# MASTER WEAVER

BI-MONTHLY BULLETIN FOR HANDWEAVERS


NOVEMBER 1953

FULFORD · QUEBEC · CANADA

# MASTER WEAVER

Z - H A N D I C R A F T S * F U L F O R D * Q U E B E C * C A N A D A *

November, 1953 No.12

F R O M T H E E D I T O R

We just came back from a rather long tour in the United States (which explains why this issue is rather late), and we wish to thank all our friends in Detroit, Chicago, Milwaukee, Urbana, Des Moines, Lincoln, Salt-Lake-City, Santa Barbara, Los Angeles, Carmel, San Francisco, and Sacramento for their wonderful hospitality, help, and cooperation.

We send them as well as all our friends in other parts of the world the very best wishes for the coming Christmas.

## CANNELÉ

In most weaving techniques the floats both of warp and weft lie reasonably straight and parallel to the direction of either warp or weft. Small distortions can be noticed in such weaves as overshot, M's-and-O's, spot lace, etc. For instance in overshot two floats skipping an even number of warp ends will not be parallel to each other, if separated by one tabby shot. This is because at one end they will come under the same float of warp, when at the other they will be under two separate floats (fig.1).

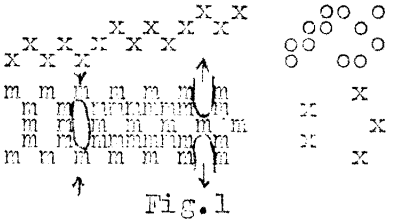

Fig.1

This effect is usually of no importance, and often not desirable. But it can be exagerated to the point when the floats form such a large angle with the direction in which they "should" go, that they produce series of elongated diamonds. The final effect is of pattern weft going not horizontally across the fabric but following a diagonal more or less steep.

We shall describe here a weave based on this principle. It has no name in handweaving, consequently we have adopted its French name: Cannelé - literally: ribbed, fluted. In industrial weaving it is done mostly with pattern floats in the warp, and belongs to the "distorted warp" family.

Fig.2 shows an example of a draft. The ends threaded on frames 1 and 4 form short floats in warp . Their role is to pull the pattern weft (treadle 3) alternately in two directions. The pattern weft on the draw down is straight, but actually it will always try to move toward the center of the warp floats (F) where it has more space than in the corners. The fabric will look more or less as in fig.3. The tie-up A is for sinking shed (counterbalanced looms) and B for rising shed. This is not important in most cases, but weaving Cannelé we rather like to see the pattern weft, which is all on one side.

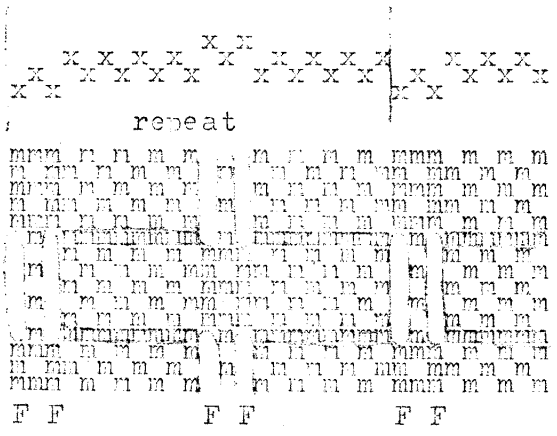


Fig.2

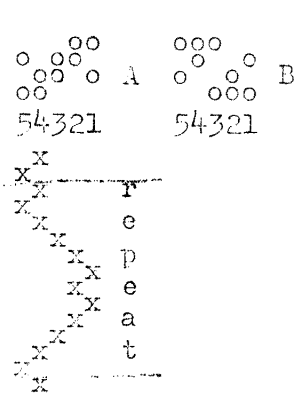


Fig.3

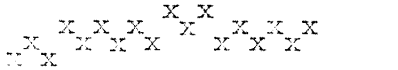

Fig.4

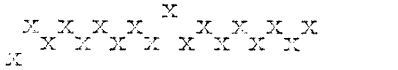

Fig.5

The length of floats in weft depends on the distance between the floats in warp (F). In our example this distance is of 8 ends. If shorter and comparatively steeper floats are wanted, the draft may look as in fig.4. Then instead of 2 we may have only one float in warp as in fig.5.

