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STRENGTHENING OF THE RAMIE TECHNOLOGY DEVELOPMENT CENTRE, CHANGSHA, HUNAN PROVINCE

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Research Report 1 - 4

Prepared for the Government of China by the United Nations Development Organisation, acting as executing agency for the United Nations Development Programme

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* The document has not been edited.

Research Report 1

The Development Of Ramie Apparel Fabrics

A considerable proportion of the fabric woven at ZhuZhou Mill is already used for various apparel end-uses including shirts, trousers, skirts, blouses and men's suits. The fabrics are mainly used in the domestic market, although some are exported, and in recent years some has found its way into 'designer' wear.

Although ramie has a distinctive appearance and drape, a major barrier to its more widespread use is the itchiness associated with yarn hairiness, in fact a major part of this U.N.I. D.O. project has been the search for a chemical finishing treatment which will remove surface hair without impairing other fabric attributes. If this search is successful, international markets for pure ramie apparel fabrics will open up; if not, they will be confined largely to outerwear fabrics which do not come into contact with the wearer's skin.

Blending ramie with polyester improves the fabric handle and crease resistance without excessively diluting the special attributes of the ramie, and such fabrics are likely to enjoy greater success in summer weight jackets and suits than pure ramie fabrics. For garments which have greater contact with the wearer's skin, blends with cotton are more appropriate.

The fabric constructions used at ZhuZhou Mill are suitable for traditional fabrics for apparel end-uses, but consideration should be given to the range of constructions designers are currently using for less formal fabrics, particularly those used for trousers, jackets and suits.

It is likely that novel fabric constructions may find a market whilst overcoming some of the disadvantages of ramie, for example, a weft faced twill or sateen woven with a cotton warp and a ramie weft would entirely avoid the disadvantages of a ramie warp and largely overcome the itchiness problem since mainly cotton would be in contact with the skin, while the outer face of the garment would show the attributes of the ramie to their full effect. Another idea might be to weave a cotton/ramie seersucker with the ramie used for the buckled sections. This fabric would again exploit the appearance of the ramie whilst minimising skin contact.

The two suggestions above are given by the author as a technologist merely as indications of what might ensue from a novel approach. The success of such an approach would depend upon the creativity and skills of a specialised designer, together with an effective marketing strategy. It is recommended that these developments should be guided by competent designers and marketing experts with a strong experience of Western fashion demands. It is also important to realise that Western fashion changes radically from year to year, so that it is possible that ramie could be in very great demand one year ,but almost completely out a year or two later. This happens with mohair particularly; but to a limited extent to silk and cashmere too. There are obvious problems of producing enough in some years and finding alternative outlets in other years.

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June 1994

Research Report 2

Setting Parameters For The Principle Yarn Counts And Fabric Constructions

1. A Brief Review Of Cloth Geometry

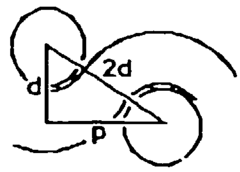
Since the latter part of the nineteenth century various attempts have be made to develop models which will predict the configuration that yarns take up in woven fabrics. There are several reasons for wishing to do so: such models allow predictions of maximum sett and hence are an aid to cloth setting; they allow predictions of weaving difficulty; they are used by loom manufacturers to predict weaving limits for their looms; and they can be used to predict fabric physical properties.

Research into cloth geometry may be divided into three groups: setting theories, geometrical models of cloth structure and physical models of cloth structure.

Early workers[1,2,3,4] were primarily concerned with developing formulae for maximum sett. Their work was mainly empirical, but some formulae were developed which allow yarn diameter to be approximated. The results of their work is still used to some extent, especially in the worsted and woollen industry.

Pierce[5] is generally regarded as having made the first detailed attempt at developing a cloth geometry. He developed two geometrical models, the latter of which, the Twin Arc Model, forms the basis for a widely used formula for cover factor, and a physical model, the Elastic Thread Model. Geometrical models consider the fabric cross section to be made up of a series of lines and semi circles. The Twin Arc Model for a maximum sett square plain structure is shown in Figure 1.

