DEVELOPMENT OF RAPIER PICKING MECHANISM TO SUIT POWER LOOM

A PROJECT REPORT

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ABSTRACT

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The cost of presently available high speed automatic loom and shuttleless weaving machines are high and beyond the reach of power loom industry. The existing powerloom manufacturers find it difficult to invest a huge sum in R & D to develop suitable low cost shuttleless loom. Also, the quality of fabric produced by the power loom industry is inferior compared to International standards and the power required to operate the shuttle during picking is about half of the power required to drive the whole loom. Also because of this heavy impact and shock, smooth sequence of weaving is disturbed which affects the maximum running speed. To overcome the above limitations of shuttle loom, the need for production of a loom with low cost and low power consumption is of high importance.

This can be achieved by modifying the power loom into a rapier loom which can run at 180 ppm. This consumes less power and the production cost is considerably low compared to a power loom.

The conversion of power loom into rapier loom involves the removal of shuttle moving parts, alteration of wooden sley and assembly of components. This mechanism expresses an idea of improving or to develop the Indian Power loom industry significantly.

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R & D – Research and Development

RPM– Revolutions Per Minute

PPM – Picks Per Minute

MPM – Metres Per Minute

HP – Horse Power

η – Efficiency

INTRODUCTION

1. INTRODUCTION

1.1 Aim of Developing A Rapier picking mechanism

Scope of Developing A Rapier mechanism:

The major scope of developing a Rapier picking mechanism is as follows:

- To reduce the capital investment.
- To minimize the power consumption.
- To improve the quality of fabrics.
- To increase the productivity & to decrease the labour ratio
- To make it simple, durable and ease of maintenance.

Special Features:

The special features in developing a Rapier picking mechanism is as follows:

- Intermediate process of pirn winding is eliminated.
- Power consumption will be lower due to direct drive.
- Insertion of weft will be stable.
- Ease of maintenance

1.2 An Overview of Weaving Loom Industry

Evolution of Weaving Looms:

History of weaving looms can be traced back to 17th century. The first power loom was invented by Edmund Cartwright in 1785. Originally Power looms were with shuttle, and they were very slow. But as the industrial demands for faster production accelerate, faster looms without shuttle came in use in early part of 20th century. As developments and innovations take place, various types of looms were developed for faster production. Today, Air-jet, Water-jet, Rapier and other computer operated looms are used to maximize production of special materials.

1.1.1 Indian Scenario of Weaving Looms:

Though weaving is one of the important sector for Indian textile industry, it has not been given due attention like spinning sector. Moreover structure of the industry plays a major role in making it competitive. Nature of this sector is mainly unorganized. The sector consists of fragmented, small and often, un-registered units that invest low amount in technology and practices especially in the power loom.

In India, there are approximately 5mn looms in the country. India has 1.8 mn Shuttle looms and 3.90 mn handlooms. The Indian loom industry is small scale unlike industry of China and Taiwan and therefore incurs high co-ordination cost. Advance technology installation demands skilled labour to understand and install such facilities, but shortage of skilled labour is also a roadblock in adaptation of new technology.

1.1.2 Power Loom:

The power loom sector produces more than 60% of cloth in India and textile ministry's estimation says that more than 60% of the country's cloth exports originated from that sector and comprises approximately 60% of total textile industry employment.

But modernization in looms is less and Indian industry still lags significantly behind US, China, Europe, Taiwan etc. (Texmin, 2005). Most of the looms we have currently in country are shuttle-less.

Shuttleless Looms:

Shuttleless weaving looms are up to three times more efficient than shuttle looms, but the penetration of modern shuttleless loom is very less. In 2001, there were some 27,000 shuttleless cotton looms in Indonesia, 21,000 in Thailand and 10,000 in India. In world share of shuttleless looms India ranked 9th. The chart shows the comparison of shuttleless loom proportion of India with other countries.

As described in the chart India has lowest number of shutteless looms among all competing countries. While competitors like China and Indonesia are far ahead in this modernization. USA and Russia has highest proportion of modern shuttleless looms.

1.2 Classification of Weaving Machines

Looms are classified mainly into handlooms and power looms. The power looms are classified further into the following categories.

- Tappet looms
- Dobby looms
- Jacquard looms
- Drop box looms
- Terry looms

1.2.2 Automatic Looms or Conventional Automatic Looms:

To get high productivity and good quality of fabric, additional mechanisms are added to ordinary non-automatic power looms. These looms are becoming popular because of their advantages of versatility and relative cheapness.

Examples:

- Pirn changing automatic loom
- Shuttle changing automatic loom.

1.2.3 Shuttleless Looms or Unconventional Looms:

In the non-automatic and automatic looms, shuttles are used for inserting the weft yarns. In these shuttle-looms, preparation of weft yarn and the weft insertion mechanism itself limit the loom production and fabric quality; they are also prone to mechanical problems in propelling the shuttle. Hence loom manufacturers have developed looms with various innovative and alternative means of weft insertion.

These modern looms are known as "shuttleless looms" and some examples of the looms are:

- Air-jet loom
- Water-jet loom
- Projectile loom
- Rapier loom
- Needle loom
- Various other methods include rectilinear multiphase looms.

1.2.4 Circular Looms:

In these looms, the shuttles move simultaneously in a circular path and tubular fabrics are produced.

1.3 Comparison of Shuttle Looms And Shuttleless Looms

1.3.1 Shuttle Loom:

The weaving is a process of formation of fabric with interlacement of two or more sets of yarns using a stable machine called loom. It is still not certain when the weaving process was introduced to human society. Except few activities elsewhere, the major developments in textile took place in England. In England the major shift from agriculture to woolen industry came in the 14th century. During all these years and a few hundred years after 14th century, the cloth was produced on hand-looms which were not equipped with fly shuttle.

In 1733, John Kay invented the fly shuttle which enabled weft to be inserted more rapidly. Edmund Cart Wright, an English clergy man, invented a so called power loom which could be operated from a single point by two strong men. Fortunately steam power was available by 1765. Soon power looms were driven by steam and most of the wooden parts were replaced with iron.

These looms then were stopped every few minutes in order to replace the empty weft pirns or cop in the shuttle and this limited the number of looms, a weaver could operate to about four. James Northrop, an English man invented an automatic weft transfer system which replaced the weft pirn in the shuttle without slowing or stopping the loom in 1889.

Similar developments took place elsewhere also, Ruti, a major loom maker of Switzerland manufactured automatic bobbin changing Northrop loom in 1898. After World War II, more productivity and efficiency were essential to overcome increasing labour costs in Western countries.

1.3.2 Limitation of Shuttle Looms:

Despite the relatively high speed and efficiencies in loom with conventional picking, productivity of these machines will continue to be limited as long as their fundamental constructions involved the use of shuttle propulsion. It is known that the power required for picking is proportional to the cube of the loom speed. If the loom speed is increased from 200 to 300 picks per minute, the power requirement would increase by a factor of $(3/2)^3$ i.e. 3.4 times approximately.

The limitation of shuttle loom results in following disadvantages:

- Greater strain imposed on the picking mechanism, thus rendering it liable to frequent failure.
- Greater amount of noise and vibration.
- Because of superior energy in shuttle, greater strain is again imposed on the checking mechanism.
- The movement of shuttle will be more difficult to control and there ... of its ejection from the loom.

The dynamic problems created by the picking and checking mechanism and the inherent process of pirn winding for shuttle looms had encouraged the loom makers to develop alternative means of weft insertion in which heavy shuttle is not projected forwards and backwards across the width of the loom. It is customary to refer these looms as shuttleless looms.

1.3.3 Development of Shuttleless Looms:

The various shuttleless looms that have been developed over a period of about 50 years can be classified into:

- Projectile Looms
- Rapier Looms
- Fluid Jet Looms
- Multiphase Looms

1.3.4 Advantages of Shuttleless Weaving Technology:

The Shuttleless weaving is becoming more and more popular due to the following advantages compared to conventional looms.

- High labour and machine productivity due to high speed and wider width of looms.
- Reduced labour cost due to higher allocation of looms and productivity.
- Defect free cloth for longer length.
- Better environment due to low noise level.
- Pirn winding process is eliminated
- Less value loss of fabrics.
- Low consumption of stores and spares.
- Less space requirement per metre of cloth.

