THE MANAGEMENT OF POWER-LOOM FACTORY

FOR USE AT

TEXTILE TRAINING CENTRE

OVERSEAS TECHNICAL COOPERATION AGENCY

The Management of Power-Loom Factory

I. Power-Its Transmission, Allocation, Installation and Operation

II. Revolution Frequency, Horse Power and Production of Power-Looms

III. Flaws and Damages in Weaving

The Management of Power-Loom Factory

I. Power - its transmission, allocation, installation and operation.

1. Power Transmission

Power looms are generally classified into two: a single-type loom operates singly independent of others having a small horse-powered motor of its own, whilst collective-type looms operate cojointly with power which comes from the common source - a big horse-powered motor - and which is transmitted to them through transmission system having shafts, pulleys, etc.

(1) Power transmission system for a single-type loom.

A motor can be installed either on the loom or on the floor. Motor revolution itself can be conveyed by belts to crank spindle or by media of gears.

Fig. 1 shows an example of transmission system applied to a comparatively small horse-powered loom. A motor (M) is installed on the floor in the rear of the loom. The motor pulley (r) and the loom pulley (R) are connected by the leather belt or V-type rope belt. This is the most-widely employed system.

It has springs, S and S, as well as nuts, a and b which combine to enable the belt attached to the motor M to keep itself an optimum level of tension with F as point of support. By this device no appreciable shocks are conveyed to the system that may be caused by the abrupt stopping of the loom.

A heavier type of loom employs sometimes gears or friction clutches in place of belts, but in all cases arrangements are made thereby to prevent such shocks from being transferred to the motors.

Points in which single-type operation excels comparing with collective-type are listed hereunder:

A. Reliability of operation. A motor for use of single-type is so fabricated as to ensure complete start-up by its excellent efficiency of revolution at the start, with the results that the initial shuttle motion is actuated smoothly and there is no fear of shuttles being stopped abruptly in the passage. There will be no border line marked on the cloth in the first stage of weaving.

B. The location of a loom could be altered freely, for in the installation it is not necessary to consider about shaft pulleys for transmission purposes, pillars and the like.

C. In case a motor is out of order, the only one loom connected therewith that is involved in this trouble.

D. There being no shaft, belt, etc. overhead, it is possible to arrange the improvement of lighting, with a minimum of danger at the same time.

E. A factory-building becomes easier as transmission shaft, bearings, pulleys, etc. need not be provided in the premises.

F. In the case of collective operation, power is transmitted as far as even to the loose-pulleys for some of the looms that have been stopped operation: whilst in case of single operation, when a loom stops operation, the motor stops simultaneously, causing no wastage in power consumption.

On the other hand, demerits of single operation are as under:

a. A great amount of investment is required in providing motors, switches, wiring, etc.

b. Motors less than 1/2 horse-powers are comparatively dearer. So single operation is not suited to a small loom.

(2) Power transmission system for collective-type looms

Recently a small horse-powered motor for looms, having specific efficiency, has been developed and made available at comparatively low price, and the present day tendency is for gradual shift from collective-type to single-type machine. In spite of this, in a factory where small-sized looms are employed, because of the fact that a small horse-powered motor (less than 1 H.P.) has comparatively poor efficiency and that the high cost of facilities is required, collective operation is regarded as more advantageous.

Transmission system for collective-type looms is generally divided into two: overhead transmission and underground transmission. Fig. 2 shows the former, and Fig. 3, the latter.

Although the majority of factories are adopting overhead transmission, recently we come across the factories quite often adopting underground transmission in appreciation of advantages gained in lighting, operation, appearance, factory construction, etc. As to which should be favoured of the two is open to question: each should be evaluated from the location of, and conditions in, the factory involved. Whilst overhead transmission is preferred from the viewpoint of factory expense curtailment and life-expectancy of the belt, and in areas where geological weakness is apparent or where liable to be flooded, underground transmission is prefered from the viewpoint of lighting, operation and vibration of structure.

Relationship between the diameter of a line shaft and distance of a bearing in weaving factories is shown below:

Bearing distance	Diameter of shaft
6 feet	1 3/8 - 1 3/4 inches
9 "	1 1/8 - 2 "

(3) Matters to be attended to in power transmission.

A. Regarding bearing distance, 9 feet is better than 6 feet from the viewpoints of power economy, location of a loom, and lighting.

B. Since a line-shaft subjects to expansion/contraction due to heat, it must be fitted with expansion-shaft - coupling at every seventy feet in case it is very lengthy.