Figure 1 The Twin Arc Model



This model has the virtue that it yields simple geometrical formulae, but can be criticised because it assumes an unrealistically abrupt change of direction of curvature as the yarn interlaces, and does not take into account a number of factors, for example thread flattening and yarn strain. Physical models are those which do, to some extent, take into account physical attributes such as dry and wet relaxation.

The development of a full model for cloth structure is unlikely to be achievable due to the number of factors which influence the final configuration which yarn takes up in a fabric. These include: yarn stiffness and density, which are a function of fibre stiffness and density, packing density and the orientation of the fibre in the yarn; the compressive forces which result from the fabric construction, weave and several loom settings, in particular warp tension and shed timing; and relaxation and sett during wet processing and finishing.

Kemp(6) developed Pierce's geometrical model by proposing a 'race track' model in which the yarn cross section was composed of a rectangle with two semi-circular ends. This model was later developed for other weaves than plain weave by Hamilton(7) and Love(8).

Pierce's Elastic Thread Model was a physical model in that it treated the yarn as an elastica and hence took in, to some extent, the internal stresses in the fabric. Olofsson(9) considered the effect of small-order horizontal stresses applied to fabric, and fabric set. Subsequent workers(10,11) have investigated the effects of the area of contact between warp and weft, Pierce's model having assumed point contact only.

2. Application Of Twin-Arc Geometry

The following formula is given for cover factor in Textile Terms and Definitions(12).

$$\text{Cover factor} = 0.1 \times \text{threads cm}^{-1} \times \sqrt{\text{tex}} \quad \text{---------------} \quad 1$$

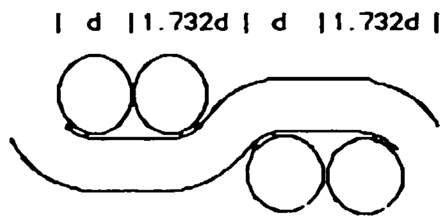
For any fabric the warp cover factor (k_1) and the weft cover factor (k_2) are calculated separately and may be totalled to give the cloth cover factor (k_c).

$$k_c = k_1 + k_2 \quad \text{------------------} \quad 2$$

The above formula, and the derivation of maximum theoretical cover factor given by Robinson and Marks(13), are based on the Twin-Arc Model.

The derivation for maximum cover factor assumes that there are two possible thread spacings in the cross section of a square sett fabric which has maximum cover factor. The thread spacing is equal to the yarn diameter where there is no intersection and 1.732 times the yarn diameter where there is. Figure 2 illustrates this for a two up, two down interlacing.

Figure 2. Theoretical Thread Spacings In A Square, Maximum Sett 2/2 Fabric



If the above formula for cover factor is used, the general formula for maximum cover factor for a square sett fabric in any weave is:

$$\frac{26.7 \times \text{threads per repeat}}{\text{threads per repeat} + (0.732 \times \text{number of interlacings per repeat})} \quad \text{------------} \quad 3$$

This formula yields values of 30.8 and 39 for plain weave and 2/2 twill, respectively. For warp-faced constructions where the warp cover factor is at the theoretical maximum of 26.7, with no allowance for interlacings i.e. the threads are just touching, the above formula can be modified in order to calculate the maximum weft cover factor. If the warp and weft are of different counts the value of 0.732 will change by a factor which depends upon the ratio of the diameters of the warp and weft. If the diameters are equal the factor remains 1; if the warp diameter is half of the weft diameter it becomes 0.5. The value for maximum cloth cover factors of plain weave fabrics increases to 40 and 44.5, respectively, by substitution in formula 3.

The use of the Twin -Arc Model in this way ignores a number of variables, for example, in addition to those mentioned in Section 1, it is known that higher values are possible with coarser yarns and also where long floats are present due to the movement of some threads out of the plane of the cloth. Nevertheless, the formulae are straightforward enough to form a useful guide when setting new cloths, and are useful for comparing constructions, especially when the designer is familiar with the yarns in question and simple weaves are used.