- Wider width fabrics and multi width fabrics can be woven,
- High degree of flexibility to suit a wide range of fibers and counts.
- Easily adaptable for market trends.
- Bigger flanges can accommodate 3 times more yarn.
- Due to less beam changes lower down-time and lesser wastages.
- Less dependency on labour skill.
- Higher design capabilities duct to microprocessor and electronic controls.
- Easy maintenance and less work load for Jobbers.
- Lesser accidents.

1.3.5 Preference For Shuttleless Looms Over Automatic Looms:

It is also observed that for additional looms as expansion/ replacement of old looms, the weavers are more in favour of shuttleless looms rather than automatic looms. Automatic looms are not manufactured in India and even if they are available, the cost is not less than Rs.6 lakh per loom. Therefore, the units are going for shuttleless looms. They are wider width looms and therefore preferred as replacement for narrow width looms. The production capacity is four times more than the auto looms in grey fabric production.

Therefore it is preferred in areas like Somanur, Palladam etc. and also in other clusters of Erode and Salem. In case of yarn dyed fabrics, there is a possibility for the weavers to go for rapier looms that are more versatile and cost effective. The availability of second hand shuttleless looms in the price range of Rs.5 lakhs to Rs.15 lakhs has been another reason for the weavers' preference for projectile looms.

1.3.6 Penetration of Higher Technology In The Looms Used:

It is observed that the looms used presently are mostly plain looms and the number of automatic and semi automatic looms is very limited or almost insignificant. Only in the recent times, some leading manufacturers have procured few shuttleless looms of second

Considering the product types of the decentralized sector which comprises of significant quantities of grey as well as yarn dyed fabrics, the type of up gradation in the loom technology is to be understood in minute details and suitable measures are to be taken accordingly.

If the measures taken are not designed to meet the sectoral variations, the modernization goal will not be achieved. Most of the entrepreneurs are of the opinion that only conventional shuttle looms or at best semi automatic/automatic shuttle/pirn change looms are economically viable for most of the qualities woven despite all the limitations posed by them.

To cite a few examples of technological changes that are taking place in the power loom sector of the state, shuttleless looms of Sulzer make have been imported and installed by units in Somanur, Palladam areas of Coimbatore cluster, Komarapalayam in Erode cluster, Salem, Chennai and nearby areas of Chennai cluster and in Rajapalayam area of Madurai cluster (where the exportable gauze cloth weaving is predominant) Computer aided designing has been started in Karur. In the Kappalur industrial estate outside Madurai, there are about 50 units each with 4-8 new automatic shuttleless or second hand imported looms. There are few units near Salem with shuttleless looms imported as second hand machinery.

A few enterprising entrepreneurs have already put up shuttleless looms as stated above but they are very insignificant in number. So far a majority of the power loom weavers have been unable to avail funds under the TUF Scheme and only a few well to do units have gone ahead with modernization albeit without TUFS.

1.4 Types of Loom

1.4.1 Introduction:

The power loom industry in the state produces grey fabrics for further processing including surgical/bandage cloth as well as yarn dyed textile items like saree, lungi, made ups like bedsheets, furnishings, napkins etc. All the yarn dyed fabrics are being produced by the handlooms also that have been taken over slowly and gradually by the power loom sector.

Based on the above production pattern, the technology level of looms used in the state has remained low and these are treated in the perception of the weavers as

Thus, the check varieties including lungi materials have been produced on plain looms without drop box attachment by resorting to manual pirn changes as required for checks. With this background one should view the technology level of looms in the state in order to understand them better.

1.4.2 Plain Loom:

Plain loom denotes the loom without any warp or weft stop automatic control mechanisms. Also, the take off motions may not be present in the loom. However, in such looms dobby, jacquard or drop box attachment may be present as additional attachments according to the requirement of the weaver.

1.4.3 Semi Automatic Loom:

This type of loom is basically the plain loom with additional attachments of automatic electronic/mechanical warp stop as well as weft stop motions along with positive let off motions. In the case of some clusters of Tamil Nadu power loom sector, the looms without positive let off motions but incorporating automatic warp and weft stop motions have been classified as semi automatic looms. As in the case of plain looms, the semi automatic loom may have additional attachment of dobby or jacquard or drop box as the case may be.

1.4.4 Automatic Loom:

An automatic loom is basically one that has auto pirn changing mechanism along with all the automatic warp and weft stop motions as well as positive let off motions.

1.4.5 Shuttleless Loom:

Shuttleless loom may be of the type of air jet, water jet, projectile, rapier etc. In the case of Tamil Nadu power loom sector, there are only projectile or rapier looms with attachments of cam-dobby etc. and procured normally as second hand machinery.

1.5 Estimated Number of Looms And Their Types

1.5.1 Introduction:

It is observed that around 91% of the looms in the state's power loom sector are the positive let off motion. Only less than 7.5% of the looms are of improved type and identified as semi automatic looms having warp/weft stop motions as well as let off motion. There are a small number of automatic and shuttleless looms in few pockets, which is gradually expanding. The survey data reveals that 1% of the looms are automatic and0.3% of the looms are of observations also, these estimates of automatic and shuttleless looms are found to be consistent.

1.5.2 Type Wise Loom age In The Clusters:

Among the clusters, the predominant presence of plain looms in proportion to the total number of looms is observed. In the case of Salem cluster, there is a predominance of semi automatic looms. Out of the total semi automatic looms in the sector, two-thirds of the semi automatic looms are in this cluster. The looms with two additional mechanisms only have been considered as semi automatic here whereas in other clusters in addition to warp and weft stop motions, positive let off motion has also been considered as an integral part of the semi automatic loom. In the case of automatic looms, Coimbatore cluster has the largest concentration accounting for 47% of the total automatic looms. Regarding shuttleless looms, significant presence is observed in Coimbatore, Madurai and Erode clusters.

S.No	Name of Cluster	Type Of Loom			
		Plain	Semi Automatic	Automatic	Shuttleless
1	Coimbatore	33.37	11.65	46.91	37.93
2	Erode	25.69	12.32	16.12	17.24
3	Karur	6.88	1.43	4.85	3.45
4	Salem	23.46	69.88	6.55	13.79
5	Madurai	5.01	4.65	24.24	20.69
6	Chennai	5.59	0.07	1.33	6.90
7	Total	100.00	100.00	100.00	100.00

Table 01: Estimated Type Wise Loomage In The Clusters (In %)

Within the clusters, the composition of different types of looms also reflects the same trend. In all the clusters, the plain looms are seen to hover around 80% or more in the total looms. The rest constitutes of the semi automatic, automatic and shuttleless looms in each cluster. In the case of semi automatic looms, it is the largest in Salem accounting for20% of the cluster's total looms. It is the lowest in Chennai cluster forming less than 1% which may be due to the non-preference of weavers for installing auto warp and weft stop motions. One more factor for the avoidance of semi auto mechanisms is that one weaver tends only one loom and most of the looms are having dobby/jacquard attachments for producing home textiles with woven designs. Automatic looms form a significant proportion in Madurai cluster as many of them are engaged in the production of medical textiles in grey form and, therefore, there is a preference for automatic looms in this cluster.

In Coimbatore and Karur also, these automatic looms are more compared to other clusters. Regarding shuttleless looms, larger number of looms are found in Coimbatore cluster which is a more advanced region compared to others and in the total 1.39 lakh looms, it forms around 0.4%. In Madurai cluster also, the proportion of shuttleless looms is very significant and the reason for this may be the higher investment capacities of the weaving units that are concentrating on export business.

1.6 Significance of Modernization

1.6.1 Introduction:

The power loom sector produces only low and medium value products in grey fabrics, yarn dyed dress materials and bed/kitchen linen items. The loom technology level is awfully low as more than 90% of the looms are plain looms without auto stop motions for warp and weft as well as absence of positive let off motions. In order to move up in the value chain, the loom technology level has to be improved substantially along with forward and backward process improvements.

The quality of fabric produced by the power loom is by and large inferior compared to the international standards. Although the quality of yarn supplied by spinning mills to weaving industries are quite acceptable, the poor quality of fabrics produced by the sector are mainly due to the following reasons.

- Power loom units are small in size, majority of them having 8 to 12 looms. The power looms used are of low cost and obsolete in technology.
- The existing power loom manufacturers find it difficult to invest a huge sum in R & D to develop suitable low cost shuttleless loom.
- The cost of presently available high speed automatic loom and shuttleless weaving machines are high and beyond the reach of power loom industry.