In treadling the number of times the treadles 5 and 4, and then 1 and 2 are used depends mostly on the kind of yarn we select for the pattern weft. The heavier this yarn, the longer should be the floats in warp (fig.3). A complete draft for a sample in Cannelé is shown in fig.6. The draft is unbalanced, otherwise the heavy pattern weft would pull out from under the floats in warp on one side of the fabric. In our case, should this happen, all we have to do is to change the direction in which we throw the shuttle. The tie-up and treadling is the same as in fig.2. The warp can be made of 10/2 cotton set at 24 ends per inch. The ground weft (used with treadles 1,2,4, and 5) may be the same as warp. For the pattern weft we can try candlewick, fine commercial chenille, silk cord, or even silk ribbon 1/8 to 3/16" wide. Bouclé gives rather poor results.

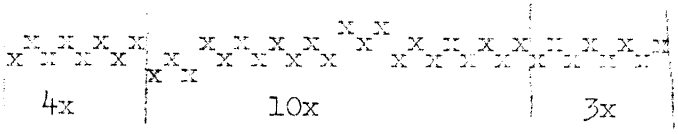


Fig.6.

There is nothing special about weaving cannelé. The beating should be rather hard. The pattern weft should be left in the shed quite free, without any tension, otherwise it will run much straighter than desirable.

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# SKILL IN HANDWEAVING

One can learn the theory of weaving from books, or even by correspondence and become quite an expert in this line. But it is not so easy to become a skilled craftsman in the same way. The practical side of weaving is composed of so many elements besides the personal factors of the weaver that it is rather difficult to discuss the whole problem on paper. However this is exactly what we shall try to do.

First of all let us give a definition of skill. It is an ability to perform different weaving operations with a minimum of effort. This implies speed in certain cases, but is not speed only. Anybody can increase the efficiency of his work by increasing the effort, but a skilful worker will have a higher than average speed with a lower than average effort. This is of course on the understanding that the quality of the finished work will be the same in each case. What actually happens is that the work performed at higher speed is of a better quality than the one done more slowly.

There are three reasons why high degree of skill is desirable in our work:

First, that the amount of satisfaction one can get out of a trade or hobby depends entirely on one's confidence in his own resources. One must be aware of his own skill to enjoy work, which otherwise becomes a source of frustration.

The second reason is that the quality fo work, as we stated above, depends on skill, and cannot be duplicated by slow and deliberate processes. Good fabric must be woven at a certain speed.

The third reason is that many hand weavers sell their weaving. Here the importance of efficiency in weaving is obvious. The labour is the most important item in figuring out prices for woven articles. It is seldom less than 40% of the wholesale price. Consequently the faster the weaving, the less time wasted in preparing the warp and setting up the loom, the more reasonable will be our prices, and the more chance we shall have to sell our products. But here the speed cannot be achieved by an increase in effort, or we could not maintain the speed for any length of time - the skill is the only answer.

Then how to acquire this skill?

There is such a thing as an inborn ability to work fast without getting tired, and there is an inborn or acquired inability to do so. We cannot deal here with this side of the problem - it belongs rather to the field of psychiatry. But given an average ability to work, and dexterity, there is still a lot to learn from other weavers' experience and from one's own mistakes.

We shall follow now all weaving operations from the beginning to the end, and at each stage point out the most common sources of wasting time and energy, as well as the proper techniques.

Planning. A warp should be as long as possible - short warps mean loss of time and of the yarn. This can be done in several ways: avoid small orders, or when accepting one make at the same time more articles on the same warp to be kept in stock, or group several small projects on one warp.

Avoid weaving with too many shuttles. Whenever possible "turn" the draft so that the colours or different yarns are in the warp.

For instance if we have to weave rather a long piece in Summer-and-Winter, it will be more reasonable to spend more time on warping and setting up the loom, than to weave with two shuttles all the time. After turning, the draft will require 6 frames, and two yarns in the warp, but only 4 treadles, and only one shuttle.

The tie-up should be always made so that the feet work alternately (see "Logic of Tie-Ups" H.W.3).