3. Consideration Of Ramie Fabrics In The Light Of Twin-Arc Geometry

The maximum cover factor for ramie fabrics is likely to be lower than that predicted by the geometry for two reasons: Warp cover factors are limited due to the difficulties in forming a clear shed when using ramie warps; and the low yarn extensibility mitigates against the high cloth fell displacement at beat up which is a feature of fabrics having high weft cover factors.

Table 1 shows the principle fabric constructions woven at ZhuZhou Mill. Columns 2 - 5 show yarn linear densities and setts in English cotton counts and threads per inch, as quoted, and columns 6 - 9 show the equivalent values in tex and threads per centimetre. Columns 10 - 12 show the cover factors.

The first nine fabrics are all square sett, or approximately square sett, plain weave, 100% ramie fabrics. The range of fabric cover factors, 21.3 to 28.3, reflects the geometry in two ways: firstly it lies between the theoretical maximum and the lower value quoted by Robinson and Marks as needed for 'adequate' dimensional stability when using cotton yarns, and secondly, the higher values reflect the use of coarser yarns. The final four are all 2/2 twill fabrics. the higher range of cover factors, 28.6 to 34.9, again reflects the geometry.

Fabrics 10, 13 and 19 show that blending the ramie with either cotton or polyester allows higher cover factors, and fabrics 14 and 15 show that blending the ramie with cotton and then doubling it improves weavability to such an extent that high warp cover factors are possible. Unfortunately, doubling considerably increases the cost of a yarn and precludes the production of fine yarns, otherwise it would be an easy solution to the problems of ramie warps.

An example follows which demonstrate how, in the context of the existing fabric range, the formulae in section 2 could be used as a guide to constructing new fabrics:

> It is proposed to construct a fabric using the same yarns as fabric 17, but in a 2/1 twill weave, with intention of weaving a lighter fabric having a similar dimensional stability. The required setts can be calculated as follows:.
>
> Maximum theoretical k_1 or k_2 equals:
>
> $(26.72 \times 3) \div (3 + (0.732 \times 2) = 17.96$
>
> Maximum theoretical k_1 or k_2 for a 2/2 twill equals:
>
> $(26.72 \times 4) \div (4 + (0.732 \times 2) = 19.06$
>
> Ratio of setts 2/1 twill : 2/2 twill = 17.96 : 19.06
>
> Warp sett = $22.8 \times (19.06 \div 17.96) = 21.5$
>
> Weft sett = $21.3 \times (19.06 \div 17.96) = 20$
>
> It should be borne in mind that the 2/1 twill fabric will probably have a higher warp breakage rate than the 2/2 twill fabric since, although the warp cover factors are equal, 2/3 of the ends will change position during each loom cycle rather than half.

The above example demonstrates how Twin-Arc geometry can be a useful guide to fabric setting, especially against a background of empirically gained knowledge, even though it is a gross simplification of fabric structure. The formulae can equally well be used to take account of changes in yarn linear density and sett. Further work by the technologists at the R.T.D.C., in the light of the references quoted, will inevitably lead to greater precision in predicting new fabric setts.