Considering the above aspects, it is proposed to design and develop a low cost rapier weaving machine as a means to modernize Indian power loom sector.

1.6.2 Upgradation of Looms:

The decentralized sector of power looms in Tamil Nadu contributes significantly to the fabric demand for domestic consumption as well as exports and therefore, it is most important and crucial to the economy of the country in general and to Tamil Nadu in particular. Improved looms with better technology will ensure the quality fabrics production either in grey or yarn dyed form.

Considering the above, Modernizing/upgrading technology levels in the power loom sector has become imperative and the central / state government has initiated urgent measures in this direction. Since the year 2001-2002, the implementation of the National Textile Policy took off with the including duty relief, concessions and special programme aimed at accelerating modernization and growth of the textile industry. It has specifically emphasized on modernization of the weaving sector by launching a programme for induction of 50,000 shuttleless looms and conversion of 2, 50,000 plain looms into semi automatic and automatic looms in the decentralized power loom sector.

In the light of the above targets and the urgency to meet the deadline of WTO regime beginning from January 2005, the induction of shuttleless looms and up gradation of the plain looms into automatic and semi automatic looms in the state is urgently called for. In order to achieve the targets in the above direction, the present status of the technology levels and loom conditions as well as the investment capabilities of the power loom owners are assessed through the study which are presented below which will help to arrive at solutions for

The power looms in Tamil Nadu are really an improved form of handlooms only. This is the reason for the dominance of plain looms in the state. The preparatory activities of dyeing, warping etc. have remained low technology activities. Therefore, it should be considered in the proper perspective. The functioning of handloom co-operative societies as well as the handloom master-weavers/manufacturers have been declining very fast and their profitability is disappearing due to the substitution of power looms production. It is now a well known fact that the number of sops being provided to the handloom sector are not resulting in desired achievements. Considering the need for replacing unviable handlooms by power looms, the approach of differentiating between handlooms and power looms in Tamil Nadu should go. There should be total integration of handloom and power loom activities in the private as well as in co-operatives, which will go a long way in improving the industry's health and fortunes.

The existing marketing set up of Co-optex will thus be open for power looms that will be great advantage for power looms to avail of the network of marketing facilities As seen above, more than 90 percent of the looms are plain looms without any auto stop mechanisms for warp and weft breakages. Irrespective of the type of fabrics stop mechanisms for warp and weft breakages. Irrespective of the type of fabrics produced, the machinery remains as simple as possible. The power loom owner is able to produce check-varieties not only with drop box looms but also looms without drop boxes by resorting to manual practices for pirn changing. Even now it is a very common practice which results in less output and lower quality. The dobby and jacquard attachments are not of sophisticated types but of rudimentary ones that the weaver is forced to install in their looms.

1.6.3 Power Loom Owner's Awareness Regarding WTO Regime

The power loom owners are not generally aware of the coming changes due to WTO regime and therefore they were asked to respond in this regard. It is observed that only 40% gave an affirmative reply regarding awareness of WTO regime to be in place fully by the beginning of the year 2005. The response for further queries relating to WTO regime and its understanding was also minimal. Nearly 60% of the units expressed the view that they were unaware about the implications of WTO regime.

The respondents were asked to confirm regarding their understanding of the export market as a result of WTO related procedures being implemented. Only 26% of the units gave a positive answer to the above. A majority of 74% confirmed that they do not understand the effects of WTO regime on the competition levels in domestic as well as export market that are going to be increased in terms of pr ice and quality. The respondents were further asked to state whether they presumed that the present quality as well as price of their products were good enough to compete successfully in the global market even after the year 2004. Surprisingly enough, a majority of 68% of the units expressed view that the price and quality of the products were good enough even after 2004 to compete successfully. Only a small percentage of balance units had opined that their quality and price are not favourable for meeting the competition.

In this context, it may be mentioned here that even the Expert Committee report has indicated the same belief and stance of the power loom sector in the following words:

"As long as the domestic market is concerned, it is cost conscious and demands are price elastic, power loom operators find little reason to invest in modernization or produce quality fabrics. A study recently conducted by the National Productivity Council on modernization of power looms has observed that for at least next 2 decades, loom operators are not expecting any change in the market behaviour and confident to manage the situation with their traditional looms. The Committee views this smugness in the backdrop of ensuing globalization of textile trade before 2005 with concern and considers it as a complete misreading or ignorance of the globalization process or its likely impact" (Satyam Committee Report).

1.6.4 Modernization Plan of The Power Loom Units:

In order to judge the level of readiness for modernizing their units among power loom owners, they were asked whether they are having any plan to modernize and or increase the capacity of their units in the immediate future. Here again, more than 52% of the units have confirmed that they have plans for modernizing the units, though the exact meaning of modernization may be differing widely for each one of them. The balance 48 percent are not having any interest in upgrading the technology level of the looms or putting up shuttleless and modern looms.

From among the 604 units having plans for modernization, 597 have reported that they are thinking of upgrading their looms or modernizing them. Around 30% of the above units have expressed that they would like to modernize their units with changes in the building/work-shed. The expected average minimum amount of investments for modernization is Rs. 40,000 and the maximum amount is seen to be Rs.3 crores.

1.6.5 Time For Completion of Modernization In The Unit:

The power loom units desirous of taking up modernization work were asked to indicate the period of completing the work. Accordingly, they indicated the possible period of modernizing their units. Out of the total 604 units, nearly 16 % of them have given the period of completion as three months; another 22 % of the respondents have given the completion period as 4–6 months. Nearly 46 % of the units have reported the completion period to be above 6 months but less than one year. The units indicating the completion period as more than 12 months form about 17 % of the 604 units having modernization plan.

1.7 Issues In Modernization

1.7.1 Modernization Issues:

The power loom units are widely dispersed and located in hundreds of semi urban and rural areas in the state. It is next to impossible to list out all the villages where the power looms are installed in tiny and cottage units. This wide dispersal and spread is unique to Tamil Nadu alone. This may be perceived as an advantage for modernization of the sector in Tamil Nadu. The space constraint is absent for the units and entry of new units is easier and existing units can easily expand by acquiring additional space at lesser cost The looms are located in sheds put up in agricultural lands Yet another aspect of the power loom sector is that in certain areas, specialization on specific products is adopted.

In Coimbatore cluster, it is grey fabrics that are being produced in more than 1.35 lakh looms. This facilitates sizing units required for grey cloth. This area-specific specialization provides certain advantages for process improvement through modernization.The modernization of pre-weaving processes/machinery will thus be in tune with the process requirements for the product groups. In the case of furnishings/ made-ups in [illegible] domestic market, the wider width fabrics and the dyed

In domestic market, generally the preference is moving towards wider width fabrics that should be addressed to. Tamil Nadu requires a different strategic approach for upgradation/modernization of its power looms. The introduction of shuttleless looms will be achieved only by a slow and gradual process and not in the short run. Modernization is definitely the need of the hour for the power looms.

The growth of power looms in Tamil Nadu is comparatively at a faster pace than its counterparts during the last two decades. This unaided growth of tiny and small unviable units is not conducive for the health of the sector.

1.7.2 Issues Relating To Modernization of Looms:

The Expert Committee refers to the phenomenal growth of the power loom production in volumes rather than in quality. It is stated in the report "Though there is a quantum jump in the production of cloth by the power loom sector over a period of time, the quality of cloth leaves a lot to be desired. There has been almost no technology up gradation in the power loom sector over the last 40 years. Though precise data regarding the level of technology and different types of looms installed is not available, it is estimated that only about 3000 shuttleless looms including a substantial number of second ones are installed in power loom sector".

In the context of Tamil Nadu power loom sector, the technology up gradation of looms and their modernization may involve the following:

- Upgrading the plain looms into semi automatic looms by providing the auto stop motions for warp and weft as well as positive let off mechanism.
- Replacing the plain looms with semi automatic looms. This will be possible by discarding obsolete looms and also ooms with width less than 140 cms (less than54 inches).
- Installation of shuttleless looms as replacement to old looms or as expansion to existing unit.

