



MATERIAL HANDLING IN TEXTILE INDUSTRIES

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Abstract: *Textile mill consumes a huge amount of raw material for conversion of raw material to final products. The mills are using a large number of machines and processes. During conversion of raw material to end product; material moves from one department to other, one machine to other machine and from one floor to other. Day by day, production of each machine is going up. To achieve the target of production, the mill management is facing the challenge of safe, efficient and economical material handling. In this paper it is tried to provide the required knowledge of material handling in reference to textile mills.*

Keywords: *Material handling, material transport, material handling equipment.*

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1. INTRODUCTION

Material handling can be defined as: *“art and science of conveying, elevating, positioning, transporting, packaging and storing of materials* Starting from the time, the raw material (such as fibres for spinning unit or yarns for weaving/ knitting unit and fabrics for wet processing or garmenting units) enters the mill gate and goes out of the mill gate in the form of finished products; it is handled at all stages within mill boundaries such as within and between raw material stores, various section of production department, machine to machine and finished product stores. A material may be handled even 50 times or more before it changes to finished product. It has been estimated that average material handling cost is roughly 10-30% of the total production cost depending upon product to process. By saving in the material handling cost, the cost of production can be reduced considerably.

Material handling involves the movement of materials, manually or mechanically in batches or one item at a time within the plant. The movement may be horizontal, vertical or the combination of these two.

Material movement adds to the cost but not to the product value. The ideal mill would have an absolute minimum of materials handling and more use of mechanical material handling equipments. The shortage of labour and increasing wages cost demand the most efficient use of labour. Proper material handling offers benefits for:

- i. improving productivity
- ii. increasing the handling capacity
- iii. reducing man-power
- iv. increasing the speed of material movement
- v. reducing materials wastage
- vi. promoting easier and cleaner handling
- vii. eliminating idle time of machines, equipment and workers
- viii. reduce fatigue incurred by the workers
- ix. increasing safety and minimising accidents
- x. locate and stock material better and in less space
- xi. minimising production cost, etc.



2. FUNCTIONS OF MATERIAL HANDLING SECTION

There are basically two functions of material handling section:

1. To select production machinery and assist in plant layout so as to eliminate as far as possible the need of material handling. For examples: in a spinning mills chute feed cards, open end spinning machine, auto-doffing ring frames and autoconer etc. reduce the material handling activities hence material handling cost.
2. To choose most appropriate material handling equipment which is safe and can fulfill material handling requirements at the minimum possible overall cost. For example: Air conveyor pipes in within the blow-room and between blow-room and cards, big size plastic container trolley for handling ring frame bobbins, cones and fabrics in a textile mill.

3. PRINCIPLES OF MATERIAL HANDLING

In general, principles of material handling are as under:

- i. Minimize the movements involved in a production process.
- ii. Minimize the distance moved by adopting shortest routes.
- iii. In order to speed up the material movements, employ mechanical aids in place of manual labour.
- iv. For moving optimum number of pieces in one unit; use the principles of containerization, unit load or palletization.
- v. Appropriate, standard, efficient, effective, flexible, safe and proper sized material handling equipments should be selected.
- vi. In order to minimize back tracking and duplicate handling; change in sequence of production operations.
- vii. If possible, utilize gravity for assisting material movements wherever possible.
- viii. To reduce damage to the materials during handling and economize material handling process; design trolleys, packages, containers and drums etc.
- ix. Handling equipments are so arranged that these should minimize distances moved by products and at the same time handling equipments should not interfere with other machine or operation.
- x. To avoid any interruption in handling; material handling equipments should periodically be checked, repaired and maintained.



4. SELECTION OF MATERIAL HANDLING EQUIPMENTS

There are two most important aspects for analyzing or solving a material handling problem are: engineering aspect, and economic aspect. Engineering factors include: the condition of existing building and plant layout, production processes and equipments, nature of materials and products to be handled, usefulness and effectiveness of existing material handling equipment. The economic factors include the cost of material handling equipment, operating costs, repair and maintenance costs and taxes etc.