Table 1 Fabric Constructions Woven At ZhuZhou Mill

Designation	Warp Count Ne	Weft Count Ne	Ends per inch	Picks per inch	Warp Tex	Weft Tex	Ends per cm	Picks per cm	Warp Cover Factor	Weft Cover Factor	Fabric Cover Factor	Fibre	Fabric Number
Crash	4.5	4.5	26	31	131.2	131.2	10.2	12.2	11.7	14.0	25.7	100% Ramie	1
Crash	5.6	5.6	36	34	105.4	105.4	14.2	13.4	14.6	13.7	28.3	100% Ramie	2
Grey Plain	7	7	36	34	84.4	84.4	14.2	13.4	13.0	12.3	25.3	100% Ramie	3
Grey Plain	14	14	56	52	42.2	42.2	22.0	20.5	14.3	13.3	27.6	100% Ramie	4
Grey Plain	21	21	58	60	28.1	28.1	22.8	23.6	12.1	12.5	24.6	100% Ramie	5
Fabric	21	21	59	54	28.1	28.1	23.2	21.3	12.3	11.3	23.6	100% Ramie	6
Grey Plain	21	21	52	58	28.1	28.1	20.5	22.8	10.9	12.1	23.0	100% Ramie	7
Fine Cambric	36	36	79	60	16.4	16.4	31.1	23.6	12.6	9.6	22.2	100% Ramie	8
Cambric	42	42	83	61	14.1	14.1	32.7	24.0	12.3	9.0	21.3	100% Ramie	9
Blended Grey Plain	11	11	51	47	53.7	53.7	20.1	18.5	14.7	13.6	28.3	55% Ramie/45% Cotton	10
Mixed Grey Plain	21	19	51	58	28.1	31.1	20.1	22.8	10.6	12.7	23.4	53% Ramie/47% Cotton	11
Blended Grey Cloth	24	24	58	58	24.6	24.6	22.8	22.8	11.3	11.3	22.7	55% Ramie/45% Cotton	12
Blended Fine Cloth	32	32	80	68	18.5	18.5	31.5	26.8	13.5	11.5	25.0	65%Polyester/45% Cotton	13
Blended Double	11/2	4.5	48	31	R107.4/2	R131/2	18.9	12.2	19.6	14.0	33.6	Ramie/Cotton*	14
Mixed Grey Plain	21/2	16	81	55	R56.2/2	R36.9/2	31.9	21.7	23.9	13.2	37.1	70% Ramie/30%Cotton	15
Suit Grey Twill	5.6	5.6	31	45	105.4	105.4	12.2	17.7	12.5	18.2	30.7	100% Ramie	16
Grey Twill	14	14	58	54	42.2	42.2	22.8	21.3	14.8	13.8	28.6	100% Ramie	17
Grey Twill	14	14	64	48	42.2	42.2	25.2	18.9	16.4	12.3	28.6	100% Ramie	18
Blended Grey Twill	11	11	74	47	53.7	53.7	29.1	18.5	21.3	13.6	34.9	55% Ramie/45% Cotton	19

* Blend proportions not given

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Research Report 3

Advice On The Introduction Of Rapier Looms Into The Ramie Industry

Rapier looms are not a new idea: the first suggestion of the principle was by Leonardo da Vinci in the 15th century, and a working, though not commercially viable, example was demonstrated by De Gennes in Paris in the mid 17th century. Production looms have been manufactured in one form or another since the middle of last century, but it was not until the 1960's that they began to seriously challenge the shuttle as a method of weft insertion in mainstream weaving. Rapier looms are well established for weaving other bast fibres, for example jute and flax, and so it seems obvious to assume that they will be well suited to ramie weaving.

Before evaluating the suitability of modern rapier looms for ramie weaving it is appropriate to consider their main advantages over shuttle looms. The four most important are:

1. Production speed. During the past decade the design and engineering of rapier looms has been revolutionised to the extent that, given optimum conditions, they exceed the weft insertion rates of projectile looms and exceed those of shuttle looms by a factor of six.

2. Weft patterning is inherently straightforward in rapier looms, whereas it requires massive, cumbersome and complicated mechanisms in shuttle looms. In fact, it was in colour woven markets that rapier looms made their first major inroads.

3. Weft supply. Cones are used to supply weft on rapier looms, as on other shuttleless looms. This simple fact means that all of the problems associated with changing pirns, or shuttles as is the case at ZhuZhou, which frequently lead to loom stoppages and fabric faults, are avoided.

4. Modern rapier looms have extremely sophisticated automated systems which are aimed at reducing weaver's workload and avoiding faults.