1.7.3 Problems Relating To Upgradation of Technology Level of Plain Loom Into Semi Automatic Looms:

The average cost of upgradation by means of adding auto stop mechanisms for warp and weft as well as positive let off mechanisms in Tamil Nadu power loom sector is stated to be Rs.15,000. Out of this, the electronic warp-weft stop mechanisms are stated to cost a minimum of Rs.5000 and the major chunk of upgradation cost of Rs.10, 000 is needed for the positive let off mechanism. As seen from the survey findings, the upgradation of technology level from plain loom to semi automatic stage is fraught with many obstacles and problems that are as indicated below.

1.7.4 Lack of Capital To Invest In Upgradation By Majority of Power Loom Operators In The State:

It is evident from the data provided above that majority of the units are tiny and small working on job orders from master weavers. They are not having enough working capital even for meeting the running costs of power, wages to worker etc. Therefore, the additional investment of Rs.15000 per loom for upgradation is not available fully or partly with the power loom operators. Secondly, even if they have some amount of funds as savings/additional investment, this will be utilized for the expansion of loom capacity only.

The reason is not far to seek as the present cost of second hand looms is near about Rs.15,000 only. This loom will be without any individual motor and therefore will be run on shaft from the existing single motor. Even if a brand new loom is desired to be installed for expansion, the new loom cost will not exceed Rs.30000 per loom (without involving any cost for motor). Therefore, the small power loom operators are tempted to invest their savings on additional plain looms and not upgradation. This kind of lateral expansion is more evident in areas like Somanur and nearby grey cloth producing areas.

1.8 Modernization Significance

1.8.1 State Government Subsidy Scheme For Upgradation:

The state government has initiated a scheme for providing subsidy to the extent of Rs.2000 per loom or 20 percent of the cost whichever is less. This scheme is restricted to [partially cut off] owning one or two looms and not for those with more than two looms.

Even if the small owners come forward to avail of this subsidy, so far the implementation of the subsidy scheme has not been given effect to. Recently the state government is set to have prepared a plan to announce the increase in the subsidy making it Rs.5000 per loom for upgradation by installing the two auto stop warp-weft mechanisms As the scheme is not applicable to a majority of power loom owners, there will be no major impact on the looms

1.8.2 Wider Width Looms:

Almost all the looms in the sector are smaller width looms and only a few thousand looms are more than 90 inches. In order to achieve quality production at economic costs, the loom should be preferably wider width. A major portion of the power looms engaged in the manufacture of towels, napkins etc. are of narrow width looms that are to be discarded and wider width looms should be increased. However, the weavers are reluctant to go for replacing the narrow width looms.

Some of these weavers are putting forth a demand to make the narrow width looms eligible for upgradation loan under TUFS. The reason for unwillingness to discard narrow width looms is the absence of resources for tiny weavers Therefore, only with attractive compensations; the narrow width looms can be removed. This is specific to Chennimalai and some other places in Erode cluster. As the majority of looms are in the range of 54-60 inches, the replacement of such looms with wider width looms calls for major efforts.

Presently, only 5% of the looms are seen to be of more than 120 inches whereas the market is increasingly growing for wider width fabrics only. Due to this factor, there is greater urgency to go for wider width looms by replacing /discarding the existing looms of48 inches to 90 inches. At the present juncture, the job work units may not come forward for scrapping their working looms and go for wider width looms.

1.8.3 Preference For Shuttleless Looms Over Automatic Looms:

It is also observed that for additional looms as expansion replacement of old looms, the weavers are more in favour of shuttleless looms rather than automatic looms. Automatic looms are not manufactured in India and even if they are available, the cost is not less than Rs.6 lakh per loom. Therefore, the units are going for shuttleless looms. They are

The production capacity is four times more than the auto looms in grey fabric production. Therefore it is preferred in areas like Somanur, Palladam etc. and also in other clusters of Erode and Salem. In case of yarn dyed fabrics, there is a possibility for the weavers to go for rapier looms that are more versatile and cost effective. The availability of second hand shuttleless looms in the price range of Rs.5 lakhs to Rs.15 lakhs has been another reason for the weavers' preference for projectile looms.

1.8.5 Modification of Shuttle Looms:

All shuttle looms can be modified in such a way that weft can be inserted continuously without frequent pirn change. This method can be used in all types of plain looms attached with dobby and also with drop box/under pick/pick and pick mechanisms. In ordinary weaving, one has to change the weft yarn during a weft pirn exhaust. In this new method two weft cones stands are provided at sides of the loom and they are specially arranged so that they have the capability of controlling yarn tension and electronic weft stop motion. The yarn from the pirn is only used to bind the weft taken from the cones. By doing so, expense on pirn winding is reduced. This method of weaving takes place by two weft threads so that the fabric is dense and with good cover. One has to change only cones here unlike rapier looms, where frequent change of pirn is required. This can weave up to one thousand meters thereby reducing manpower and time.

Fifty percent of the total warp threads are lifted at a time and the remaining are kept down for the first pick and for the next pick the system is reversed. To enable this, the heald frames are connected to dobby in such a manner that there is no collision in between the healds. The dobby mechanism can be used to select the weft colours as and when required. A special mail eye is fitted in the dobby and they are lifted so that the required colour weft can be drawn through a particular mail eye. An additional hole has been made in the shuttle to give proper tension of pirn threads, which interlock the pirn from the cones. With this system one can weave half of the fabric with one colour, another half with a different colour by keeping two different colour threads in both sides of the cones. By providing more number of cones of different colours at the feeding end (selection of weft colours by dobby) one can weave stripe or check patterns without drop-box mechanism.

The advantages of this system are numerous. For wider width looms this production without any additional expenses. Using this method one can weave fabrics like cotton, rayon, polyester, silks using normal plain power looms. The electronic warp stop motion and electronic weft stop motion on these looms give a fault free fabric. The system is less expensive and easy to maintain. The productivity improvement in terms of saving of time for weft replenishment is from fifteen to twenty percent. Further fabric quality obtained from this innovation is quite good due to very few stoppages for weft replenishment.

In the preparatory operation, the weft winding which includes a separate machinery and manpower is practically eliminated. It results in a considerable saving in terms of manpower, machinery and floor space. Overall workers community says "this innovation will lead to significant improvement in productivity in the existing low cost conventional power looms. It can be readily applied in almost all the power loom weaving clusters. Also, it results in a considerable saving in terms of man power, machinery and floor space.

1.8.6 Strategies To Be Adopted By The Small Scale Sector To Optimize Production And Control Cost:

The following strategies to be adopted by the small scale sector to optimize production and control cost:

- Procure the indigenous/imported shuttleless looms ready to weave with healds, heald frame. Warp beam, drop pins can be procured locally from reputed manufacturers to bring down the capital cost.
- Humidification system should be for minimum 24 looms to keep the cost low.
- In case of air jet loom, compressor should be running 24-48 looms to reduce the cost. Air should be free of moisture and oil.
- Employ contract skilled labour for knotting /drawing/loom cleaning to bring down the labour cost.
- Arrange to have the warp beam size from reputed sizers.
- Shuttleless loom utilization should be 95% and above.
- Maintenance personnel can be shared among a group of entrepreneurs.

- Common spare parts storage to bring down the loom down time.
- Insist on loom manufacturer's representative to do the loom audit and maintenance check-up.
- Cloth inspection / packing should be on contract basis.

1.8.7 Significance of Modernization:

The power loom sector produces only low and medium value products in grey fabrics, yarn dyed dress materials and bed/kitchen linen items. The loom technology level is awfully low as more than 90% of the looms are plain looms without auto stop motions for warp and weft as well as absence of positive let off motions. In order to move up in the value chain, the loom technology level has to be improved substantially along with forward and backward process improvements.

The quality of fabric produced by the power looms is by and large inferior compared to the international standards. Although the quality of yarn supplied by spinning mills to weaving industries are quite acceptable, the poor quality of fabrics produced by the sector are mainly due to the following reasons.

- Power loom units are small in size, majority of them having 8 to 12 looms. The power looms used are of low cost and obsolete in technology.
- The existing power loom manufacturers find it difficult to invest a huge sum in R & D to develop suitable low cost shuttleless loom.
- The cost of presently available high speed automatic loom and shuttleless weaving machines are high and beyond the reach of power loom industry.

Considering the above aspects, it is proposed to design and develop a low cost rapier weaving machine as a means to modernize Indian power loom sector.