C. As bearing, a ball-bearing is recommended from the viewpoints of power economy, low consumption of lubricants and its nimble and satisfactory movement.

D. The revolving belts for transmission must be so arranged that the lower one is kept always on the stretch and the upper one gets loose.

E. The power of pulleys should not be set not bigger than six times. Four to five times is desirable.

F. The pulley on line-shaft for transmission to the loom had better be smaller by about 20% than that of the loom. Example: In case the loom's pulley is of 12 inches, the shaft's had better be of 10 inches diameter.

G. The belts have limitation of course from the transmission efficiency viewpoint, but wide and long ones are suggested as far as practicably possible.

The following are points that characterize a V-shaped belt which is increasingly used recently.

a. It is feasible to produce the speed of up to ten times by which an intermediate shaft in the past can be eliminated.

b. It can be used at angles of greater scope.

c. It produces no vibration nor noises, working smoothly.

d. There is little slipping and big transmission efficiency is achieved accordingly. Some of V-shaped belts have a record of 98% efficiency.

e. It endures well and, therefore, is economical.

2. Location of Looms and Factory Building

Major consideration in locating a loom should be the convenience of a weaver. A factory building is to be so shaped and constructed as best suited to the location of a loom. Desirable relationships between loom and building are as under: under:

(1) All surface of a loom & its fixture should be well-lighted.

(2) The positions of pillars should be arranged in

accordance with the location of a loom.

(3) Constructional facilities enabling a weaver to take case of a number of looms simultaneously should be given due consideration.

(4) Transportation of materials, etc. should be easy and convenient.

(5) Supervision should be easily made.

Hereunder added are some explanatory notes on the points listed in the above.

(1') Lighting methods commonly adopted by factories are lighting from side-windows, lighting from skylights or the combination of the two.

Lighting from skylights is most desirable from the viewpoint of ensuring the evenness of intensity of illumination: however the importance of lighting from side-windows should not be lost sight of. Small factories often rely entirely on side-windows in lighting, but big, spacious factories usually are provided with skylights, without which their work places inside would not be sufficiently illuminated since side-windows supply only partial light.

To a loom, lighting as ample as possible should be accorded whole day during working hours with little change in the intensity of illumination.

Saw-teeth windows - a kind of skylights - are most widely observed in Japan and these roofs are open facing north. Japan being in the northern hemisphere, they are not exposed to the direct rays of the sun and variation in the intensity is scarcely appreciable throughout a day.

Saw-teeth windows are divided into two kinds: inclined and vertical ones.

Inclined roofs have planes of an angle, 75° - 85° so that a good amount of rays be taken in. At the same time this device is liable to absorb also snow, soot, dust and the like, which darken the inside below on the days of rain or snowfall. (Fig. 4)

Vertical roofs take in smaller amount of rays, but their window planes are not so readily stained and cleaning troubles can be dispensed with. For this reason, vertical roofs are being increasingly adopted recently in the snow-falling districts.

Generally speaking, the standard dimension of a sky-lights is between 2/10 - 5/10 of the floor space of working place, and that of a side window is above 7/10 of the wall-space. Whichever lighting method is adopted, it is important that direction of lighting be paralleled with the crank shaft of a loom: by this arrangement a weaver will not be troubled by the shadow of his own hand.

Further, when side-window lighting system is adopted attention should be invited to the need for fitting in frosted glasses thereby obstructing the view of inner working place from outside, which has two advantageous points: workers can concentrate their attention and not direct but diffused light can be admitted into.

The position and height from the floor of a side window is to be decided in consideration of the loom installed and the operating position of a weaver. It would be ideal, if the expense allows, to have the ceiling and wall dimension upward of three feet above the floor painted white or pale rose-colour, having the window frame painted green or other suitable colour.

(2') The pillars, according to their positions, greatly obstruct the work of weavers, affecting production efficiency adversely and fatiguing them a great deal. So care must be taken for suitable positioning of pillars, taking the location of looms into consideration. Pillars should be generally in rear of looms and at the opposite side of the let-off motions of looms. It is common practice that four looms are installed around one pillar.

Kind of factory	Saw-tooth roof Length (m)	(of one-storied house) Width (m)
Silk-cloth weaving factory	5.8	5.4
Cotton-cloth weaving factory	5.8	3.5
"	6.8	4.7
"	6.7	3.85

(3') Fig. 6 indicates arrangements universally observed when one weaver takes care of four looms. One shaft operates two rows of looms and each two looms in the same row are placed closely side by side. Distance between stays (A) is about 5cm. Operating passage (B) is about 70cm, and rear passage (c) is about 60cm wide which gives the required apace for spindles to be replaced easily. Note that in case a pillar intervenes the width of such passage is expanded to about 85cm. A weaver is expected to take care of four looms confronting with this operating passage between the twos.