The choice of a particular equipment depends upon specific requirements or the condition of an industry. For selection of Material handling equipment, the following factors should be taken into account:

- i) Type/shape of materials to be transported:** The size of material, its shape, weight, delicacy and its chances of getting damaged during handling etc. should be considered.
- ii) Mill building and layout:** The route of material movement, width of doors and aisles, inequality in floor levels, height of the ceiling, strength of floor and walls, columns and pillars etc. to a great extent influence the choice of a material handling equipments.
- iii) Machine production:** Different machines have different outputs per unit time. The material handling equipment should be able to handle the maximum output.
- iv) Type of material flow pattern:** A horizontal flow pattern will need trucks, overheads bridge cranes, conveyors etc, whereas a vertical flow pattern will require elevators, conveyors, pipes etc.
- v) Types of production:** The selection of the material handling equipments depends a great extend on type of production such as: mass production and batch production. Conveyors are more suitable for mass production on fixed routes and powered trucks for batch production.
- vi) Other factors:** Some other factors also considered during selection of material handling cost are: cost of material handling equipment, handling costs, life of the equipment and amount of care and maintenance required for the equipment.

5. MATERIAL HANDLING EQUIPMENTS

A wide range of material handling equipments is available in the market; which are suitable to the most of the industrial requirements. Material handling equipments are classed as:

1. Industrial trucks: manual and powered



2. Cranes: overhead bridge crane, jib crane and gantry crane
3. Hoists : chain type manual, electrical and pneumatic,
4. Conveyors: belt conveyors, roller conveyor, drag conveyor, bucket conveyor, pipe line (pneumatic) conveyor, chain or cable conveyor
5. Monorail
6. Slides and chutes
7. Lift
8. Tractors and trailers etc.

In the textile mills, there are many types of materials viz. raw materials, purchased components, material in process, finished goods, packing material, maintenance and repair supplies, scrape and waste etc. These materials are of various size, shape and specific features. For this purpose, mostly special and some general type material handling equipments are used in textile industries.

A. Material handling in spinning units

Types of material handling equipments used in the spinning mills are as under [Table 1]:

Table 1: Material handling in spinning units

| S. No. | Process | Material | Material handling Equipment |
|--------|--------------------------------------|-------------------------------|---|
| 1. | From supplier to mill | Cotton/polyester in bale form | Truck or train or ship |
| 2. | From truck to store | Bale of raw material | Manual 2, 3 or 4 wheeled truck |
| 3. | Raw material store to mixing section | Bale | Manual 2, 3 or 4 wheeled truck |
| 4. | Mixing to blow room line | Loose cotton | Special designed trolleys or lattice or suction |
| 5. | Blow room to card | Laps or loose cotton | Specially designed trolley or Air pipe conveyor and chute |
| 6. | Carding to draw Frame | Sliver cans | Manual trolley or cans fitted castrol wheels |
| 7. | Draw Frames to Speed Frame | Sliver cans | Manual trolley or cans fitted castrol wheels |
| 8. | Speed frame to ring frame | Roving bobbins | Manual trolley/Tapa or special designed trolley |
| 9. | Ring frame doffing | Ring bobbins | Doffing trolleys |
| 10 | Ring frame to winding | Ring bobbins | Specially designed plastic trolley |
| 11 | Winding to packing | Cones | Big size plastic trolley or special designed trolley |

i. From truck to mill stores

In the most of the textile spinning mills, raw material i. e. cotton or polyester or viscose in the forms of bale and other supplies are carried to mills by means of motor trucks. After arrival of trucks, cotton or manmade fibres bales are manually pushed down on the floor. These bales are transported with the help of 2, 3 or 4-wheeled industrial trucks/trolleys (Figure 1&2) for storing in godown one by one. This consumes time, requires more workers. Sometimes Forklifts (Figures 3) can be used to unload bales (2 or 3 at a time) directly from trucks, transport and stack them in godowns.