LITERATURE REVIEW

CHAPTER 2

LITERATURE REVIEW

2.1 Development of Weaving Machinery In Past

2.1.1 Replacement of Shuttle:

When Northrop patented his pirn changing mechanism it revolutionized the weaving industry by eliminating the process of weft replenishment of the shuttle from the work of the weaver and making it possible to greatly increase the number of looms allocated per weaver. The shuttle, however, continued to carry the weft from selvedge to selvedge not withstanding numerous attempts to replace it by rapier and air jet weft insertion. The Murata MJ-4 air jet weaving machine was the first commercially successful air jet weaving machine. Then the Elitex machine with single jet and Ruti `C' Strake L5000 with relay nozzles came.

2.1.2 Launch of Rapier Looms:

In the 1920s, attempts were made to dispense with the shuttle and insert weft by rapiers from a large external package. Gawsworth inserted the weft by a carrier which acts as a small shuttle and weft is inserted from one side of the loom alternatively and after insertion returning with a pick from a second weft supply at the opposite side of the machine. The weft was accurately cut into two pick lengths, so that only alternate picks were cut at each selvedge. The Gabbler rapier system introduced the weft in the form of a hairpin by using the loop transfer system. All rapier machines in current production utilize the Dewas system of single sided insertion with tip to tip transfer.

The working hours required to weave 100 meters of fabric have been reduced from about 20 to 0.25 during the last 125 years, and in the last 40 years there has been a reduction of 95% in operative hours per standard unit produced.

2.2 Need For Shutteless Weaving

2.2.1 Limitation of Shuttle Looms:

The shuttle has to be accelerated rapidly at the starting of the picking cycle and also to be decelerated, stopped abruptly at the opposite end. This process creates heavy noise and shock, and consumes considerable energy. The power required to operate the shuttle during picking is about half of the power required to drive the whole loom. Also because of this heavy impact and shock, smooth sequence of weaving is disturbed which affects the maximum running speed.

The small weft package requires frequent replenishment, which increases the workload of a plain loom weaver. In case of automatic looms where the replenishment is done automatically, for each change there is a possibility of weft failure. The probability of fabric defects in weft way is higher due to frequent replenishments. It may be noted that about 70% of the fabric defects are in weft way in case of shuttle looms. In case of multi color weft insertion, there is necessity for multiple box motion which limits the speed of the machine.

2.2.2 Alternation To Shuttle Looms:

To overcome the above limitations of shuttle loom, the need for a better weft insertion system without shuttle has been realized and many attempts have been made. In the early fifties projectile weft insertion has been accepted as commercially viable unconventional weaving machine i.e. Shuttleless loom. Later in late sixties the rapier weft insertion and in early seventies air-jet, water-jet weft insertion systems were broadly accepted by the industry. These unconventional weaving machines proved technically and commercially feasible alternatives to shuttle looms.

The different types of weft insertion systems were used for different fields of application. For example air-jet weft insertion system can be used for medium range mass production requirement, rapier weft insertion system can be used for fancy and fashion materials, projectile weft insertion system can be used for industrial fabrics etc.

The replacement of shuttle by other methods of weft insertion does not bring any fundamental change in the sequence of basic weaving operations i.e. shedding, picking and beat-up. However, lot of improvements in terms of precision has been taken place in order to withstand the comparatively higher speeds. Similarly primary and auxiliary motions like take-up, let-off, warp stop, weft feeling etc. do not differ in principle.

2.2.3 Feature of Unconventional Weaving Machines:

The most common features of all unconventional weaving machines are:

- Large weft supply package, mostly in the form of a cheese or cone.
- Unconventional selvedge formation i.e. Leno, tucked in etc.
- Weft accumulator
- Weft cutter on either one or both sides.

2.3 Salient Features of Rapier Machine

2.3.1 General Factors:

- The low cost rapier loom can be manufactured by small power loom manufacturers, which will be affordable to power loom units.
- Weft way defects like starting mark, weft crack, etc. can be minimized.
- Stable weft insertion.
- Intermediate process of pirn winding can be eliminated.
- More allocation of looms per weaver.
- Gain of 2.5 times more output per shift.
- Low power consumption due to direct drive.

2.3.2 Weft Insertion By The Rapiers:

The main distinctions as regards weft-insertion methods are illustrated in Fig.2. In the simplest cases, in each loom cycle' the tip of a single rapier is inserted across the whole width of the shed and then withdrawn, weft being inserted during rapier motion in one direction only. Because the progress of shedding and beat-up is inhibited over the whole period for which the rapier is in the shed, the loom cycle is not utilized well, and only a few looms use this method; it has the merit that problems of weft transfer do not arise.

The loops of weft at the other selvedge can be secured either b knitting them together or with a catch thread. The rapier can simply have the weft permanently threaded through a hole near its tip, and it must then enter the shed from the weft supply side. This technique is widely used on narrow fabric looms and on carpet looms, but otherwise on a few special-purpose machines. If single picks are inserted then, of course, the normal range of weaves can be produced, but looms using this technique are slow running and it too is not often used.

2.3.3 Loop Transfer Method:

Normally, two rapiers enter the shed from opposite ends and the weft is transferred from one to the other when they meet, and they are-then withdrawn. In this way, the intervals for rapier insertion and for rapier withdrawal are both used for weft insertion. Invariably, on full width looms, only a single pick of yarn from a given supply package is inserted, but it may be inserted as a loop up to the time of transfer, and the transferred loop straightened out during rapier withdrawal from the shed (the loop-transfer or Gabbler system). Yarn withdrawal from the weft package is thus completed at the time of transfer. This has the disadvantage that prior to the transfer the rate of weft withdrawal from the up ply package is' high (it equals twice the rapier velocity), and subsequently it is zero; also after transfer the free end of the pick could untwist (Fig. 2 c). Loop transfer was at one time widely used as it can facilitate the formation of semi-conventional selvedges, but it is now available as one of the options on only a few looms. With loop transfer the use of some form of weft accumulator is often standard.

2.3.4 Tip Transfer Method:

Almost invariably it is the cut end of the weft which is transferred (end or tip transfer, also known as the Dewas system, Fig. 2 d). This entails incorporating yarn clamps in the head of both the giver and taker rapiers, instead of just yarn guides. There is a continuing development of new techniques to improve weft control or conditions during the weft-transfer operation and four quite different strategies may be noted. First, the yarn clamps in the rapier heads can be positively actuated at the transfer (in addition to any positive actuation at weft pick-up and release) as on the Dornier and Iwer K2-330 100ms.Second,

. Note the guidance of the rapier head by the reed and race board on some rigid rapier loom such as the MAV, and the use of electromagnets in the central zone of the race board on the Meteor loom, for instance.

2.3.5 Indirect Transfer Method:

Third, the rapier displacement-timing characteristic may be elaborated with the aim of giving more favourable conditions in the transfer region. As an example, we may note the varying pitch along the screw-cam on the Vamatex Propeller loom. Fourth, there is the use of indirect transfer. That is, problems of yarn handing during transfer are avoided, by transferring the yarn clamp from one rapier to the other than the weft yarn itself, which remains gripped by the same clamp throughout If indirect transfer is used to insert weft from only one side of the loom, a given yarn clamp will have to be returned empty o the supply side ,after use, and different methods of doing so are encountered on the two currently available looms. On the Acutis loom there are several yarn clamps, and these are returned empty to the supply side by a conveyor running under the weaving zone, in a manner reminiscent of the Sulzer machine. On the Mintiss each rapier enters the shed carrying a clamp, and these are exchanged at transfer, one bringing yarn from the supply side, the other returning empty.

The ability to insert single pick is usually required, to give the normal range of weaves, but some weaves can be produced most efficiently if in addition, when required, picks of more than one yarn can be inserted together in a single-loom cycle. It is only possible for given yarns to be inserted dither together in this way or separately, as required, on shuttle-less looms, and this facility has been provided on some rapier looms Eg. Dornier Iwer. (The possibility of simultaneously inserted picks twisting needs to be considered though.)

2.3.6 Present Nature of Rapier Weft Insertion:

Finally, it may be remarked that now a day's rapier looms almost always insert weft from one side of the loom only. Apart from avoiding the need to duplicate the weft supply and selection systems, each rapier has then to perform only one role, that of giver or taker, and can be designed specifically for that role. Insertion from both sides was common,

2.4 Types of Rapiers

2.4.1 Flexible Rapier:

The rapiers used for weft insertion usually take the form either of rigid rods or of flexible metal or plastic tapes or bands. Both rigid and flexible rapiers have long been used on comparable numbers of makes of loom. Rigid 'rods can, of through the shed from outside the working width.