(4') P is a passage along the length of factory having at least 60cm in width so that spools and woven cloths are readily carried about. Further, a wider passage of about 3m running through the center, or two such passages along the both sides of factory must be provided and connected with emergency exits. D is 30 — 35cm and C is 60cm approximately.

As stated when two looms in each row are paired and installed at adjacent positions, one is operated by right handle and the other, by left handle. But in case of automatic operation, only left-handled machines are used irrespective of their positions for obvious reasons.

3. Installation of looms

(1) Foundation work

Firstly, an allocation plan of looms and foundation on which looms are to be installed must be made. Needless to say, the foundation should be as strong as possible to ensure steadiness of looms after installation. The most widely adopted is concrete foundation. Its size varies according to the size and revolving frequency of the loom involved, but most commonly used concrete foundation measures 46cm in height and 30cm in width. (Concrete is made up of cement 1; sand 3; pebbles 6) In this foundation work, case should be taken not to bury the screw bolts of a loom-frame in the concrete foundation; for once concrete becomes hardened and set, the bolts would be immovable when desired to shift their positions. For such eventuality, arrangements had better be made for a more or less conical shaped piece of wood to be buried about 21cm deep, pointed edge downward, into the concrete foundation. When the concrete has dried up and hardened the wooden piece will be taken out. Into the hole thus made the bolt of the frame of a loom will be inserted when it is assembled and ready for installation. Concrete foundation is durable forever but a wooden foundation for semi-permanent use can be built up with comparatively small expenditure of money.

(2) Basic line of installation

Before starting installation, lower two plumb-bob lines from any two points on an optional side of the line-shaft to find two points on the floor, stretching out an inking line. In paralled with this basic line, a line for the crank-shaft of the loom is inked on the floor. After that a central line between the two frame-sides is stretched out meeting at right angles with the line for the crank-shaft.

(3) Assembling of a loom

Place a roughly assembled loom on the foundation and lowering plumb-bob lines from the crank-shaft or bottom-shaft so that they fall on the inked lines on the floor above-described and also on the central line of the machine. Thereafter check with a level vial whether crank-shaft, bottom-shaft, breast-beam and frames of the loom are fixed level with the ground. And the low places detected by thus checking will be treated by packing a thin slice of dried hard wood (such as oak and cherry). The permissible width of such a slice is up to about 1.5cm and by no means thick packing should be employed. Next, solidify the machine by inserting bolts into the pre-arranged holes which are plugged after with mortar (sand: 3 and cement: 1). When the mortar is dried up, the bolts are clamped tightly, fixing the frames. In case the foundation has been constructed using stones, the bolts are customarily solidified by pouring into the holes melted sulphur or lead.

Assembling of a loom is undertaken by fixing the following units in that order: frame, crank-shaft, bottom-shaft, rocking-shaft, slay-legs, connecting-rod, stay, crank-ring, shuttle box, shuttle replacement unit, taping-up mechanism, letting-off device, shedding mechanism, warp protection, weft stopping, starting-up and controlling equipment.

In assembling a loom attention is drawn to the following points:

A. Bolts at various places must be clamped but gradually each by turns several times until they have been tightly secured. Such adjustment only contributed to the smooth operation of a loom.

B. It must be assembled correctly and precisely using necessary tools such as level vial, rule and the like.

C. In clamping nuts, screws, etc. we often cause a split or crack in cast-iron or apt to chop off screw-heads, therefore, thought should be given to the appropriate application of force in the fixing-up of such gadgets.

4. Operation of looms

(1) Test operation

An assembled loom will be further provided with the following before the starting-up.

A. Picker, stick, stick-band, reed, etc.

B. Adjust relations between each part. For example, shuttle and shuttle box: swell and pressure: presence/non-presence of shuttle in shuttle box and effect on safety-device: crank circle and shuttle motion: shuttle and shedding motion.

C. Lubrication of all parts

1st test operation aims at the smooth running of a loom without setting on warps. Except weft fork, warp stopping motion is kept inact and test operation is gone into quietly. During 1st test operation, attention will be given to the following:

A. The bolts that have become loose must be clamped tight.

B. All parts should be duly lubricated for smooth operation and check if any part has become heated through frictions unforeseen.