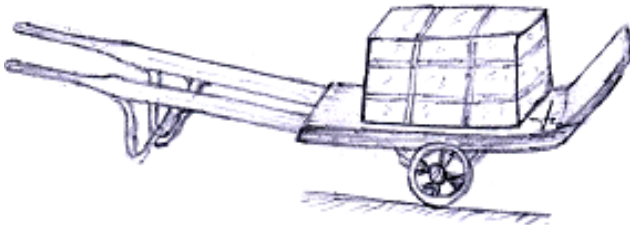


Figure 1: 2-wheeled industrial trucks/trolleys

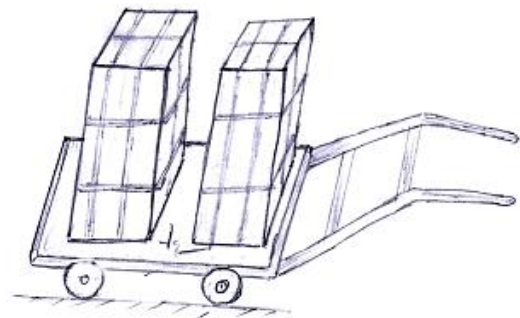


Figure 2: 4-wheeled industrial trucks/trolleys

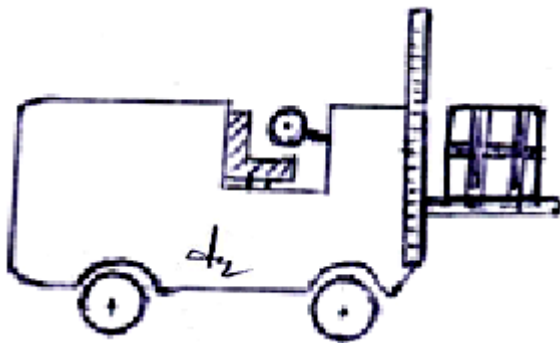


Figure 3: Forklifts

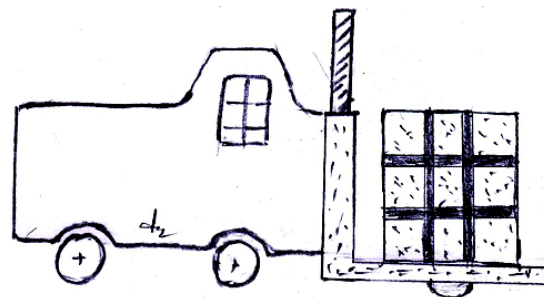


Figure 4: Platform trucks

ii. From raw material store to mixing department

From godowns, bales are manually transported to the mixing department using single bale trolley. 2, 3 or 4-wheeled industrial trucks/trolleys manual or powered are utilised for handling the bales of raw material such as bales of cotton/polyester/viscose etc.. Some times, mills can use platform trucks (Figure 4), by which a single operator can transport up

to 3 bales at a time and deliver them at the appropriate place in the mixing department. If mixing department is situated at an elevated place, forklifts can be used.

iii. From mixing to blow-room

The raw material (such as cotton) from the mixing to the bale breaker is transported by means of a mixing trolley. Earlier this was done manually by hands or by using bamboo baskets which not only took more time but also caused cotton being dropped on floor leading to more waste and poor housekeeping. In the, middle age, to reduce these disadvantages, special designed manual or mechanical iron trolleys (Figure 5) are used for transporting the material from mixing stock to bale breaker. To supply bales near bale plucker mills can use platform trucks (Figure 4). Recently, lift-able spring type pedal operated mixing trolley (Figure 6) is used to improve the material handling. This type of trolley can transport up to 30 kg of material at a time.

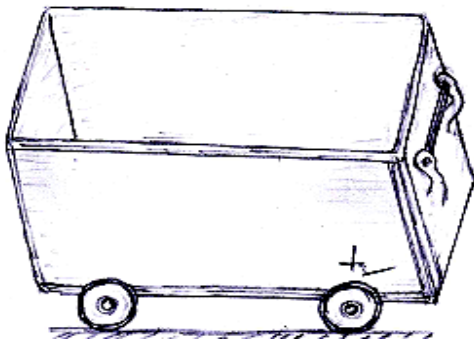


Figure 5: Iron trolley

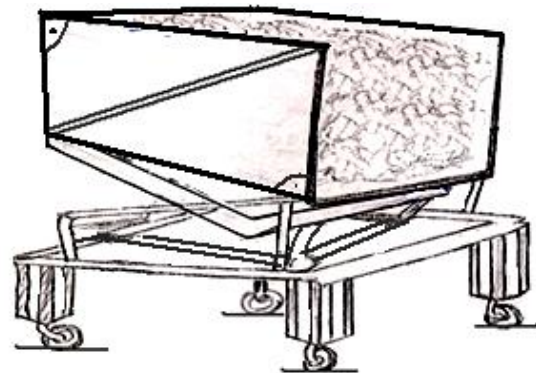


Figure 6: Mixing trolley

iii. Within blow room line

Within the opening and cleaning machine the material is transported with the help of conveyor belts (Figure 7). From initial opening machines, the cotton is shifted from one opening machine to other by pneumatic pipes (blown air pipes conveyor) with the help of exhaust fans and cages (Figure 8).