In some cases, though, guidance within the working width is provided at the shed boundary by a board, possibly aided by the upper warp sheet or reed, or both, presumably to facilitate control over rapier location at weft transfer. In contrast, rapiers consisting of flexible tapes must always be guided within the working width.

In some cases the rapiers are guided at the shed boundary as described, but more often guide plates mounted on the sley at short intervals across the width are used. The motion given to the plates is such that they enter the shed through the bottom warp sheet as the sley moves back, and leaves by the same route prior to beat-up.

2.4.2 Rigid Rapier:

Rigid-rapier method lends itself to simultaneously inserting weft in two sheds one above the other, using a separate pair of rapiers for each shed, Rapier looms of this kind have been found to have advantages for the face to face weaving of warp-pile fabrics, and such looms are also available for weaving two separate fabrics without pile, one above the other.

A third type of rapier has recently come into use. Like the rigid rapier this has lateral rigidity, but consists of two or three 'telescopic' components. One component is connected directly to the rapier drive, and its weft-way position determines that of the second component, by means of a mechanism such as, the rapier thus becomes fully extended when' inserted in to the shed, and the components telescope together when it is withdrawn.

2.5 Benefits of Rapier Loom Over Conventional Power Loom

Conventional Power-Loom	**Rapier Loom**
55-65% Efficiency	85-90% Efficiency
Max. 120 RPM (eff. 70 RPM due to lower efficiency)	Max. 350-400 RPM
Lower Output per shift	Up to 3 times more output per shift
High Labour requirement	Low labour requirement
'Kandi / Shuttle / Pirn-Winder' machine & operator required	Shuttleless (No Kandi, No Pirn, No Pirn Machine Operator)
High Maintenance because of extremely high vibration	Extremely low vibration, hence lower maintenance
Light-Weight leading to shorter life and higher vibrations	Heavy-Duty Structure to reduce vibration thus leading to longer life
Lower Output per unit area of floor space	3 times more output per unit area of floor space
High Production Cost: Due to lower labour productivity and lower efficiencies and higher costs per T meter of fabric.	Lower Production Cost: Due to lower labour and lower area and lower power requirement per meter of fabric.

Table 02: Conventional Power Loom Vs Rapier Loom

2.5 Techno–Economics of Power Loom After Converting Into Rapier Loom

Quality of the fabrics produced by automatic looms is by and large inferior compared to the international standards, in spite of availability of better yarn quality and also, cost wise it is becoming very difficult to compete with other developing countries. The manufacturer's who are in position to give maximum attention to productivity, quality and economy will survive in this competitive market. The commodity fabric requires simple but highly productive weaving machines such as the jet weaving. In the complex fashion oriented fabric market, highly flexible machines such as rapier weaving machines are required.

In the last decade the loom installations have seen competition in air jet and rapier technology. By understanding the need for modernization and the technical merits of new weaving technologies, the economics of different types of looms has to be considered and revaluation has to be done. Many people feel that fastest running machines will give better profitability. But in many cases the fastest running machine is not the most economic and cheapest one. The reasons are certain products have physical limitation, which do not allow full utilization of the maximum speed. Furthermore, in the case of fashion fabrics, other values have priority, quality, and design, running properties of the machine independent of the different yarns.

2.7 Challenges Faced For Automation In Weaving

The nature of the weaving industry is changing. Around the early 80s, the focus moved from composite mills to decentralized units and new clusters such as Bhiwandi, Surat, Ichalkaranji, Erode, etc. began to develop. Because the resultant units are smaller, the focus on having a trained workforce, established work-practices, data collection and utilization has diminished. Due to insufficient awareness, decision-making is not always rational and the investment capability of the units also has diminished. It is only very recently that the trend has started to reverse and decentralized units are successfully adopting a mill-like approach to their business.

METHODOLOGY

3. METHODOLOGY

We have purchased the ordinary power loom with the width of 56". In which the shuttle moving parts are removed.

The race board is altered and the hook guides are assembled. In both the sides the shuttle boxes are removed and rapier weft insertion mechanism is assembled. The following steps are carried out to develop the rapier picking mechanism to suit power loom.

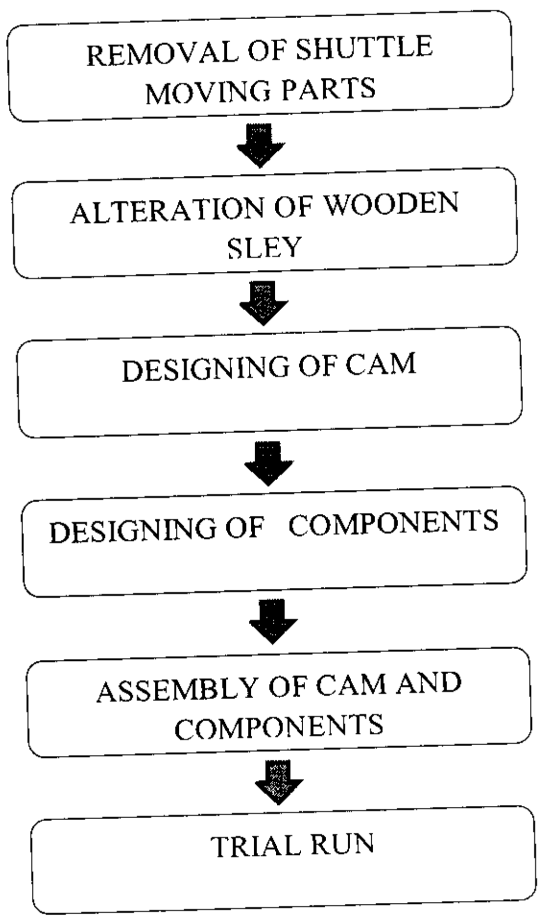
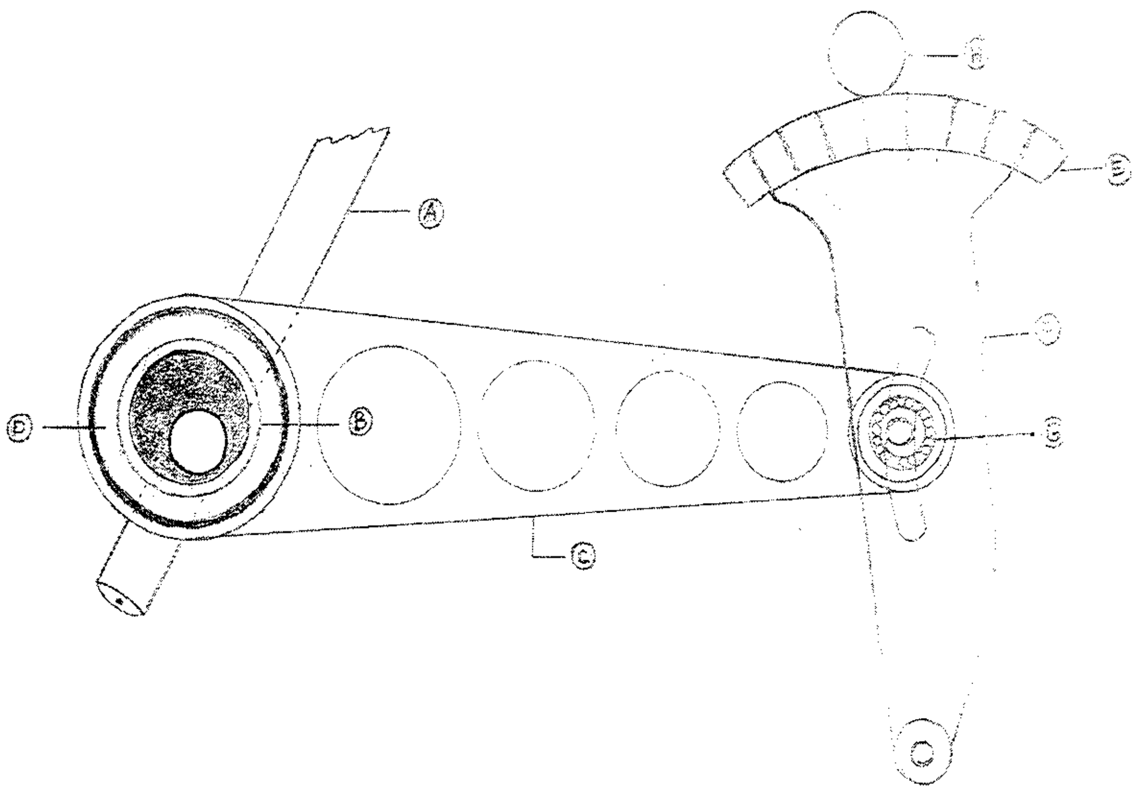