C. All motions be checked minutely.

2nd test operation This concerns the reed provided and shuttles that is made to travel through.

A. Shuttle's thrown-in power, its travelling and shuttle stopping motion will be checked.

B. Attention must be paid to shuttle box and buffer. Clean the inside of the shuttle box with oil-cloth so that the shuttle slips well.

C. This test operation had better be held for 2 - 3 days.

3rd test operation Now that all parts have been checked and adjusted for operation, in this test warps are set, the heald is hung and picking motion commences for weaving. Here it is important to observe the following carefully and ensure complete weaving:

A. Fix the position of the heald.

B. Adjust relative positions between shedding and picking motions.

C. Adjust relative positions between shedding and beating motions.

D. Adjust relations between letting-off and taking up motions.

(2) Matters that demand attention in operation of looms

A. Attention before operation

a. Adjust the position of weave-fell and the shed.

b. Adjust a broken warp and tension of warps appropriately.

c. Send the leash back to rear.

d. Push the shuttle into the innermost part of the shuttle-box. In case of a single shuttle it goes to the shuttle box on the handle-side; in case of one-side shuttle-box loom, to the single shuttle box; and in case of two-side shuttle-box loom, to the shuttle-box on the handle-side.

e. Take off the hook of weft-fork from hammer.

f. Loosen the brake of the loom.

g. The placing of the crank between back and top centers.

B. Operating hints

a. During the first few revolutions in the starting-up, draw up the reed cap by hand and assist the smooth operation.

b. During operation attention should be drawn all the while to the woven cloth, warfs and shuttle race as well as the breaking-off of warfs and wefts.

C. Attention to be paid when the operation is suspended

a. When suspension of the operation is desired remove the handle, holding down simultaneously the reed-cap by hand so as to see the crank-pin stops at a place little higher than the back-center.

b. When the operation has been suspended, immediately loosen the brake of the loom.

c. When the loom itself has stopped operation, loosen the brake and thereafter check all parts involved.

d. When the operation is suspended more than one day with the woven cloth left on the loom, be sure that the shuttle is taken out of the shuttle-box, the shedding of warfs is closed and the brake for spindles is loosened.

II. Revolution frequency, Horse-power and Production of power-looms

1. Revolution Frequency of Looms

Revolution frequency of looms is related direct to production efficiency: in other words, the greater frequency results in the more increased weaving efficiency. However there is naturally the boimdary of frequency, over which troubles apt to occur, deteriorating weaving efficiency. It is important therefore to study on the standard frequency of revolution which is most desirable.

Generally speaking, such frequency of a power-loom differ by its structure, width of a reed, strength of threads to be woven, kind of fabric, preparation processes, skill of weavers, etc.

Hereunder is shown the frequency of looms for plain fabrics which are not provided with shuttle-box fixtures. However, in case of twill, satin weave, etc. about 10% speed reduction is necessary and in case of a dobby machine, Jacquard machine and machine provided with shuttle-box, 10 - 20% speed reduction. Further, the required frequency in weaving the same kind of fabrics on the same kind of machine but with reeds of different width can be obtained in inverse proportion to the square root of the width of a reed. For example, supposing that the correct frequency of a machine having 36'-wide reed is 170, the same of a machine having 72'-wide reed will be obtained from the following formula:

$$\sqrt{72} : \sqrt{36} = 170 : x$$

$$\therefore x = 119$$

Kind of machine	Width of reed (inches)	Revolution frequency per one minute
Cotton loom	36	160 - 200

Silk loom	-	120 - 180
Glossed silk "	36	100 - 150
Flax "	36	140 - 160
Worsted "	52	130 - 150
Woolen "	66	80 - 100

2. Power-looms and Horse-powers Required

Horse-powers required by looms depend on various factors as in the case of the revolution frequency above-stated. And these are obtained, if the looms are of a kind, proportionately to the square of the frequencies.

Among the motions pertaining to a loom, shuttle motions demand more than one thirds of total power, followed by reed beating and shedding motions in that order. The following shows horse-powers required by various kinds of machinery.

