rocker assumes the outward position. Motion will be imparted to the arm  $e_1$  in such a manner that it will move up and down, being up when the bottom knife is out and down when the top knife is out, the latter being the position shown in Fig. 21, while the former is the position shown in Fig. 20.

Starting with the position shown in Fig. 21, as the rocker is moved by the connecting-rod the arm  $e_1$  will be moved up, thereby pushing up the rod  $e_2$ , which in turn will act on the togglejoint  $e_3$ . This action will push the arm  $g$  outwards, since  $f$  is fixed. As the arm  $g$  is pushed out it will turn the shaft  $g_1$ , which motion being imparted to the segment  $h$  will cause the harness to be lifted.

When the rocker  $e$  has reached a vertical position, the rod  $e_2$ , togglejoint  $e_3$ , and arm  $g$  will assume the positions shown by the dotted lines, thus pushing back the segment  $h$  so that the harness will be lifted half the space of the shed. As the rod  $e_2$  continues to be lifted by the arm  $e_1$  it will push  $e_3$  still higher, but it should be noticed that after  $e_3$  has passed the central position, as shown by the dotted lines, instead of pushing the segment  $h$  from the loom, it commences to bring it to its former position until the harness is again at its lowest position. This position is shown in Fig. 20.

Following the action of these different parts on the next pick, or while the top knife is moving out, the segment  $h$  will receive the same motion, although in this instance the rod  $e$ , is moving down instead of up. Consequently, the ends drawn through the harness worked by the jumper will be lifted to the center of the shed and then lowered while one knife is moving out and the other in. In this manner the desired half lift is obtained for the ground ends.

**23. Weaving Plain Cloth.**—Reference has previously been made to the fact that it is possible to weave plain cloth with a gauze arrangement on a single-lift dobbie. It is also possible to weave plain cloth with doup and standard harnesses on a double-lift dobbie.

Referring again to Fig. 21, the lever  $j$  is in close contact with the forward part of the loop  $h$ . If it is desired to give to the harness its full lift, as would be required in weaving plain, it is only necessary to insert a peg in the pattern chain, which will give to the lever its full lift; the lever in rising will come in contact with the loop, thus raising the harness to the top of the shed.

In weaving a pure gauze fabric, however, the lever  $j$  is left out of consideration entirely, since the jumper gives to the harness all the motion that is required to produce the weave.

**24. The Yoke.**—It is necessary next to consider the motion by means of which the doup end is brought from the top to the center of the shed to meet the ground end and then returned. When weaving a true gauze the doup harness is raised on one pick without the standard, and on the next pick the doup and standard harnesses are raised together. This point should be continually borne in mind when considering the device applied to the standard and doup harnesses of a double-lift dobbie. Fig. 22 shows a view of this device, which is known as the yoke.

When weaving a true gauze fabric on a double-lift dobbie, the standard harness is attached to the second lever of the dobbie in the manner common to all regular harnesses. To the doup harness are attached the regular harness straps,

but these straps, instead of being attached to a loop that slips over the lever, are connected to a point  $u$ , on the yoke  $u$ , shown in Fig. 22. The hook  $u_1$  of the yoke fits into a notch in the first lever of the dobbie and the springs attached to the bottom of the harness keep it firmly in place.

To illustrate the action of the yoke, the position of the mechanism during two picks will be considered, the doup harness being raised without the standard on the first pick, while both the doup and the standard harnesses will be lifted on the second. On the first pick, the first lever of the dobbie will be lifted, which, catching in the hook  $u_1$ , will raise the doup harness. On this pick the second lever will be down, and, consequently, the standard harness will be lowered. On the second pick the harness chain will be pegged to lower the first lever and raise the second. The action of the yoke

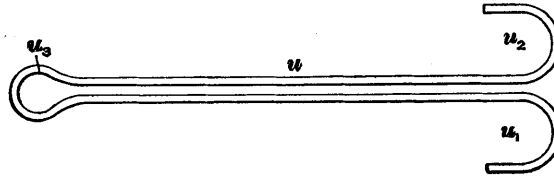


FIG. 22

during the lowering of the first harness and the lifting of the second should be carefully noted. As the first lever is dropping, the yoke and, consequently, the doup harness will drop with it, the springs on the bottom of the harness keeping the yoke firmly pressed against the dobbie lever. When, however, the first lever reaches the central part of its drop it will pass the second lever, which is rising and bringing up the standard harness. At this point the second lever will catch in the hook  $u_2$  of the yoke and thus carry the yoke back to the full lift of the lever, so that, although the first lever during this pick drops to its lowest point, the yoke and, consequently, the doup harness will only drop half way, when it is caught and carried back by the second lever. Thus, the doup harness, which was at the top, will drop half way, when it will meet and be carried back with the standard harness, which was down on the previous pick and is now being lifted.