Figure 01: Methodology

Front View of Rapier Kit Developed



A- Bottom shaft

B- Cam

C- Eccentric shaft

D- Bearing

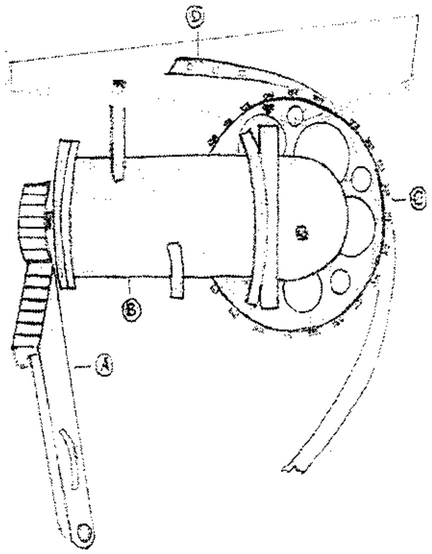
E- Nylon gear

F- Fan shaped gear

G- Slot & Pin

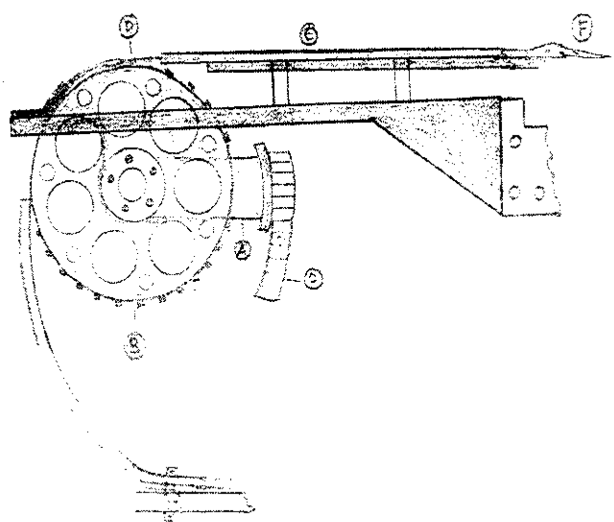
H- Gear box

Side View of Rapier Kit Developed



A- Fan shaped gear B-Gear box

C - Tape wheel D-Gripper tape



A- Gear box B-Tape wheel

C-Fan shaped gear D- Gripper tape

E- Tape guide F- Gripper

3.1 Collection of Components:

Gripper:

The gripper is used to transfer the weft yarn from one end to other. There is two gripper, one is giver and another is taker. It transfers the weft yarn at middle of the race board.

Cam:

Cam is an important drive mechanism used in rapier loom. It is used to drive weft link mechanism. It is connected to the bottom shaft.

Weft insertion link:

It is a link mechanism which provides drive from cam to fan shaped gear. The weft insertion link is placed over the cam in the bottom shaft and other end is connected to fan shaped gear. It is made up of cast iron.

Fan shaped gear:

It is a special part which has a nylon gear at its head. It transfers the drive from weft insertion link to gear box.

Tape wheel:

It is a circular wheel which is used to drive gripper tape. It is made up flexible plastic with slots in it. It provides to and fro motion.

Gear box:

Gear box is made up of aluminium the gear box which converts the horizontal motion into vertical motion from fan shaped gear tape wheel. The gear box consists of plain gear wheel and three bevel gear.

3.2 Working Principle

The rapier weft insertion loom works on following principles.

- The motor pulley drives the bottom shaft pulley which drives the bottom shaft. The cam is connected to the bottom shaft and gets drive from it.

- The cam gives eccentric momentum to weft insertion link. The other end of weft insertion link is connected to fan shaped gear, through a special slot in it.

- The eccentric momentum of the cam is transferred to the to and fro motion of the fan shaped gear, with the help of weft insertion link.

- The fan shaped gear is directly connected to the gear box. The gear in the gear box is directly seated over the nylon gear disc. The fan shaped gear drives the gear box.

- The tape wheel is placed over the open end of gear box. The gear box drives the tape wheel.

- The tape wheel transfers the drive to forward and backward motion of the gripper. Then the weft thread is transferred from one gripper to other.

- Weft yarn tensioner gives tension to the weft yarn and also acts as a guide.

3.3 Technical Specifications of Rapier Loom Developed

Machine Type	**Flexible Rapier**
Reed Space Width	56" (or) 142 cm
Speed	180 ppm
Shedding	Negative cam type
Let-off & Take-up	Positive & 7-wheel
Weft Selection	6 or 8 colours
Motor	0.75 Hp
Weft feeding	Tensioner
Warper's beam dia	700 mm
Cloth beam dia	400mm

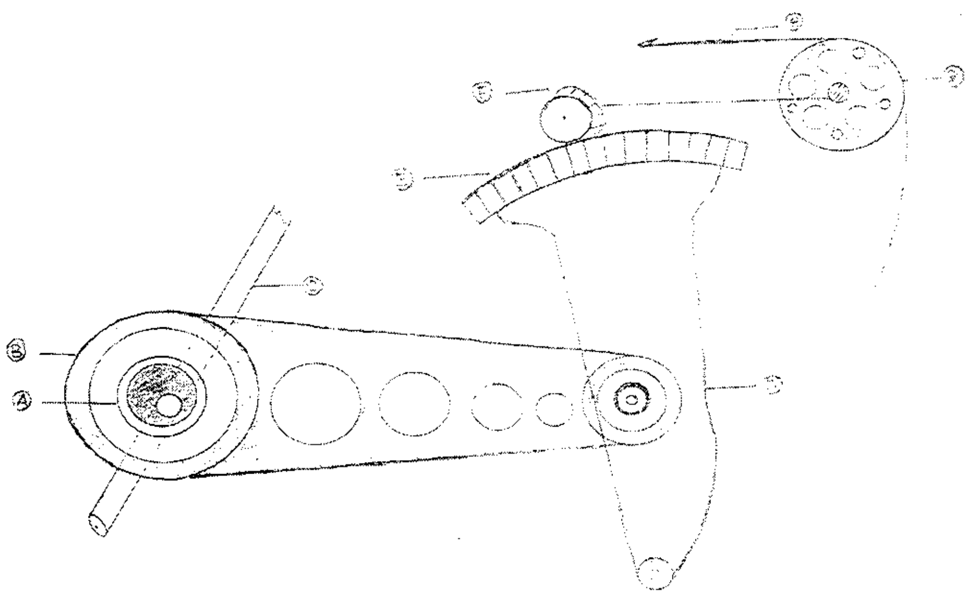
Table 03: Technical Specifications of Developed Flexible Rapier

RESULTS AND DICUSSION

4. RESULTS AND DISCUSSION

As a result of our work the design is developed, fabrication & assembly of components is done.

Over All View of Rapier Kit Developed



A- Cam	E- Nylon gear
B- Eccentric cam shaft	F- Gear box
C- Bottom shaft	G- Tape wheel
D- Fan shaped gear	H- Gripper tape

4.1 Assembly of Components

The steps taken to develop rapier picking mechanism to suit power loom are as follows.

STEP 1: REMOVAL OF SHUTTLE MOVING PARTS

The parts like shuttle, picking stick, picking lever, picking strap, and cam are removed. The Sley wood is arranged with a set of guide hooks and the box sides are fixed with rapier tape side plates and covers.

STEP 2: ASSEMBLY OF GUIDE HOOKS

The guide hooks are fixed with screw and bolt to the sley rod. A set of 47 guide hooks are fixed over sleyboard for the rapier tapes movement.

STEP 3: ASSEMBLY OF CAM & ECCENTRIC SHAFT

The cam is designed and developed to provide the drive to the gripper for weft insertion mechanism. By measuring the length of the gripper from both the side the cam is developed.