Kind of machinery	Width of reeds (inches)	Horse powers required
Cotton loom	36	0.17
Silk "	36	0.12
Flax "	36	0.25
Worsted "	52	0.2
Woolen "	66	0.5

3. Production

Production of a power-loom varies according to its revolution frequency, density of a weft, working hours, etc. On the assumption that the loom has been operated without stopping, its production can be worked out by the following formula:

Production per minute

(i.e. length of cloth woven in cm.)

$$= \frac{\text{Revolution frequency of loom p.m.}}{\text{Density of wefts of 1cm}}$$

Production per day

= Production per minute x 60 x operation hours

The above equations merely indicate the production theoretically calculated. In actuality the operation of a loom has to be discontinued at times through the breaking-off of warps, the necessity of suppling of wefts, the failure of weaving mechanism, etc. So the actual production is less than theoretical one. The relationship between the two is called production efficiency or production factor as shown below:

$$\text{Production efficiency} = \frac{\text{Actual production}}{\text{Theoretical production}}$$

Production efficiency which depends on material threads, craftmanship of workers, factory conditions such as temperature, humidity and facilities, is 70 - 90% in the case of an ordinal loom. Production efficiency for figured texture is about 50%. Even in auto-weaving loom it rarely exceed 95%.

Actual production can be obtained from theoretical production multiplied by production efficiency.

$$\text{Actual production per day (cm)} = \frac{\text{Revolution frequency per minute} \times 60 \times \text{Working hrs.} \times \text{Production efficiency}}{\text{Density of wefts of 1cm}}$$

(Example 1)

What is the production of a silk-loom, with density of wefts set at 32 pcs. per 1cm: 10 working hours per day: 75% production efficiency?

Ans. $\frac{120 \times 60 \times 10 \times 0.75}{32} = \underline{1,687.5\text{cm}}$

(Example 2)

Working 10 hours on a cotton loom with 160 revolution frequency and wefts picked 55 pieces per 1 inch, 39 yards of cloth has been woven. What is the production efficiency of this loom?

Ans. Theoretical production = $\frac{160 \times 60 \times 10}{55}$

= 1,745.5 inches or 48.5 yards

But the actual production being 39 yards,

Production efficiency = $\frac{39}{48.5}$

= 0.804 or 80.4%

III. Flaws and damages in weaving

1. Breaking-off of warps

Flaws on the surface of woven cloths due to the breaking-off of warps are characterized by the disorderly appearance of horizontal lines or structure of cloths and hence they are distinguishable from those due to other causes. The causes of the breaking-off of warps may be cited as follows:

(1) When low-quality material is used. To minimize the risk of breaking-off, paraffin may be applied to the threads or gelatine solution may be sprayed upon them. Care to be taken not to accord them too much tension power and therefore the brake on spindles should not be applied too firmly.

(2) When threads have spots. In adjusting warps before weaving, spots on threads in forms of balls or knots must be got rid of as they will subject to friction while the heald and reed are in action and will become liable to be broken in consequence.

(3) When warps have been badly wound. The width of rolled warps must have an appropriate proportion to the width of passage of the reed. Warps must be wound around the warp-beam on its center part, avoiding to wind warps leaning toward either of the edge parts of the beam width-wise; otherwise the heald and reed in action may cause the breaking-off of warps.

(4) When threads have been too densely picked by the heald and reed. The heald can take a maximum of 15 pcs. per 1cm. When this number is exceeded the heald employed must be two - three times as big in capacity as the one theoretically calculated. In the case of the reed, it is two wafts usually that are taken care of by one dent. A rougher type of reed should be employed, if several-more than two-threads are to come together for beating motions.

(5) Warfs and bad tension methods. The tension given to warps must be proper and right one varying according to the cloth to be woven and the quality of threads used. The improper tension of warps makes it impossible for a complete shed to be opened, constituting a factor responsible for the breaking-off of warps. The raffle of a warp-beam must be very slippery so that a rope or chain around it can freely glide away from it.

(6) When the heald has been too strongly stretched. Big friction will be produced between the mail and warps, inviting the breaking-off of the latter.

(7) When the shed is imperfect. When the shed is not sufficiently opened, with several warps in it, the warps become liable to be broken off by the shuttle.

Therefore, when the shuttle is at most backward position, lower warps touch slightly the shuttle while upper warps hang up the heald in the back. In this way all warps at the shed are aligned.

(8) When there is a scratch on the shuttle. The tip of the shuttle must be always pointed, and the pointed metal part must join the rest-wooden part-on the same plane. In case the wooden part of a shuttle is scratched during the motion by the shuttle-box, such a scratch must immediately be polished out by fine sand-paper.

(9) When the mail and dent lack smoothness and slippage. In case a part of the mail is damaged and warps get caught by this part, the mail should be replaced at once. In case the dent gets rusty, coarsening its face, it should be polished and smoothened.