Avoid all techniques for which you have no proper equipment; do not use unbalanced tie-ups on c.b. looms without shed regulator, do not try cross weaves (leno) on jack-type looms, pile weaves with loops in weft, etc. And in connection with this - avoid pick-up of any kind. Use more heddle-frames, or a pattern harness (H.W.7). The only case when pick-up is justified is free weaving, tapestries etc.

Selection of yarns. Efficient weaving is hardly possible with unsuitable yarns. We may occasionally take pride in weaving with poor quality and consequently difficult yarns, but making it a habit is a great mistake. The warp ends should not break during weaving. If they keep doing so, and if neither the loom not the weaver are responsible, the yarn should be rejected - it may be still good for weft. The yarn for weft on the other hand should not make loops either at the edges or anywhere else - this usually indicates too hard a twist. In some cases the yarn is too springy and may be softened (see "How not to weave linen" H.W.1).

Warping equipment. Probably nothing is more frustrating for a beginner as well as for an experienced weaver - than poor equipment, and unfortunately poor equipment is rather rule than exception in hand weaving. In warping we may have a choice of either a warping frame, a horizontal warping reel, and a warping mill. The first for short warps, the other two for longer ones.

A good warping frame should be strong and permanently fixed to the wall, if possible - in front of the loom. It should not be very large: it is worthless if the weaver has to walk to reach both sides of the frame. The spaces between the pegs must be wide enough for a hand to pass freely. There should be two sets of pegs for making the crosses - one at each end.

A warping reel is very useful for longer warps provided that it is a horizontal one, or at least that it can be easily converted from vertical into horizontal. It should be very strong, since it is subjected to very high stresses.

Warping mill of the type described in the 8th and 9th issue of H.W. is the best of all. Not only it makes a very good warp in a very short time, but the beaming is done directly from the mill without any helper.

Sectional warping in most cases is completely unsatisfactory, regardless of the equipment used. The two exceptions are: very long warps, and warps with many colours used irregularly, or in long repeats. Otherwise if the weaver cannot find a helper for beaming, the warping mill is a much better solution.

Warping and Beaming. To illustrate how much time can be wasted in these two operations we may quote from M.Atwater "Shuttle craft Book", where she writes that with some weavers, making a warp takes "several days with the help of at least two other persons". It is not an exageration, there are weavers not only here but even in Scandinavia who do their warping and beaming in such a wasteful way. Actually it takes less than one hour to make a small warp, and to beam it (300 ends, 15 yds). It will take several times as long

with sectional equipment if the winding of bobbins is counted, and still longer with a vertical warping reel.

In our opinion the following methods of warping are the most economical.

1. Warping Frame. Warp from two tubes or cones. Make a cross at each end - it is not necessary to cross singly. Or warp from more than two tubes using a paddle to get single cross at one end of the warp. Use very little tension in warping. When the warp is finished pass the lease rods through one of the crosses (if one is crossed singly and the other in groups of ends, use the second one). The lease rods should be tied together permanently on one end. After the rods are inserted in the cross the free ends are tied too, thus securing the lease.

Now we measure the length of warp necessary for the lease-rods to reach the back of the loom, and tie the rest to the warping frame. Then the portion of warp from the lease rods to the tie on the frame is slid off the pegs, and the lease rods tied to the loom frame between the slabstock and the harness. The latter should be lowered previously, or in case of a narrow warp it may remain in place with the heddles pushed as far away from the center as possible.

When the lease rods are in place we fasten the raddle on the slabstock (use open raddle, never a reed), spread the warp, and lace it to the apron either directly or over an additional steel rod. Now we remove the lease rods from the first cross, beam the warp with a helper, and insert the lease rods into the second cross. Use paper to separate the layers of warp when beaming. The best is either building paper, or wrapping paper on a roll.

2. Warping reel. Make the warp very carefully without piling the ends, and with very little tension. Again either 2 tubes or a larger number with a paddle can be used. Eight is a very good number. Then place the reel in front of the loom, and beam exactly as in case of warping frame. Never chain the warp. Each stage of beaming should be done without combing the warp - it is not necessary if the warp was properly made.

3. Warping mill. We described the warping and beaming methods in 8th and 9th M.W.

In all three methods we can warp either from 2 or from a larger number of tubes or cones. Since making of single crosses at one end of the warp takes time, and since this time is the same for 4, 6 or 8 tubes, it is advisable to use the largest possible number of ends warped at the same time. However if we have for instance only 4 tubes, it won't pay to re-wind them on smaller ones to get 8 in all - the time gained in warping will be lost in winding. When we have 8 tubes of yarn we use all eight, but if we have less than that, we warp from only two at a time, without making single crosses.