The first of these advantages is not achievable with ramie yarn. Modern, narrow width rapier looms are designed to operate at up to 550 picks per minute compared with 150 picks per minute for shuttle looms which weave ramie. The staff at ZhuZhou abandoned attempts to weave ramie on rapier looms precisely because they felt a loom speed of 200 picks per minute was too high. Whilst the author does feel that, with improved warp preparation, 200 picks per minute may be possible, it is unlikely that operating speeds for ramie be much greater in the foreseeable future. Most modern rapier looms are not suited to weaving ramie warps for a different reason. The increases in speed in recent years have necessitated a reduction in the movement of the reed and the healds, in other words a smaller shed is produced. This means that clinging is far more likely with hairy yarns - precisely the main difficulty with ramie warps. This is an even greater problem with flexible, guided rapiers where clinging may cause ends in the lower shed to be trapped between the rapier and the guides.

Weft patterning is not currently a feature of ramie fabrics, though if it were to become one, any rapier loom would have an advantage over shuttle looms since weft patterning devices are essentially a 'bolt-on' mechanism which can easily be retrofitted to rapier looms.

Dispensing with shuttle change mechanisms would be a considerable advantage in ramie weaving, especially at ZhuZhou Mill where the increase in weaver's work due to faulty change mechanisms is significant.

Whilst improved systems for fault avoidance are an advantage in any field of weaving, reduction in the labour requirement is far less important in the Chinese weaving industry than in Western countries due to the comparatively low labour costs. Whilst the balance will no doubt change over time, it is unlikely to do so within the useful commercial life of a modern rapier loom.

Chinese-made rapier looms of the type installed at ZhuZhou, although unsophisticated, do have a single overwhelming advantage: price. Figures which have been quoted suggest that the price ratio between rapier looms of the type installed at the R.T.D.C., a Somet SM93 (current model: Thema II), and Chinese-made rapier looms is somewhere between forty and eighty to one. A second advantage is that they share a shed geometry with the 1515 shuttle loom, in other words clear shed formation will be no more of a problem than it is at present, and any remedial action, such as the proposed use of restrictor rods will be equally applicable.

The recommendation with respect to rapier looms in ramie weaving is that development should centre on the Chinese-made rapier looms, but only after the quality of warp preparation has been significantly improved. This does raise the question of the value of the Somet loom installed at the R.T.D.C. The answer with respect to pure ramie warps is quite simple - it has none. It could, however, be used for research and development work on other yarns. It is known for instance that Somet and other manufacturers of similar looms have sold a number of machines in China, and it is conceivable that the R.T.D.C. may pursue links with the purchasers.

Research Report 4
Quality Control In Ramie Weaving

1 Introduction

An effective quality control system results in a product which is fit for its end-use at a cost which is acceptable to the market. This report does not dwell on the philosophy of quality control - there is an abundance of texts available which can do this with more authority than the author - instead a number of recommendations are made which are intended to address particular issues affecting the quality of fabric woven at ZhuZhou Mill.

There are many factors which influence the quality of woven fabric, accordingly, the scope of this report is broader than the title suggests, encompassing as it does winding, warping and sizing as well as weaving. The report has five further sections: the first describes the author's perceptions of the general situation, and the others make specific recommendations related to winding, warping, sizing and weaving.

2. General Observations

The fault rate in fine ramie fabrics woven at ZhuZhou Mill is higher than is desirable or necessary, and the weaving efficiency is considerably lower than that which could be achieved. These two factors are related: a reduction in the number of loom stoppages will inevitable lead to a reduction in the fault rate. Effective quality control procedures and an improved standard of maintenance throughout yarn preparation and weaving are essential to any strategy for improvement.

At present a traditional approach exists in that the technologists employed at the Mill have the main responsibility for quality. They conduct, in an effective manner, rather infrequent production studies during which the causes of stoppages are noted, although it is not clear what action, ensues. Other strategies include fabric inspection and feedback regarding faults to the department responsible. For example, yarn faults removed during winding are collected and returned to the spinning department. This approach does not adequately reflect the important contribution that each person involved at the various stages of production makes to the quality of ramie fabrics.

Each operative should:

1. Be aware that if their fabrics are to compete effectively in domestic and international markets quality and efficiency must be maximised;

2. Be aware of the effects their actions have on downstream efficiency and fabric quality;

3. Actively seek to improve quality.

The technologists should be responsible for:

1. Setting quality standards;

2. Monitoring quality in order to ensure that the standards are met.

3. Identifying causes of off-quality and instigating remedies.

Management should be responsible for:

1. Engendering a quality ethos so that people are encouraged, in a positive fashion, to actively seek methods for improving quality.