(10) When the reed is fixed low. The reed should have ample space above and below. In case upper warps touch the upper part of the reed, pushing it up, warps get caught by this and put the structure in disorder or cause the breaking-off of warps. On such occasion the reed must be replaced or the position of shuttle-flake should be heightened. If necessary, glass rods may be affixed onto the stay to prevent possible damage.

2. Breaking-off of wefts

Breaking-off of wefts is characterized by disorder by structure in the woven cloth as in the case of warps and it is distinguishable from other flaws caused by other factors. This disorder resulting from the failure of wefts does not extend over the whole width of woven cloth: in this it differs from the breaking-off of warps.

The following are cited as causes of the breaking-off of wefts:

(1) When wefts are excessively weak. In case wefts are slender and weak it is difficult to prevent them from breaking-off. If necessary, twist them and relieve tension as much as possible before shuttle box motion starts.

(2) Bad functioning of weft spooling machine. Good warping and weft spooling are requisite to the production of good cloth. A good spooling machine is one which enables threads to unwind therefrom smoothly without any hitches. For this purpose, knots and balls should first be removed. When several yarns are joined together forming a weft, please see to that any one of the yarns should not part from the rest or that such should not get caught by the spool. Spooling must be done in accordance with the size of the shuttle. Care must be taken so as not to cause wefts touch the edge of

the shuttle.

(3) When the shuttle box is too narrow for shuttles. Wefts are often pressed between shuttle and the shuttle box, ending in the breaking-off eventually. So the dimension of the shuttle-box must be given thought to. It is advisable to check whether the shuttle-spindle is not loosened, the position of which is not too high or too low, and whether the glass or porcelain applied to the end of a thread is not damaged.

(4) When the surface of weft-fork is coarse. When the weft-fork presses wefts onto the lattice, wefts get caught by the coarse surface of the weft-fork and are unable to slide off. So by this strong impact wefts are liable to be cut off. This demands that the weft-fork must have surface of smooth finish.

(5) Tension of wefts. Tension of wefts must be adjusted in accordance of the quality of woven cloth and strength of a thread. In case furs and other stretching methods are employed, care should be taken that no wefts get caught in that device.

(6) When the shuttle jumps back inside the shuttle-box.

(7) When the weft-fork come too much out of the lattice.

(8) When wefts are caught between the picker and the picking-spindle.

(9) Spooling. When wefts are spooled either too tightly or too loosely.

(10) Tube. When a distorted tube is used or when a tube is not correctly fixed on the shuttle-spindle.

(11) Timing. Failure of timing in picking motion.

3. Floating

When warps are cut between the reed and the heald and get intertwined one another, the warps in that patch fail to form proper structure. This situation is termed, "Floating." This flaw is easily distinguished by more than two warps which have been pushed up, side by side.

And this defect in weaving can be avoided by checking before operation if there are obstacles present between the reed and the heald and removing completely if there should be any.

4. Errors in Loom Preparations and Drawing-in Process

As incomplete preparations are the incorrectly placed treadle and disorder in organization arising from defective cards of Dobby or Jacquard. In case of multiple shuttles, errors on the comber board or cards combined with the de-rangement in the order of wefts may end up in the design not initially planned. To prevent these errors, it is necessary that weaving directions and complete sample cloth be kept along with the design drawings. Errors in drawing-in processes are apt to be committed by unskilled weavers. Errors in drawing-in of the heald are responsible for disorder in structure, whilst those in the reed, for partial density of warps which otherwise should spread and be arranged equally alike.

5. Excessive Narrow Width of Woven Cloth

(1) This is apt to happen when throwning-in of the shuttle is effected too strongly.

(2) Regarding the shed, shrinkage of the width of woven cloth in the case of inner-picking is bigger than in over-picking and so suitable adjustment must be made in the shuttle motion and in the tension of wefts.

(3) When density of wefts is conspicuously great compared with warps and the woven wefts are napped and wet, there will be shrinkage in the width of woven cloth. Temple devices such as roller, ring, etc. can prevent such shrinkage to a degree but not completely.

(4) Attention should be paid always to the tension of warps, since weak tension of warps tends to result in the shrinkage of width of woven cloth.

6. Warp-stripes

Soiled warps sometimes cause warp-stripes appear on the surface of woven cloth, and so care must be taken, especially when the cloth is white or of light colour. This warp-stripes occur also when there are some warps, loosely strung, due to carelessness on the part of a weaver in the warping or warp-spooling, or due to unskilled labour in piecing strings together. When warp-stripes begin appearing, warps should be replaced and the newly replenished warps be so adjusted as maintain the same tension with others. Warp-stripes also appear when very fine or very thick threads are intermixed in the warps. They should be replaced accordingly.