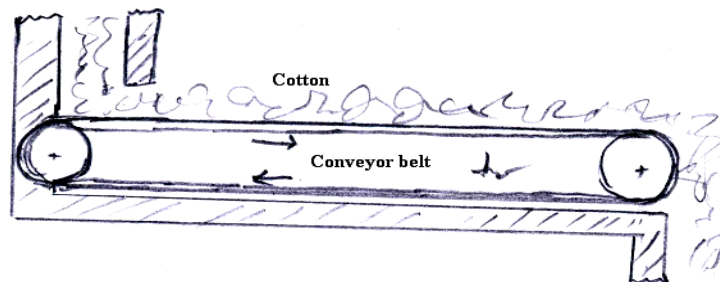


Figure 7: Belt conveyor

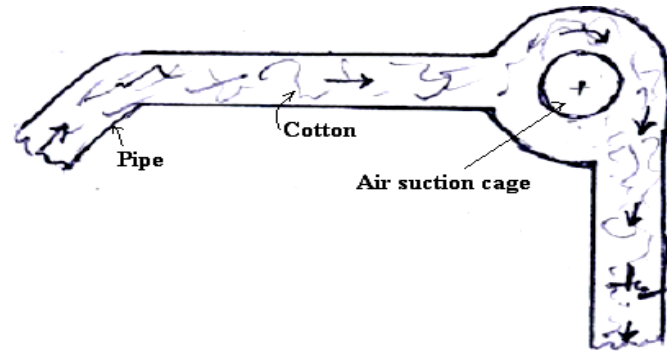


Figure 8: Air pipe conveyor

iv. From blow room to carding departments

In conventional mills, blow room laps are transported manually by the workers keeping one lap at a time on the shoulder. Many mills are using special designed mechanical trolley to transport blow room laps to carding section (Figure 9). It can handle 4 to 6 laps at a time. There is little possibility of any damage occurring to the laps since they are already stacked vertically in blow room. Recently, with the advent of chute feed cards the blow room material handled by blown air pipe conveyors and chute (Figure 10). In chute feed card, the chute feed the material to the liker-in of the carding machine through feed roll and feed plate as in the case of lap feed.

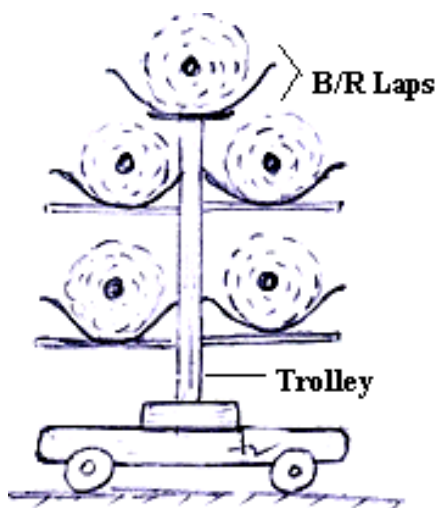


Figure 9: Trolley for blow room laps

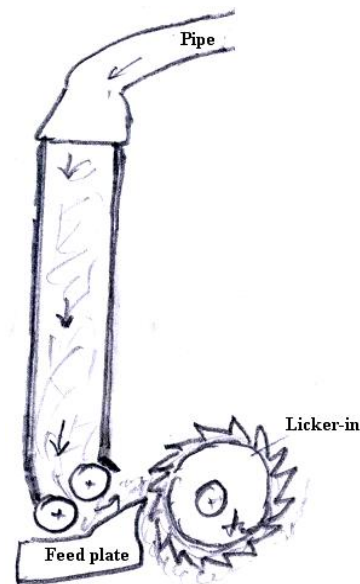


Figure 10: Chute feeding system

v. From carding machine to draw frame and draw frame to speed frame

The material delivered in the form of sliver at the carding machine, comber and draw frame is collected in cans. According to machine make and design, they may be various sizes such as can's diameter is 14", 16", 42" or 48" etc. with and without wheels. (Figure 11).

These cans (both full and empty) are to be transported between cards, draw frames, comber preparatory machines, combers and fly frames. In many mills, cans are transported manually by dragging them on the floor. This practice would not only spoil the floor, damage the can and result in wastage of sliver but also consume more time. The trolley shown in Figure 12. can be used to carry 3 or 4 cans at a time. For easy transportation, latest cans are of big size and having wheels (caster) at bottom.