The tension during beaming is not very important if we use heavy paper to separate the layers of warp. It can be always increased after the warp is threaded and tied-in, simply by turning the warp beam until the desired tension is reached.

Threading. It seems that there is not much difference in speed between many methods of threading and sleying. This depends much more on the weaver, than on the method. Some weavers achieve remarkable results. The average for both operations together should be somewhere around 400 ends per hour, but it depends a lot from the draft and the number of frames.

Where many weaver waste time is not the threading itself but the correcting of mistakes, particularly rethreading of a part of the warp. This can be avoided completely by the following method.

First of all we do the threading and sleying at the same time, with a slightly longer hook than usual, and without helper. The best posture for this method is to sit sidewise quite close to the frames, actually leaning on them with the left arm over and selecting the ends from the cross, when the right hand pulls the hook.

Before the threading we prepare a paper tape about ½" wide, and place it on the batten so that it touches the reed with its upper edge. It can be glued or pinned to the batten. On this tape we mark with a pencil all the repeats of the draft, making the marks right opposite the blades of the reed. For instance if we thread a 10 x 10 huckaback, and the sleying is 2 per dent, the distance between two marks is 5 dents. If the repeats are very long it is better to subdivide them, marking the subdivisions both on the tape, and on the threading draft. When during threading we come to the end of a repeat, the threading should coincide with the mark on the tape. If it does, there is no need to check - the probability of making two mistakes in the same repeat: one in threading and the other in sleying so that they would cancel each other is negligible, and even then the rethreading would not be necessary. When however the mark does not correspond to the end of the draft, we have to check - but only the last repeat. Thus we have eliminated two operations (one of separate sleying, and one of checking), and we can be quite sure that no matter what other mistakes we made, we won't have to re-thread the loom.

Tying-in. Many weavers waste time by tying-in first, and then correcting the tension of the warp, which means re-tying the strands of warp. This may go on for quite a long time. There are two methods which give an even tension without re-tying. One consists on lacing the warp to the apron with a continuous cord which slides through the strands of warp, and it is rather well known. The other has two stages: first the warp is tied to the rod in the apron with only half of a knot (half-hitch), then the tension increased by turning the cloth beam until all knots will start slipping. In the second stage the tension is released and the second half of the knot made.

Weaving Equipment. We have already discussed looms at a certain length (The Best Loom, H.W.5) and we have said a few words about shuttles (H.W.9). But the question of selecting a good loom for a particular purpose is not limited to the type of the loom. The type may be all what is required, but still the loom may be of a very poor quality. Loom of a definite type may be still too high, or too low, too heavy or too light, tooweak, too slow, or too difficult in operation. It would be a good lesson for all loom constructors if the customers insisted on a demonstration, before buying a loom. For instance it is a fact that a four frame loom should give on a narrow warp a speed of 60 picks per minute, and this speed should be maintained for a few hours without too much strain on the weaver, should not result in broken ends, or scobbs.

Many sincere weavers live under the delusion that they are poor craftsmen, because they cannot achieve not only any considerable speed in weaving but not even a good rythm of movements. In most cases it is the loom which is responsible, and not the weaver.

Granted that nearly all (but not all) looms on the market are good enough to make samples at a very low speed, but there are very few which are of any use whatsoever for production. By production we

do not mean the 18th century industrial weaving when the requirements were really high, and a loom built for wool would be never used for linen and vice versa, but just plain weaving which may go for hours at a speed from 40 to 60 picks per minute.

Then the first condition of acquiring higher skill in weaving is to find a loom which would work. One of the reasons why there are so many poorly designed looms on the market is that too many weavers have completely false ideas about the possibilities of a loom. They would like to have a good loom, but since they have a small appartment they would like it to become invisible when not in use, and at the same time it should be light and small enough to be taken in a car. Why, there was a constructor in Montreal, who produced a loom to be used in a crowded street-car.

What would we think about a driver who would agree to pay for a car on the condition that he could keep it under his bed, but otherwise would expect it to perform like all other cars? We take it for granted that a car requires storage space, even heated space at that. Why not a loom then?