7. Weft-stripes

This occurs when threads have spots and are not of same thickness, or when wefting motion sets in without thorough cleaning. In such cases, part of the wefts responsible for this defect, or the whole of wefts have to be replaced out of the spool.

8. Rings

Rings are made in wefts under the following circumstances:

(1) When the shuttle bounds back in the shuttle-box. Remedy: weaken the shuttle motion or narrow the shuttle-box.

(2) When wefts in the shuttle were not given appropriate tension. Remedy: give more tension to the wefts by affixing

woolen cloth or fur onto the shuttle or adjusting tension on other parts of mechanism.

(3) When strongly twisted threads are used in wefts, loops are apt to be formed already at the time of their being released from the spool. Remedy: give strong tension to the wefts and arrangements must be made for the wefts not to get loose before arriving at the shuttle-box. When several shuttles are used in turn loops tend to be formed, so proper methods are to be contrived to evade this formation.

(4) In the case of thick fabric, when the tension of warps is weak and shedding is not complete, the wefts sometimes scoop or hook up the warps and by this process loops are formed with the wefts pushed against the end of front weave.

9. Irregular Density of Wefts

(1) When gearing for taking up motion is either too shallow or deep. Space of about 1mm must be retained between, and it must be so devised as hand operation be made possible.

(2) Check if the worm and worm-wheel for taking-up motion has exceedingly worn out.

(3) Check if the keys or screws fixing the gear and spindle are not loose.

(4) Check if the teeth of the ratchet wheel are irregular

or part of such has been worn out and damaged.

(5) See to that when the catch of the ratchet wheel recede, the wheel itself will not recede together with the catch. In case the ratchet wheel should recede, adjustment must be made to the brake preventing the ratchet wheel from sliding back.

(6) The brake preventing vibration of the ratchet wheel should be cleaned at times: it should not be oiled.

(7) Between the ratched wheel and the catch must be co-relationship in motion. In case unbalanced movement is observed between the two, check if the related parts are worn out and damaged or if screws have become loosened. Thorough investigation is to be conducted.

(8) Rollers connected with take-up or let-off motions must be of complete round shape. Axles must be penetrating at the centers of rollers.

(9) Check if the pin and gun-metal of the connecting-rod between the crank and stay are not worn out, or if the cotters of the straps forming the connecting-rod have not been loosened.

(10) In negative let-off motion, the brake-rope and raffle must be always prepared to enable them to slide down, especially in weather with much humidity.

(11) See to that during operation the brake-weight will

not touch the floor.

(12) In positive let-off motion, the worm and worming-wheel must be protected against wearing-out and check if the screws have not been loosened. Especially when the ratchet wheel is provided, check must be made of the catch if it is working.

(13) In case the shed is irregular, it affects wefts. So against any picking motions, the shed must be kept equally of the same size.

(14) Looms must be operated without change in the frequency of revolution.

(15) When a take-off roller with emery cloth affixed thereon is used, woven cloth sometimes slips which becomes a cause for unevenness in woven cloth. So it is essential that such a roller be kept in good order, repairing it when necessary, and thus prevents the cloth from slipping on the roller.

10. Warps-stripe caused by the Dent

This flaw is a stripe formed by warps densely lined together and it is therefore distinguishable from other defects in woven cloth. It occurs as under:

(1) Bad take-in process. Take-in process of warps into the reed being unsatisfactory, damage caused by its dent appears on the woven cloth.

(2) Inappropriate tension of warps. The tension of warps should be adjusted for qualities of the cloth to be woven.

For example, twill weave requires smaller tension than plain weave and satin weave requires smaller tension than twill weave.

(3) When the back-rest is provided too low.

(4) Irregular shed.

(5) Too slow closing of the shed.

(6) When the shuttle-fleak is provided too high. Against the position of the shuttle-flake at the last stage (namely, behind the rear-center of the crank) middle orifice of the shed should be positioned 1 inch lower and in case of upper orifice, about 3/4 inches lower.

(7) When the thickness of the dent is not proper. The bigger is the density of the reed, the better will be the distribution of warps, and the thinner is dent, there will be the less fear of the reed-stripe being formed on the surface of the weave. This concludes that a proper reed has to be used according the cloth to be woven.