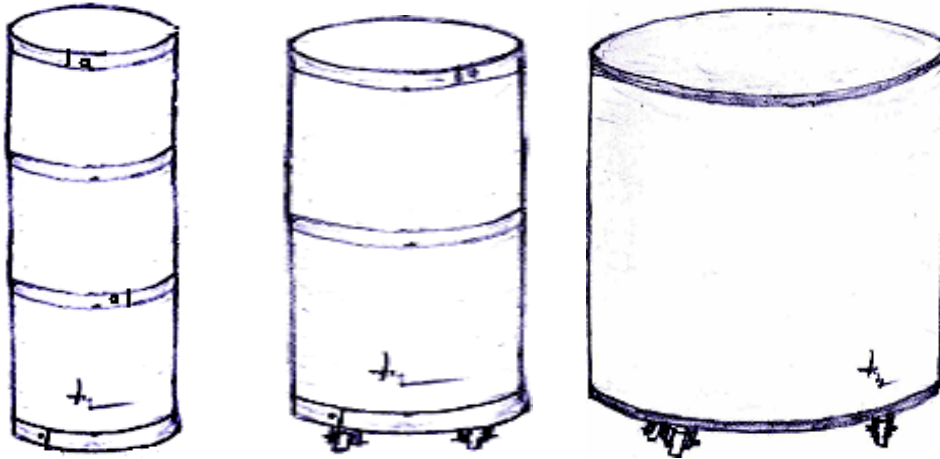


Figure 11: Sliver cans

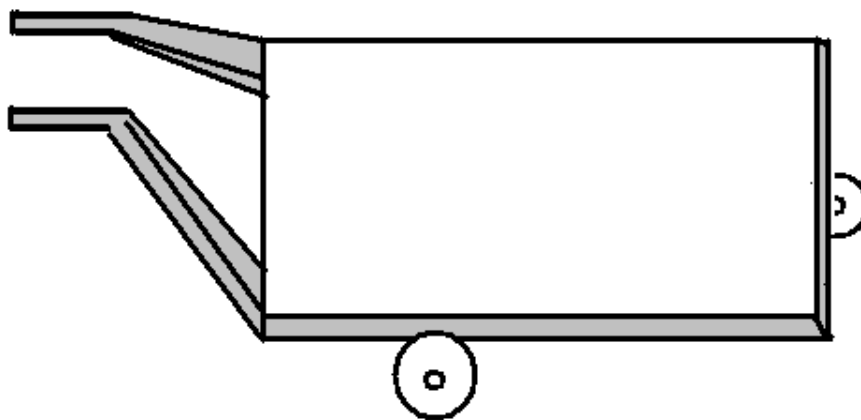


Figure 12: Cans carrying trolley

vi. Sliver lap/ribbon lap machine to comber

The sliver/ribbon laps are generally transported to the combers manually, i. e. by carrying one or two laps on hands at a time which takes a lot of time and also results in wastage of material. A special designed trolley (Figure 13) is mostly used to transport eight laps at a time. Since the design is simple and compact, it can be moved easy along narrow alley.

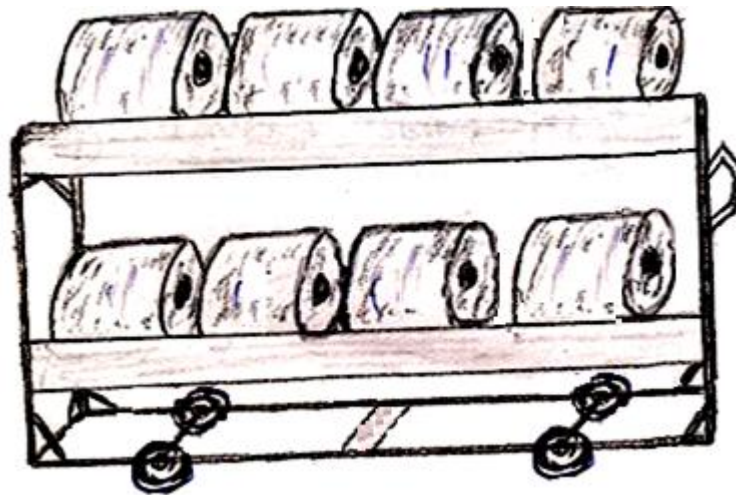


Figure 13: Sliver/ribbon laps carrying trolley

vii. From speed frame to ring frame

In the conventional practice, speed frame doffers normally keep the doffed bobbins on the arms and then carry 6 to 8 bobbins by hand to the storage place. This practice is not only laborious but also sometimes results in bobbins falling on the floor and the roving material getting spoiled. It is also cause injuries to the workers.

Mostly, big size plastic container trolley is used for handling the material from speed frame to ring frame. (Figure 14). It can handle one full doff of a speed frame bobbins. Here, bobbins are haphazardly stacked. This often causes damages especially at the bottom row.