A good loom cannot be either light or small. It could be light if made of metal but then it would have to be bolted to the floor. We must decide that if we like weaving, we have to find space for it. And if we want to take a loom in the car, it must be a special one good only for making samples and experimenting.

Too many looms on the market are an unhappy compromise between the different requirements. Thus they are too heavy to be taken with you on vacations, but too light for any serious weaving, too small for comfort, but too large for the size of the apartment anyhow.

Now, if we are ready to get a real loom, what to look for? First of all it must be strong, then not folding or collapsible type. Not a table loom good only for samples, or occupational therapy. It must be heavy not only because of the strength, but because its weight must resist the shock of beating - otherwise it will travel all over the apartment. It must be large, so that we can sit comfortably with enough space for the legs. The knees should not touch the cloth beam, but at the same time, but at the same time we shouldbe able to reach the batten without bending the whole body. The treadles should be wide enough to press only one at a time without touching the other ones. Then there should be a sufficient number of them, at least two more than the number of the frames. So called direct tie-up (number of frames equal to the number of treadles) can be tolerated only in looms used for demonstration and experiments. The shedding motion (movement of the frames) should be easy and light, but still all sheds should open fully regardless of the tie-up and warp used. Particularly the lower part of the shed should be completely smooth, otherwise there is not much hope for fast weaving.

The frames go with the loom, so we can only hope for the best. They should be easily lowered down for beaming, or entirely removable without untying any cords. If there is any upper tie-up (jacks, rollers, pulleys, horses) it must be adjustable, and so of course must be the lower tie-up (between the lamms and the treadles).

The heddles are largely a matter of taste. Probably the best are good quality wire heddles, the flat-steel ones sometimes cut the yarn, particularly with close setts of the warp. Cord heddles are very good, and if one works with yarns of extreme count (one way or the other) they are the only ones.

The batten should be adjustable in all directions, and what is more - its weight should be adjustable, or we should have two or three

battens for each loom. This revolutionary idea was a common knowledge in the 18th century. The weight of the batten should be directly proportional to the width of the warp, otherwise we cannot produce the same fabric in different widths.

We already have said all there is to be said about the shuttles (H.W.9). We can add that there are very few on the market which are any good. Incidentally what we did not say about shuttle-races is that they should be of the same length as the width of the warp. Otherwise the shuttle cannot be properly thrown, or caught. This implies a set of shuttle-races easily exchanged. Otherwise the shuttle race may be used only in connection with flying shuttle.

We spoke about bobbins and quills when discussing selvedges (H.W.6), and shuttles (H.W.9). There is little to be said about other accessories such as bobbin winders, templets, doubling stands, and special attachments.

Weaving. By weaving we understand the action of throwing and catching the shuttle, beating, and changing the shed. This is in other words the "rhythm of weaving". These operations are the most difficult to describe since they happen in a fraction of a second, and still the order in which they happen is of the utmost importance.

We shall first describe these operations, and discuss their coordination later on.

Throwing the shuttle. The shuttle is held between the thumb from above and the middle finger from below, the index slightly touching the point. The ring finger may help the middle one, particularly with heavy shuttles. The little finger holds the weft when a new bobbin is started, or when making fringe. In the moment of throwing, which is done with the whole hand, the index is the last to leave the shuttle and gives it the proper direction. The shutlle should not be sent into the shed by a short, jerky motion, but by a swing of the hand starting about 12 inches from the shed.

Catching the shuttle. When catching, only the thumb and the middle finger are working. The index must find its proper position before the next shot. The shuttle should not be stopped when it emerges from the shed but is carried away from it with a decreasing speed. One should not exagerate and pull the shuttle too far away; just enough to keep out of the way of the coming batten, so that at the end of its travel the shuttle is in the right position for the way back.

Beating. Try to beat fast, but not hard. There is a difference. Grasp the center (!) of the batten lightly and pull it forward as fast as possible. Let the weight of the batten do the work. Do not press it to the cloth - it is a completely useless effort. One stroke of the batten at the proper time is quite sufficient. If more than one are necessary it means that the batten in too light, and that it should be changed or weighted.

The batten returns to its original position immediately after touching the cloth. It has then the natural tendency to return on the rebound, and hardly any effort is necessary to push it away.