(8) When the tension of wefts is weak. Within the permissible scope of strength of wefts full and strong tension is recommended enabling thereby to weave firm and sturdy fabrics.

(9) When a distorted or bent dent is used, it is likely to produce stripes. So threads to be taken into the reed as quietly as possible, and further, care to be taken not to accord forcible movement to it while in motion.

11. Loose and Wrincled Cloth

(1) When tension of the wefts is not sufficient or it is irregular, this happens. Especially in the case of silk cloth, it is essential that appropriate tension be accorded to wefts, if perfect cloth is to be woven.

(2) Spooling and warping are considered the second important condition in weaving good cloths.

(3) When shuttle motion is too strong. Generally speaking, this degree of strength that will transmit a shuttle from one shuttle-box to another is considered optimum. Adjustment to this level is required.

(4) When the shuttle bumps inside the shuttle-box. In this case, weaken the shedding motion and at the same time narrow down the dimension of the shuttle-box. Further, buffer should be maintained on suitable strength.

(5) Suitable arrangement between shedding and picking motions is respect of sequence of time.

(6) When the motion of heald is irregular.

12. Wefts-back of Binding Force

(1) When tension of warps is weak. Strong tension of warps should be maintained so that density of wefts and intensified beating motion thereof be arranged.

(2) When holding of wefts by the reed is for short duration. In this case short-connecting rod or twice-beating device is employed.

(3) When spring holding down the reed is too weak.

(4) Take-in motion is incomplete.

(5) Let-out motion is incomplete.

(6) Relation between the timing of closing the shed and picking motion is not proper. In this case, remedial steps differ according to the kind and thickness of wefts, and if the wefts are thick, the shed is first closed and thereafter, picking motion be started.

13. Selvedges of Inferior Quality are Produced:

(1) When the width of wefts-spool is too big or too small.

(2) When the releasing of selvedge threads is irregular on account of unsatisfactory winding around the spool.

(3) When the shed is either too small or irregular.

(4) When the upper part of warps at the shed are given too much tension or are excessively loosened.

(5) When shedding motion is too fast for picking motion.

(6) When selvedge threads are too densely taken into the reed.

(7) When the heald for selvedge threads is too far apart from the reed.

(8) When the shuttle bumps inside the shuttle-box.

(9) When wefts are released excessively.

(10) When wefts get caught by the shuttle-box or others.

(11) When the spool for wefts is out of order.

(12) When the orifice of the shuttle is damaged.

(13) When the dent of the reed is distorted or damaged.

14. Woven Cloth with Soils

(1) When wefts contact the wall of the shuttle-box.

(2) When the shuttle-box is dirty.

(3) When excessive oil permeates into the picker or buffer.

(4) From pulleys applied to Jacquard loom, Dobby machine, etc. oil drops to make spots on the cloth. So oiling of machines in motion should be cautiously undertakedn.

(5) When coloured threads, which are subject to discolouration by the sun, are used, expose only the portion that is being weaved at present and the rest should be kept from the sun and protected.

(6) Sometimes the cloth is soiled by the saliva of

weavers: so they should be taught not to chat about facing the looms.

(7) When the cleaning of looms is neglected. It is advisable that they should develop a habit of cleaning the machines before commencing and after finishing their work.

15. Selvedges Fail to be Tightened:

(1) When tension of wefts is too weak.

(2) When picking motion is too strong and the shuttle bumps in the shuttle-box.

(3) When the shed is irregular.

(4) When dinsity of wefts is uneven.

(5) When cloth of narrow-width is woven on the loom intended for fabrics of wider-width.

16. Gaps in Wefts is Occasioned:

(1) When the working of the spool is not satisfactory.

(2) When the safety device and brake for wefts are not functioning properly.

(3) The two devices in (2) above function properly but the operation of the loom does not stop. This phenomenon occurs at times through imperfect leather-belt reaction to the loose pulleys.

(4) When there is much gap in the gun-metal bush of the connecting-rod or when the connecting pin has become loosened.

(5) When take-in motion is effected only intermittently.

(6) When the finger of the loose reed interlocks with the lower-most part of the frog.

(7) When the power of spring pushing down the reed is too weak.

17. Part of Cloth Where Density of Wefts is too Visible

(1) When taking-in motion is irregulàr and the above phenomenon appears the following checks should be made:

a. Gearing for taking-in motion is functioning properly.

b. Pulleys for taking-in motion are in order.

c. The pole for the brake is working. And where there are troubles with the above remedial adjustment should be attented to immediately.

(2) When tension warps is not even.