The most appropriate trolley for carrying full bobbins to ring frames without causing any damage to the roving, is specially designed porcupine type trolley (Figure 15). In this type of trolley, each bobbin is placed separately on a peg

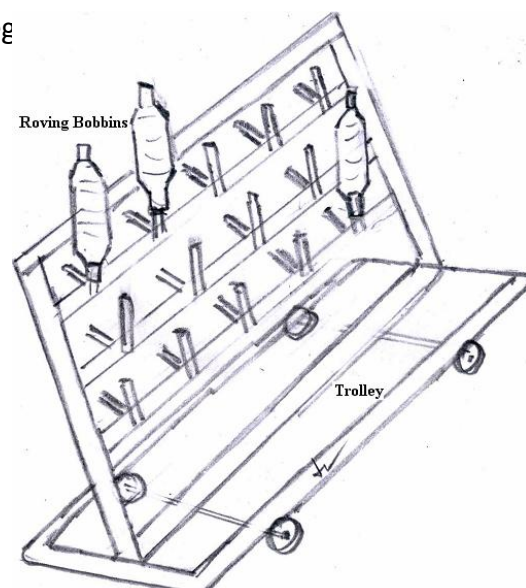
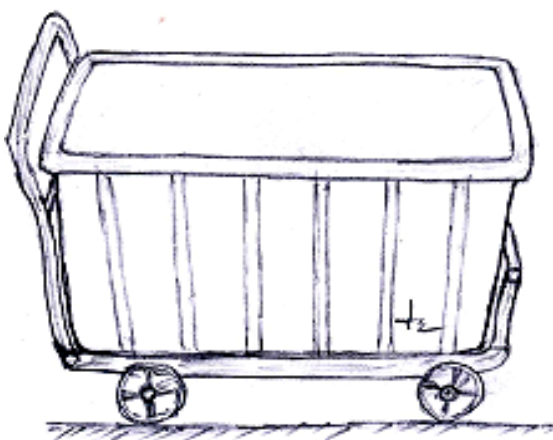


Figure 14: Big size trolley for speed frame Figure 15: Porcupine type trolley for speed frame

viii. Trolley for speed frame flyers

At the time of speed frame maintenance or cleaning, the flyers are removed from the machine. This trolley (Figure 16) is used to carry all the flyers from the speed frame to maintenance store and maintenance store to speed frame.

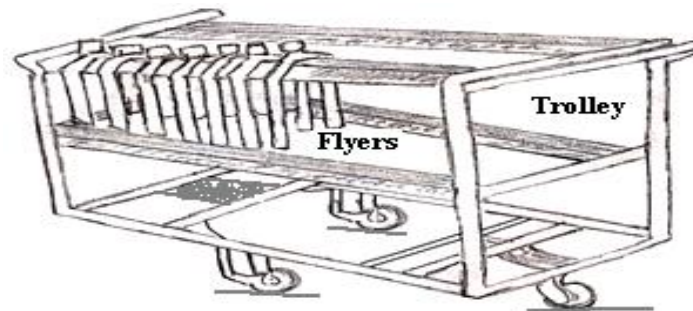


Figure 16: Trolley for speed frame flyers

ix. From ring frame doff trolley.

To save costly floor area in any industry, Doffing Baskets are widely used in textile spinning, ring doubling, twisting, finishing and winding sections. Easily stackable and can be easily mounted on the trolley for the ease of movement. These bobbins from doffing baskets are shifted to a small plastic container trolley (Figure 17) which carry the material to winding department. In ring frame, mostly, a trolley carrying two containers of plastic (Figure 18) is used during doffing. In this, one container carries the empty bobbins and the other for full bobbins. One trolley must be given to each doffer.

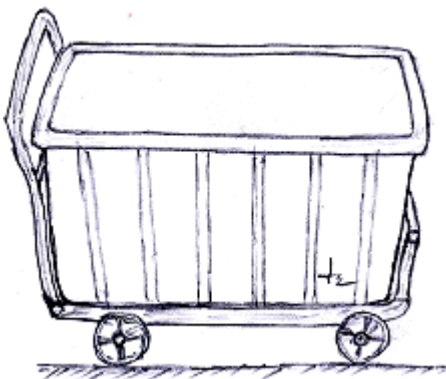


Figure 17: Ring frame doffing trolley

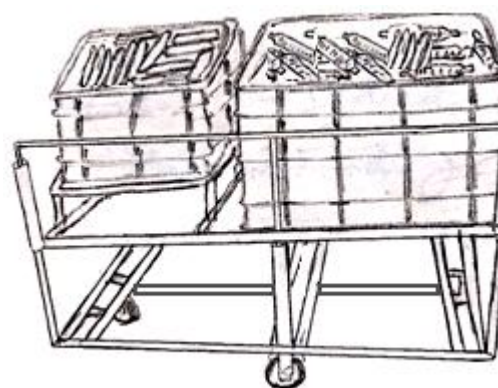


Figure 18: Ring frame doffing trolley

x. From ring frame to winding/doubling/reeling.