Changing the shed. The movement of the frames up and down should be fluid and not jerky. The tie-up should be made so that the treadles touch the floor, when the shed is fully open. This protects the warp against unnecessary strain and friction. Incidentally it protects the weaver too from overexertion. If the construction of the loom prevents the treadles to go down all the way to the floor, a piece of wood should be placed under the treadles. The best way of changing

the shed is to slide the feet on the treadles - it requires the least effort. Thus when the right foot moves forward, the left slides backwards at the same time. The shed must be fully opened only in the moment of throwing the shuttle, so there is plenty of time to change it gently.

Coordination. The normal order of weaving is as follows: the shed is fully opened, the shuttle thrown e.g. from the right and caught by the left hand. Right after this the right hand is on the batten and starts pulling it forwards, when one foot slides backwards and the other forwards on the next treadle to be used, thus closing the shed. The shed is closed in the moment when the batten touches the cloth. The batten returns and the feet continue to move until the shed is opened again. Now the left hand throws the shuttle and the right one cathes it. The left hand after throwing goes on the batten and starts moving it forwards. The shed is changed again in the moment of beating and the cycle starts all over again.

This order may be slightly changed in special circumstances (compare Selvedges H.W.G) i.e. that the beating may come a fraction of a second before or after the shed is changed. It is completely different only in such weaves as basket, some variations of swivel, and certain bound weaves (shed changed much before beating).

The weaving should not go on for more than about two inches. Then the warp is moved forward, and the weaving resumed. It may seem that moving the warp so often is a waste of time, but it is essential for the quality of weaving to work more or less at the same distance from the harness. Besides this, it is difficult to maintain good rhythm when the length of strokes of the batten changes by several inches.

From the point of view of efficiency as well as of quality of weaving, it is advisable to weave without stopping for a few hours. It takes about one half of an hour to reach the top speed, and to fall into rhythm. Then it can be maintained easily for quite a long time. Interruptions slow down the work.

Long as this article is, we realise that we did not go into all the details connected with the problem of efficient weaving, but at least we have discussed the most important points.

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# DOUBLE TIE-UP LOOM

Here is the list of parts and materials needed for the construction of the loom:

1. About 60 running feet of 2"x3" lumber dressed on all sides. What kind of wood to use, depends very much on local conditions. If you can get a really dry, seasoned (not kiln-dried), straight grained hardwood, it will be the best choice. If not kiln-dried soft pine will be better, than doubtful hardwood. Pine does not warp easily unless it is knotty.
2. About 50 feet of 1½"x2" in very light wood for treadles.
3. About 75 feet of ½"x1½" in light wood for heddle-frames.
4. About 15 feet of 2"x2" hardwood for the batten.
5. About 75' of 3/8"x1½" hardwood for the lamms.

The batten, lamms and levers must be made of hardwood. One should take particular care in selecting the best wood available for the lamms. They are rather thin and must remain straight.

6. 2 pieces of round wood about 4" in diameter and 45" long for the warp and cloth beams. There are weaving loom manufacturers who sell ready made beams at a reasonable price.
7. 3 dz of 5/16 carriage bolts, most of them 2½" long.
8. 42 pulley wheels, 2" outside diameter, ½" hole, 3/8" thick.
9. 10 feet of round steel rod, ½" diameter.
10. 30 feet of flat steel 3/8"x3/32" or thereabout.
11. 22 dz small screw-eyes.
12. 10 dz small snap locks.
13. Up to 300 feet tie-up cord.
14. Assorted wood screws etc.

These are of course approximate quantities. The exact amount, particularly of lumber can be figured out only when detailed plans of the loom are made.

To arrive at definite dimensions we start with enlarging the drawing in the last issue of H.W. (fig.2, page 12) about 3.4 times on a piece of graph paper with 10 or better 12 divisions per inch. In the first case 20 divisions will be equal to one foot, in the second - two divisions = one inch. Then we correct the dimensions according to our own requirments. For instance the height of the breast beam is of 30" but it may be too high for many weavers and should be changed accordingly. If we are not too sure we can compare the dimendions with other looms. Particularly important are: the distance from the breast beam to the first heddle-frame, the size and position of the batten, the length and distribution of the treadles, and finally the height of the bench. In our case the bench must be longer than the width of the loom.