Required measurements

Gripper L1 =128.5cm

Gripper L2 = 104cm

STEP 4: ASSEMBLY OF WEFT INSERTION GUIDE PLATE

The sleyboard of the ordinary loom is altered into the weft insertion guide plate and consists of a slot in which tape wheel is fixed.

STEP 5: ASSEMBLY OF GEAR BOX

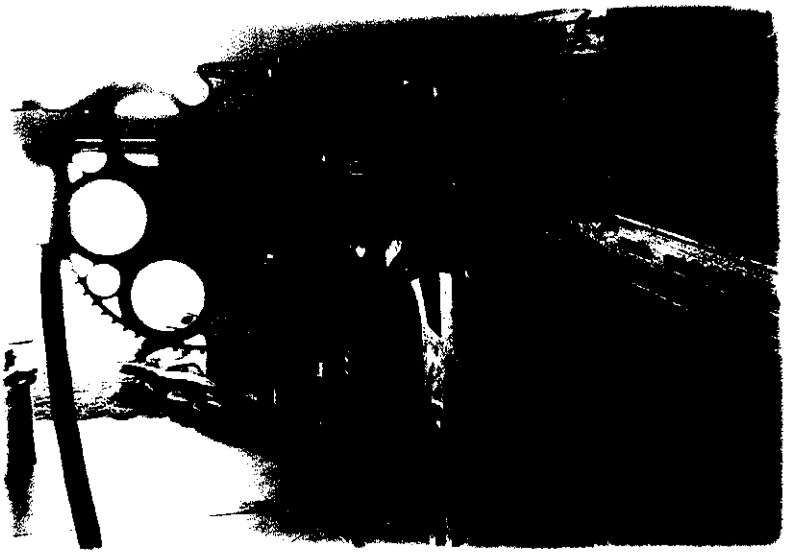
The gear box is fixed over the sleyboard. The sleyboard consists of five sley keys which gives balanced support to the gear box.

STEP 6: ASSEMBLY OF FAN SHAPED GEAR

The weft insertion link is fixed over the cam with the help of bearings. The link is fixed over the cam with the help of bearings in fan shaped gear. The link is fixed over the cam rigidly so that slippage can be avoided.

STEP 7: ASSEMBLY OF TAPE WHEEL & GRIPPER

One end of the weft insertion link is fixed in the slot of fan shaped gear by locking sleeve. The tape wheel is fixed over the gearbox at one end, through which Griper is driven.



4.2 Cost of Conversion

The total cost of converting an ordinary Power loom into a Rapier loom depends on various factors as follows.

S.No	Particulars	Cost(Rs.)
1	**Conversion of Spare Parts**	25000
2	**Machining Charges**	5000
3	**Erection Charges**	10000
4	**Miscellaneous charges**	6000
	Total	**46000**

Table 04: Cost of Conversion

4.3 Comparison of Developed Rapier with Other Looms

4.3.1 Comparative Loom efficiency and Looms/Weaver for Different types of Looms:

Type of Loom	Looms/ Weaver	Expected Efficiency (%)
Power loom	4	75
Developed Rapier	6	80
Rapier	8	85
Air-jet	10	95
Projectile	8	95

Table 05: Comparison of Looms per Weaver and Efficiency

From these observations, it is clear that the newly developed rapier loom provides a little higher number of looms per weaver with increase in speed when compared to ordinary power loom. The efficiency is also 5% higher than a power loom.

4.3.2 Comparative Power Consumption per Loom Shift (8 hrs):

Type of loom	Power Consumption/loom shift of 8 hours (in units)
Power loom	8.8
Developed Rapier	12.6
Rapier	17.6
Air-jet	20.6 + 30.0 (for air compressor)
Projectile	14.7

Table 5: Comparative Power Consumption per Loom Shift Of 8 Hours

The use of flywheel in the power loom consumes more power whereas in developed rapier loom, the power consumption is less due to absence of fly wheel and presence of individual drive for motor. From the table, it can be seen that developed rapier consumes less power than projectile, rapier and air-jet looms.

4.3.3 Comparison of Rapier Loom to be Developed & Imported Shuttleless Loom:

S.No	Details	Conventional Power Loom	Newly Imported Rapier loom	Rapier Loom Develope d
1	Cost of loom (Rs. in lakhs)	0.90	17.00	1.25
2	Production in meters per loom per day at 80% efficiency	25	159	57
3	Conversion cost per pick (Paise)	15	25	25
4	Consumable spares cost per loom shift (Rs.)	5	40	15
5	Value loss (%)	5	1	2
6	Power Consumption in H.P	1	11.25	3

Table 6: Comparison of Rapier Loom Developed & Imported Shuttleless Loom

The above comparisons are made assuming the same sort of fabric in all the looms at standard efficiency of 80%. From the above table, it can be seen that the cost of the newly developed rapier loom is not very high than the semi-auto drop box loom, and also significantly less than used and new imported rapier loom.

The power consumption is lower for newly developed rapier loom compared to imported rapier looms. The power consumption is almost triple that of the indigenous shuttle loom, about half of the used imported loom and about one fourth of the new imported loom.

The cost of consumable spares per loom shift for new developed rapier loom is expected around Rs. 15/-, whereas the same for used imported rapier loom is at Rs. 65/- and for new imported rapier loom is at Rs. 40/-. However the consumable spares cost per loom shift is three times higher than that of indigenous shuttle loom.

The value loss due to rejections is expected around 2% for developed rapier loom which is better than the indigenous shuttle loom and is comparable with the imported rapier loom. Due to lower cost, higher production and better labor productivity, an attractive payback period of 5 years for a 12 looms unit is possible. This is better than the payback period for indigenous shuttle loom and new imported rapier loom and is equal to the payback period for used imported rapier loom.

CONCLUSION

5. CONCLUSION

The following conclusions are drawn within the limitations of this experimental study.

A Low cost rapier weft insertion mechanism has been designed and fabricated. The ordinary existing power loom is modernized with developed rapier weft insertion mechanism.

Through this work, an attempt was made to help the existing power loom manufacturers to develop shuttleless looms in short investment which caters to the societal needs with the following benefits.

- The technology transfer of designing a rapier loom with low cost and low power consumption as retrofit for power looms.
- More allocation of looms. In other words, less numbers of weavers required in loom shed.
- The loom is ideally suitable for decentralised power loom sector. Since weft insertion is continuous from one feed and intermediate process of pirn winding is eliminated.
- The quality of the product would be significantly high compared to the fabric woven from a power loom.
- Easy maintenance and less work load for jobbers.
- Low power consumption and less pollution.
- Better environment due to low noise level.
- Low consumption of spares and less floor space.
- More economical and is made cheaper.
- The speed of the loom can be increased up to 50% when compared to ordinary power loom.

SCOPE FOR FURTHER STUDY

6. SCOPE FOR FURTHER STUDY

The following are the scope for further study in converting a power loom to rapier loom:

- For industrialization further research & precision needs to be done.
- Scrutinized settings must be done and production comparison must be studied.

It can be assured that a promising future awaits the power loom sector based on the notes of available literature on the development of the same. Research in this field should be focused on the development of novel manufacturing techniques and quest for technology upgradation.

REFERENCES

7. REFERENCES

1. Allan Ormerod, Walter S.Sondhelm, 'Weaving – Technology Operations' (1988).

2. Dr.Arindam Basu , (2002), 'Weaving – A Special Feature', SITRA in Indian Textile Journal ITJ, P.23.

3. Lord P.R. and Mohammed M.H.,(1973), 'Conversion of yarn to fabric', Merrow publication.

4. Oldrich Talavasek, 'Shuttleless Weaving Machines', Elsevier publisher, Svaty Vladimir (1981).

5. Survey on Productivity and Cost for Shuttleless Looms and Automatic Cone Winding Machines; BTRA.

6. Survey Report No. 03.1.41 (February, 1998).

7. Talukdar, Sri ramalu, Ajgaonkar, 'Weaving – Machines, Mechanisms, Management'.

8. Thakkar A.I., (NCUTE, New Delhi, 1999), 'Shuttle Looms - Its Present Status' NCUTE Pilot Programme on Weaving I - Shuttle looms Page. 47.

9. Vincent J. J. (1959), 'Journal of Textile Institute', vol.JTI, Page 261.

10. www.pdexcil.org/news/40N1002/advances.htm

11. www.fibre2fashion.com ; www.premierloom.net