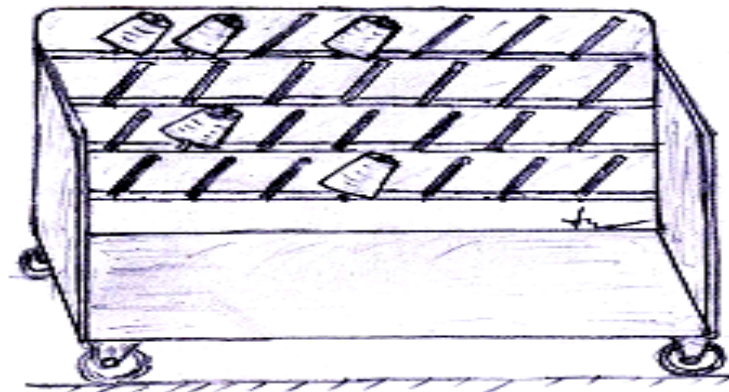
In some mills, doffed cops are first transferred to bamboo baskets or big size metal containers and they are transported to post spinning department in trolleys. This practice not only results in damages to some cops (top layer of yarns) but also causes entanglement

leading to yarn waste. In winding department, the tenter has to transfer the cops from these containers/baskets either to bins or to other small containers. This would also result in entanglement of yarn leading to more waste.

Instead of transferring the doffed cops to the baskets, the plastic crates, which are used for doffing, with cops themselves can be loaded on the trolley and transported to the post spinning section.

xi. Post spinning

In many mills, full cones are transported to the packing section by using basket or steel trolley. This practice would cause damages to the cones. To avoid this, mills must use trolleys fitted with cone holder pegs (Figure 19). When the cones are kept in this trolley, it is easy to inspect them for package defects. This trolley can also be used to transport cheeses from doubler winding machines to TFO twisting/ring doubling.



xii. Packing section

In many mills, packed cone bags or cartons are transported to finished yarn go down by carrying them manually. This reduce the capacity of material handling and some time it cause of material damage. To avoid this, a platform truck can be used.

xiii. Stores section

In modern mills where material and spares are stored in racks, electric order picker can be used to pick the required items.

B. Material handling in weaving units

| S. No. | Process | Material | Material handling Equipment |
|--------|----------------------------|--------------|--|
| 1. | Winding cones to warping | Cones | Container plastic trolley or trolleys fitted with cone holder pegs |
| 2. | Warping beams to sizing | Warping beam | Warp Beam Carrier |
| 3. | Sizing to beaming | Sized beam | Manual 2 or 4 wheeled truck, Hoist |
| 4. | Beaming to loom shed | Weave's beam | Special designed trolleys |
| 5. | Loomshed to grey inpection | Cloth beam | Specially designed trolley |

i. Warping to sizing

Special designed equipments are used to carry warp beam (Figure 20) and to carry empty beam (Figure 21&22):

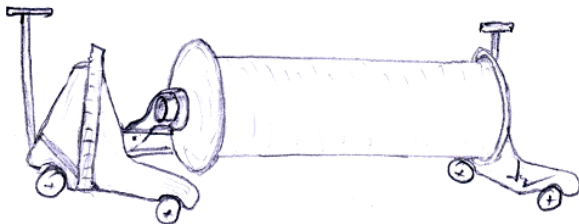


Figure 20: Warp Beam Carrier

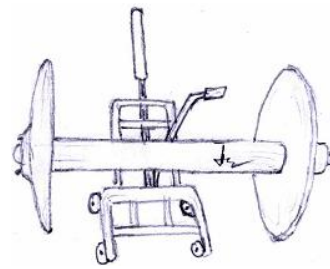


Figure 21: Empty Beam Carrie

The warp beam should be stacked on rails by which they will be held at a height above the floor and will be supported on barrel rather than on flanges. Beam can be stacked on vertical racks (Figure 23). This method will require less space compared to the earlier., but separate beam lifting arrangement are required for loading and unloading the beams. Either overhead mono-rail with a chain lock or beam lifting trucks can be used for this purpose.