This completes 2 picks of the weave, but, in order fully to understand the mechanism, its action for the next pick will be considered. The standard must be lowered on the next pick, while the doup harness must be dropped half the distance and then brought back again. In order to accomplish this, the pattern chain is pegged to raise the first lever and drop the second. The action of the levers for this pick will be found to be very similar to their action during the previous pick, with the exception that in this case it is the second lever that is dropping and the first rising. As the second lever is dropping, it will cause the standard and doup harnesses to be lowered, but when the second lever has reached a point that is half of its drop it will pass the first lever, which is rising. As these two levers pass each other, the first lever will catch in the hook  $u_1$  of the yoke and thus carry the yoke, together with the doup harness, back to its full lift, while the standard harness is dropped to its lowest point. Thus, during the time that the standard harness is being carried from its lowest to its highest position, the doup harness is being lowered from the top to the center of the shed and then carried back again, and also while the standard harness is being lowered from its highest to its lowest position, the doup harness is being brought to the center of the shed and then raised again. In both these cases, the doup harness will occupy the same length of time in changing that is taken by the standard harness in changing from one position to another.

By the use of the jumper and yoke the necessary motions are given to both the ground and doup ends; that is, the ground end is brought from the bottom to the center of the shed, while the doup end is brought from the top to the center of the shed. The turning of the ends around each other is made while they are at this central position and then they are returned to their original positions; that is, the ground end goes to the bottom, while the doup end goes to the top of the shed.

Since this movement of the separate ends occupies the same length of time that is required in forming the regular

shed, it is possible to run a double-lift dobby with leno motion attached at as high a rate of speed as is possible without the leno motion, although when weaving leno patterns it is better to reduce the speed of the loom somewhat. As was stated previously, some leno patterns are better woven on a close-shed machine, but these are only the more intricate ones, and in most cases the double-lift dobby with the leno motions attached will answer all purposes. A double-lift dobby can be converted into a single-lift dobby, as far as its operation is concerned, by changing the gearing so as to drive the lifting knives twice as fast, and pegging the pattern chain for one knife only. The other knife, doing no work, is counterbalanced by a number of springs.

One disadvantage of the jumper is its positive action; that is, the harness to which the jumper is attached is forced to rise half the space of the shed and then be lowered on each pick. In the case of leno weaves where a turn of the ends is not required at each pick, this is an unnecessary motion and, consequently, will put more strain on the ends drawn through that harness than is absolutely necessary. Numerous inventions have been made to raise the jumper harness only when required, but as yet none have proved practical.

**25. The Harness Chain.**—It is necessary in this connection to consider the method of pegging the harness chain for a leno cloth that is to be woven on a double-lift dobby with leno attachments such as have just been described. As in previous examples, the chain illustrated will be one that will give a pure gauze weave; that is, a weave in which a turning of the ends takes place after each pick. In this case, as well as in former instances, the several points in connection with leno weaving should be carefully noted; that is, that on one pick the doup and back harnesses will be up, while on the next pick the doup and standard harnesses will be raised and the back harness will be down; also, that when the doup and standard are both raised, the slackener must let the ends loose. In this case an additional motion is brought into use, namely, the jumper, but since this motion is automatic, it

needs no attention when making a harness chain; the hooks that actuate the jumper harness are generally tied up in such a manner that there will be no liability of their being caught by the knives.

Fig. 23 shows a harness-chain draft that will give the weave previously described. Although the weave is complete on 2 picks, 4 picks, or two repeats, are given. Each harness and also each pick is marked so that the workings may be readily understood. On the first pick, the first lever and the lever actuating the harness through which the doup end is drawn at the back are raised, thus bringing up the doup end. On the next pick, the lever operating the stand-

	Y		J		
1st Pick	■	■	■	■	■
2d "	■	■			■
3d "	■	■			■
4th "	■	■			■
	Doup	Standard	Ground	Back	Slackener

FIG. 23

ard harness, or the second lever, is raised while the first lever is lowered. This action of the levers will lower the doup harness half the space of the shed, when it will meet and be carried back with the standard harness. Thus, on this pick the doup and standard harnesses are raised while the back harness, through which the doup end is drawn, is

lowered. The slackener lever is also raised on this pick, thus letting the doup ends loose.