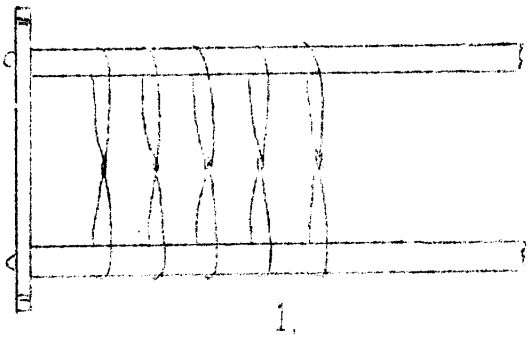
At this stage we must decide upon the number of heddle-frames (better not more than 10), and the width of the loom, or rather of the widest fabric woven. Unless we have very good wood for the lamms, it is better not to attempt a larger loom than 36 inches.

In a similar way we should make a drawing of the front of the loom, on the same scale. From both these drawings we get the exact size of any part of the loom.

We measure first all parts of the loom frame, i.e. all the parts which do not move. Cut the lumber accordingly, drill holes for bolts, etc. Then sandpaper the lumber on all sides, and rub it with linseed oil. This is because other-wise the wood gets dirty during

the assembling, and cannot be cleaned easily unless it is protected by oil. The loom frame should be assembled before other parts of the loom are ready, first to check that there are no mistakes in the frame parts and second to be able to fit into it all moving parts. Of course for the final assembling the frame must be at least partly dismantled.

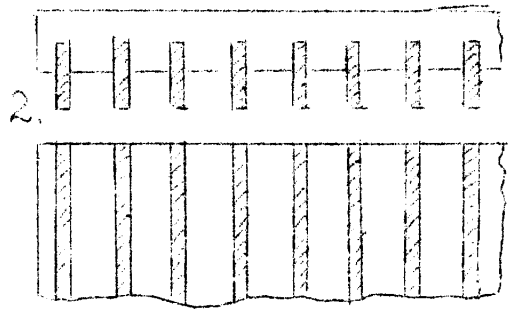
Now we can proceed with other parts. We start with frames. The total height of the heddle-frames should be not less than 14", and the heddles (string heddles of course) are strung directly on the frame, to avoid any loss of space inside of the frame. The two wooden shafts are connected with flat steel sides (fig.1). One of these sides must be attached to the shafts on small bolts so as to be easily removed. The frames are hung on these steel sides, and the sinking lamms are attached to the lower ends of the sides also.



1.

The levers oscillating on the central shaft (fig.1, page 12, M.W.11) are about 14" long. They have a $\frac{1}{2}$" hole in the center through which passes a $\frac{1}{2}$" steel shaft resting on two transversal beams. The same beams support at each end similar shafts for pulley wheels. Both pulleys and levers are spaced on the shaft with $\frac{1}{2}$" washers.

The lamms are slightly longer than the heddle-frames. There are 2 of them for each frame. One hangs directly under the frame, the other right beside it from the cords going around the pulleys to the levers. They may hang quite freely, but it may be better, to prevent their tangling, or striking the loom frame to provide some sort of guiding device (fig.2) fixed to the sides of the loom. The thin hardwood guides can be easily cut on a power saw.



2.

The treadles have a $\frac{1}{2}$" hole on one end, and they are all attached to the loom frame by a $\frac{1}{2}$" steel shaft passing through these holes, and fixed to the loom at both ends and in the center. The ties for the lower tie-up pass through small vertical holes in the treadles. They have snap locks at the upper end, and an adjustable knot at the lower - below the treadle.

The lamms have rows of screw-eyes directly above the treadles. The tie-up is made by attaching the snap locks on the ties either to the rising lamm or to the sinking one.

The cloth and warp beams have both friction brakes. We shall describe those in the coming issue of M.W. To release the warp beam we use a hand lever on the left hand side of the loom, and to turn the cloth beam - a similar lever on the right hand side.

The final assembling starts with both beams. Then the frames are hung, the lamms attached to the frames and levers. The longest part of it is the adjustment of some 60 cords in the upper tie-up and 120 in the lower. However this adjustment is made only once, and does not need to be repeated unless the cords stretch.

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## INDEX OF ARTICLES IN THE FIRST 12 ISSUES OF THE "MASTER WEAVER"



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