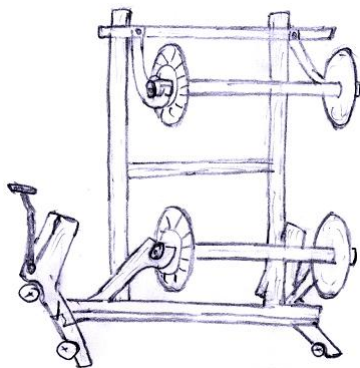


Figure 22: Double Warp Beam Carrier



ii. Figure 23: Cloth Roll Stocker Trolley

ii. Sizing to beaming

The hoists are used to transport sized beam to beaming. They can handle heavy material through overhead space. However, they can serve only a limited area. Hoists are of three type: electrical, chain type and pneumatic (Figure 24).

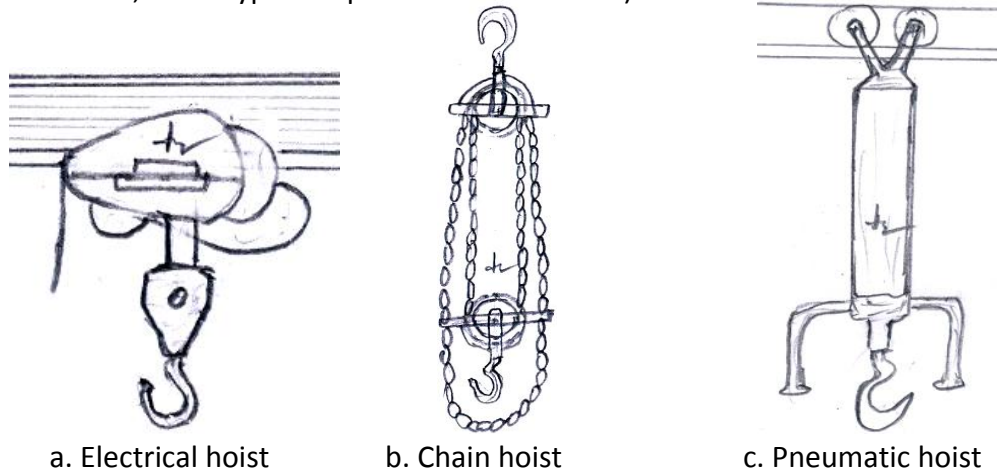


Figure 24: Hoists

iii. Beaming to loom shed

Safety is considered to be the most important factor while handling these beams because of their size and weight. The weavers beam in convention mill transported by manual methods. Recently, a trolley which has a curved top surface (Figure 25) is used for handling weavers beam, so that a beam does not roll off while being moved from one place to another, is used. In modern units a special trolley is used for transportation of beams.

iv. Loom shed to grey inspection

The fabric should be transferred by using cloth roll doffer carrier (Figure 26). In some mills, use box type trolley having castor wheels so that it can taken to the grey folding department carrying at a time a number of cloth rolls depending upon the size.

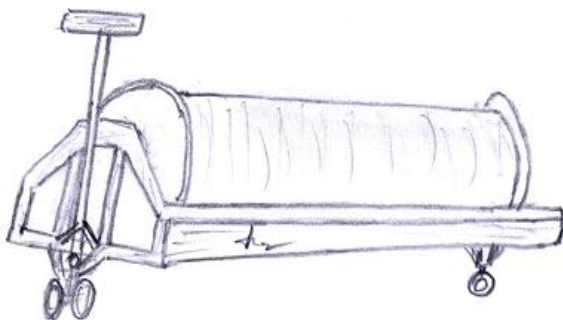


Figure 25: Hydraulic Beam Pallet Trolley

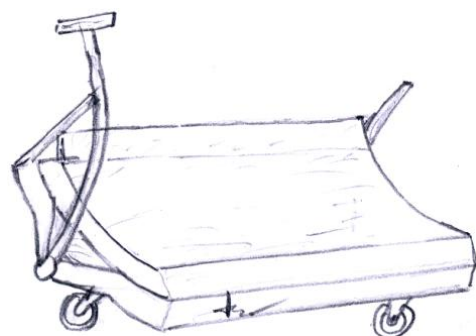


Figure 26: Cloth Roll Doffer Carrier



6. CONCLUSIONS

Although in the market a large variety of material handling equipment available in which some are very conventional and some are modern. Modern material handling equipments are economical, safer and can handle more material in unit time than conventional equipments. The material handling department basically perform two functions: eliminate the need of material handling as far as possible by choosing appropriate production machinery, and choose most appropriate material handling equipment which is safe, efficient and economical. The selection of material handling mainly depends upon: Type of material to be handled, mill building, layout, speed & type of production (mass prodn or batch production) and material flow pattern. There are two most important factors for analyzing or solving a material handling problem are : Engineering factors ,and Economic factors.

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