2. Implementing strategies which ensure that operatives are aware of their role in maintaining quality - the concept of quality circles might be a suitable mechanism. Another might be for employees to spend some time in other sections observing at first hand the interrelationships between their functions. For example, a sizing operative who spent some time working alongside a weaver would soon come to appreciate the problems which are caused by crossed ends.

3. Providing resources, both human and material, which facilitate the operation of quality strategies.

There is no doubt that the recommendations made in this report will increase the amount and cost of quality control and maintenance which are carried out in ZhuZhou Mill; there is also no doubt that then potential gains in productivity, quality, customer and employee satisfaction far outweigh those costs.

2. Winding

2.1 Maintenance

The recommendations given here should be regarded as being in addition to those given in the manufacturer's handbook.

At present the machine which is used to wind 36's ramie is fully inspected and maintained at three month intervals, a breakdown policy being operated in between. The difference in the state of the machine between July 1993 and February 1994 suggests that this is an inadequate strategy. It is recommended that, in addition to the routine maintenance schedule, the mechanic inspects each spindle once during each week for the following:

1. Correct functioning of the stop motion, the clearer and the mechanism which lifts the cone when full;

2. Satisfactory cone shape and density (subjective assessment);

3. Application of the correct type and number of tension discs;

4. The general condition of the tensioner, guides and stop motion bar - items which are excessively worn, grooved or pitted should be replaced;

5. Bouncing cones, cobwebbed cones and irregular traversing.

2.2 Production Studies

Automatic monitoring is becoming the rule on modern machinery, but it will be some time before this is the case in ZhuZhou Mill, and consequently manual monitoring should continue. The current production studies are suitable but their frequency should be increased to once a week. In addition, a cone from each spindle should be measured, weighed, and the mass of yarn found by subtracting the mass of the wooden centre. The results should be compared with standards drawn up as a result of the relevant project outlined in appendix 24 of the accompanying final report. This procedure will check not only the mass of yarn on the cone - this is already done - but the package density. The correct package density is vital to ensure satisfactory yarn withdrawal, especially when the package is nearly empty.

Each week the running tension of twenty five winding heads should be checked using a tension meter of an equivalent standard to the Schmidt unit now in the possession of the R.T.D.C. This test should preferably be made on the side which is out of production whilst winding yarn from cone to cone thus ensuring that the packages are used for each spindle.

An additional, monthly, quality control procedure should be to test the regularity of yarn taken from a random selection of ring tubes and cones. The results should be compared with standards which will be drawn up following the conclusion of the relevant project outlined in appendix 24 of the final report.

The results of these studies should be fed back the same day to the winding operatives, the winding mechanic and the supervisor of the spinning section.

3. Warping

3.1 Maintenance

The recommendations given here should be regarded as being in addition to those given in the manufacturer's handbook. As in winding, planned routine maintenance should continue. In addition it is recommended that the following occurs weekly:

1. Correct functioning of the stop motions and brake;

2. Application of the correct type and number of tension discs;

3. The general condition of the tensioners, guides and reed.

4. Misaligned cones.

3.2 Production Studies

The current production studies are suitable but, once again, their frequency should be increased to once a week. In addition the operatives should the record the frequency of stoppages by cause.

The results of these studies should be fed back the same day to the winding department.

4. Sizing

4.1 Maintenance

The recommendations given in the manufacturer's handbook should be followed. Particular attention should be paid to the condition of the creel brakes, the squeeze roller covering, and instruments for measuring size bath temperature, drying cylinder pressure and temperature, yarn moisture content and stretch. Each back beam and weaver's beam used should be checked to ensure the distance between flanges is constant, and that the flanges are not crooked and are sufficiently tight.