On the third pick, which is a repetition of the first, the first lever is raised and also the lever that works the harness carrying the doup end at the back. On this pick, the first lever in rising meets the lever actuating the standard harness, which is dropping, at a point half the distance of their rise and fall, and, as the first lever is passing the second, it catches and carries back the yoke and consequently the doup harness. In the chain draft shown in Fig. 23, the spaces corresponding to the ground harness are left blank, since the harness lever has nothing to do with the raising or lowering of this harness. The reference letter *Y* shows that the doup and standard harnesses are to be connected by a yoke, while *J* indicates that the ground harness is to be operated by a jumper.

### FIXING

**26.** When weaving gauze or leno fabrics, care should be taken in setting the different parts, as it is very essential in this class of work that all the separate motions are exactly adjusted and work in unison with one another.

**27. Regulating the Shed.**—The shed should be carefully regulated, since this governs, to a great extent, the quality of the product of the loom. When weaving lenos, as small a shed as possible should be used since considerable additional strain is put on the yarn due to the crossing of the ends, which takes place back of the reed. To further offset this strain, the slackener should be carefully set. In setting the slackener, see that the lever is lifted just high enough to allow the ends to receive the half turn without any additional strain. Care should be taken, however, that no more slack is let off than is absolutely necessary to relieve the ends. An important point to be noted in connection with the slackener is that it is not desired to relieve the doup ends until the crossing of the ends takes place, which occurs at the center of the shed; consequently, the harnesses can move half the space of the shed before it is necessary for the slackener to operate. If the strap that connects the dobbie lever to the slackener were tight, the slackener would commence to lift as soon as the harnesses. To prevent this, the strap is made slightly longer than is required to extend from the dobbie lever to the arm of the slackener, and any slack in the strap is taken up by the spring, as shown in Fig. 12. As the lever of the dobbie commences to lift, the spring will be extended until the slack in the strap is taken up, when the arm of the slackener will be raised. This is so regulated that the slackener will not commence to move in until the dobbie lever has moved through about half the distance it travels. When the slackener is not operating, the

rod  $d_1$  rests on a bracket  $d_2$ , thus preventing the spring on the strap  $d_4$  from being strained.

**28. The Yoke.**—The yoke should not be placed too high on the dobbie levers, since this will result in the doup harness being lifted too high and putting additional strain on both the ends and doups. They should be lifted just high enough to form the shed and no more.

**29. The Jumper.**—The principal point to be considered when setting the jumper is to see that it does not lift the harness any higher than the center of the shed and, on the other hand, does not drop it any lower than the rest of the harnesses forming the bottom shed. In setting this motion, place the different parts in the position shown in Fig. 21; then the connecting-rod  $e_1$  will be down and the segment  $h$  will be at its inner throw. When in this position, the connections with the ground harness should be tight and the outer end of the loop  $h_3$  just touching the harness lever, as shown in Fig. 21. This may be regulated by loosening the setscrew that fastens the segment to the shaft  $g_1$  and placing the segment in any desired position. When this has been set, turn the loom over until the connecting-rod  $e_2$  is at its highest position and see that the loop  $h_3$  in the strap is in the same position as when the connecting-rod  $e_2$  was at its lowest position. If it should not be the same, it may be regulated by the nuts shown at the bottom of the connecting-rod.

As previously stated, when the connecting-rod is at its lowest position and also when at its highest, the harness is down; but when the connecting-rod is half way between these two points, the harness is raised half the space of the shed.

If the lift that the segment imparts to the harness is not sufficient to raise the harness to the center of the shed, it may be regulated by moving the connecting-rod in the slot where it is joined to the togglejoint  $e_3$ . By moving the connecting-rod toward the dobbie levers, a greater lift is obtained and by moving the rod toward the segment, a shorter lift results.

**DIFFERENCE BETWEEN AMERICAN AND EUROPEAN  
METHODS**

**30.** The method of drawing in the ends that has been described, and which is universally adopted in America, differs somewhat from that used in other countries. In order to avoid confusion, all the descriptions that have been given apply to one standard method, but in Germany and some other countries, the method in which the ends are drawn in when weaving lenos is to have the doup end drawn through the third harness before passing through the doup, while the ground end is drawn through the fourth harness.

This is exactly the reverse of the American method, in which the doup end is drawn through the back harness and the ground end through the third harness. With this method, however, the same result is obtained, the only difference being that in one case the doup end has a little larger space between the two harnesses through which it is drawn, and, since it is this end that stands the strain of the crossing, it would appear that the more space given to it, the easier would be its action.

By referring to Fig. 6 the slight difference that would exist should *a* be drawn through the third harness and *a*, through the fourth will be readily noticed. It will also be seen that this would not in any way interfere with the crossing of the ends, provided of course that these 2 back harnesses are operated in such a manner as to meet the needs of the ends drawn through them.