4.2 Procedures

The procedures in use for gaiting a new set of back beams are correct except that the ends must be counted into the reed rather than dropped in. The procedure for this is that the reed is raised so that the ends drop into the dents, traversed to the right, and the correct number of ends selected, moved to the lett and placed in the appropriate dent. Counting in could take up to an hour for an experienced operative, but the benefits which accrue from the reduction in crossed ends are very considerable. Two other points which require close attention are the optimum alignment of the back beams and the setting of the creel brakes.

During sizing, periodic measurements should be made of size viscosity and the size bath level. The various parameters for which there are gauges, for example size bath and cylinder temperatures, and especially moisture content, should be constantly under surveillance.

4.3 Technologist Measurements

The measurements which are currently made of stretch and moisture content should continue, and the results fed back without delay to the sizer.

5. Weaving

5.1 Maintenance

It is recommended that, in addition to the maintenance which is already carried out (which is likely to reduce as a result of what follows), each weaving mechanic should carry out a number of checks according to a time schedule for each loom. The checks are as follows:

Daily for each loom:

Observe a shuttle change.
Check the length of yarn on the pirns in the ejected shuttle.
Check length of weft tails at the edge of the fabric.
Inspect the fabric.

Weekly for each loom (i.e. check 1/5 of the looms per day).

Stop the loom using the warp stop.
Check the stop position.
Remove the shuttle and check it for damage which might indicate faulty flight.
Check the condition of the pickers.
Cut the weft on the shoulder of the pirn, replace shuttle and start the loom in order to check the weft stop.
Check the bottom shed position.
Insert a single pick and check the bottom shed position.
Restart the loom.
Check the condition of the remainder of the shuttles.
Check the let-off motion and back rail for consistent and accurate operation.

Whenever the warp is changed:

Check the shed timing for both sets of cams.
Check the condition of the temples and the take-up roller.

Check the picking settings and the condition of pickers, lugstraps and swells.

Lubricate all parts not usually accessible.

The result of each check should be recorded on an appropriate form as 'correct', 'out of adjustment' or 'new part fitted', as appropriate.

5.2 Control Of Fabric Appearance

The results of more than one investigation have shown that the relationship between the settings of the healds, warp stop motion and back rail and the appearance of the fabric are not fully appreciated. It is critical that the following standards are maintained.

1. Heald shafts should be fitted with enough rider clips so that the riders do not bend excessively. Six, three at the top and three at the bottom are needed for narrow looms.

2. The shedding cams should be set so that the healds level timing is between 270° and 280°, and should be the same on both pairs of cams. This is easily achieved in the following way: the loom is turned to the correct timing; the heald connectors are slipped onto the treadles and tightened to just remove play; the cam bolts are loosened and the cams allowed to turn so that the treadles are approximately level; the cam bolts are tightened slightly; a sufficiently long straight edge is placed so that it rests on both pairs of treadles; the first cam set is tapped as necessary until the treadles are exactly level and the bolts are tightened; the second cam set is levelled and tightened in the same way; the loom position is rechecked.

3. The heald connectors are adjusted so that the healds are perfectly level and the lower sheds just on the race board.

4. The backrest height setting at each side should be accurate to within one millimetre.

5. The horizontal and vertical warp stop motion settings at each side should be accurate to within two millimetres.

6. If, as is expected, the full trial described in appendix 24 of the final report leads to restrictor rods being adopted as a replacement for lease rods, similar accuracy of setting is essential.

5.3 Production Studies

It is recommended that the production studies which are currently carried out continue, but twice as frequently. Even at the increased frequency there will be a very long interval between studies on any one set of looms due to the low number of looms in a weaver's complement, and the results of a single study cannot be said to be representative of average weaving conditions. It is therefore recommended that a daily activity sampling study be added. This requires the technologist to visit each loom in the weaving shed and record it either as running or stopped, and if stopped to note down the cause. This type of study gives a useful 'instant' picture of weaving conditions in the shed, and the results of a number of such studies give a reliable indication of average weaving conditions. It is important that the time of the study is randomised. It may be interesting to point out that in Europe all looms are connected to a computer and records of loom activity and reasons for stoppages are continuously available both in the manager's office and in the loom shed.

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