

REDESIGN OF BLISTER PACK MACHINE
DIPLOMA PROJECT

SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENT FOR THE POSTGRADUATE DIPLOMA
IN INDUSTRIAL DESIGN.

BY MUKESH KOTHARI

INDUSTRIAL DESIGN CENTRE
INDIAN INSTITUTE OF TECHNOLOGY
POWAI, BOMBAY

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All the studio and administrative staff

Shri M. S. Govindrajan

and my friends.

In the limited time available, no attempt is made to change the technical parts of machine. Though it is possible to change the complicated working of some of the components and systems in the machine, to improve its performance.

As no specific user data and consumer demands while purchasing the machine were available, with the results only one machine of Larsen & Toubro has been discussed in this report.

The report presented here generally deals with the improvements in ergonomic (convenience of user) and visual aspect of Blister Pack machine.

Some of the systems are redesigned to achieve fineness and sophistication. All the statements made in report are only relevant for Larsen & Toubro Machine.

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1. INTRODUCTION

1.1 DEFINITION

Packaging may be defined as a means of protecting the product to ensure the safe delivery of a product to the consumer in a sound condition, at a minimum cost incurred in production. The type of packaging of the pharmaceuticals depends upon the properties of a substance packed, the manner and condition in which they are conveyed, stored and used.

Container of medicine above all other, are important parts of a products themselves and require rigorous test in order that containers may not be found wanting. A failure of a pharmaceutical container may mean contamination of product and not merely dissatisfied customer or economical loss, but can be threat to his health and thus basic purpose of packaging is loss.

Pharmaceutical products may be roughly divided into three categories according to their physical state. i.e. liquid, solid and semisolid or semiliquid.

The moisture, heat, light and oxygen have their adverse influences on pharmaceutical products and package is expected to prevent this influences.

1.2 AVAILABLE PACKAGING MEDIA & THERE RELATIVE ADVANTAGES

<u>Containers</u>	<u>Use of container for</u>	<u>Material</u>	<u>Advantages</u>
Glass	Liquid, solid, and semisolid packaging	Glass of various composition	Chemical resistance Cheapest

Plastic	Liquid, solid and semisolid packaging	P.V.C. Polyethylene	Chemical inertness Relative unbreakability Lightness and aesthetical appeal.
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Flexible packaging	Only for tablets	Papers in various forms. Regenerated cellulose. PVC film and combination of above all.	More easy to handle. Low cost Aesthetic appeal Individual doses may be more easily carried in the pocket than full bottle of tablet. It is possible to buy loose or in a small quantity. The prescribed doses of tablet can be removed without disturbing other tablets.
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1.3 TYPE OF FLEXIBLE PACK (PACK OF 10) & THEIR RELATIVE COST.
(Refer photograph 1 2)

Strip	Cost	Area in sq.cm.of each strip
Paper strip	9 paise	8 x 20
Paper - cellulose	12 "	8 x 16
Cellulose pack	14 "	8 x 16
Aluminium foil	17 "	7 x 15
BLISTER PACK	18 - 22	4 x 10

Though Blister pack/relatively costly, but overall cost is less and this type of packages has several advantages. Lis

Since the project deals with development of machinery for Blister pack, details of this type of package are discuss^L briefly in next Led chapter.

2. DATA COLLECTION

2.1 GENERAL INFORMATION ABOUT PRINCIPLE OF BLISTER PACK

Source of information were survey of catalogue and published material at home and abroad.

2.2 WORKING OF BLISTER PACK MACHINE

Source of information were manufacturer and user.

2.1 GENERAL INFORMATION ABOUT PRINCIPLE OF BLISTER PACK

2.1.1 WHAT IS BLISTER PACK ?

A Blister pack is a combined construction of a heat formed transparent bubble or blister in plastic film usually shaped to follow the contour of the article or articles being contained, sealed to a suitable backing card to completely encapsulate the said article or articles and designed initially as a preventive package to combat pilferage in our modern system of open store selling.

2.1.2 INTRODUCTION TO BLISTER PACK MACHINE

Blister pack machine is a special purpose packaging machine, which can be remotely compared with other strip packaging machines. The essential difference lies in fact that blister pack machine uses P.V.C. on one side and backing material like Aluminium foil or paper on other side. Where as strip packaging machine uses aluminium foil on both sides. The other difference lies in fact that Blister pack machine forms P.V.C. blister as pockets for tablets where as in strip packaging the aluminium foil stretches and provides space for tablets without pre-forming. The blister pack machine produces compact push through packs showing all tablets for easy inspection and has a great display value.

2.1.3 WORKING OF BLISTER PACK MACHINE

Blister pack machine utilizes P.V.C. and aluminium foil which are in roll form. The blister forming drum over which P.V.C. foil

is threaded is exposed to radiant heaters, which soften the P.V.C. to formable state, at this stage, vacuum holds the P.V.C. film and forms blisters, After the forming is completed, the film with the blisters, pass under the tablet hopper and then heated aluminium ~~heated~~ foil seals the pack, sealed web travels to the blanking tool (unit) where the blanking die cuts the individual pack in designed sizes (for more information refer Annexure 1).

2.1.4 TYPES OF BLISTER PACK MACHINE (Refer Photograph ³ D1)

There are only two manufacturers in India who produce this type of machines.

cost

Fully Auto - Machine

Rs. 1,30,000

Manufacturer :

Larsen & Toubro, Bombay.

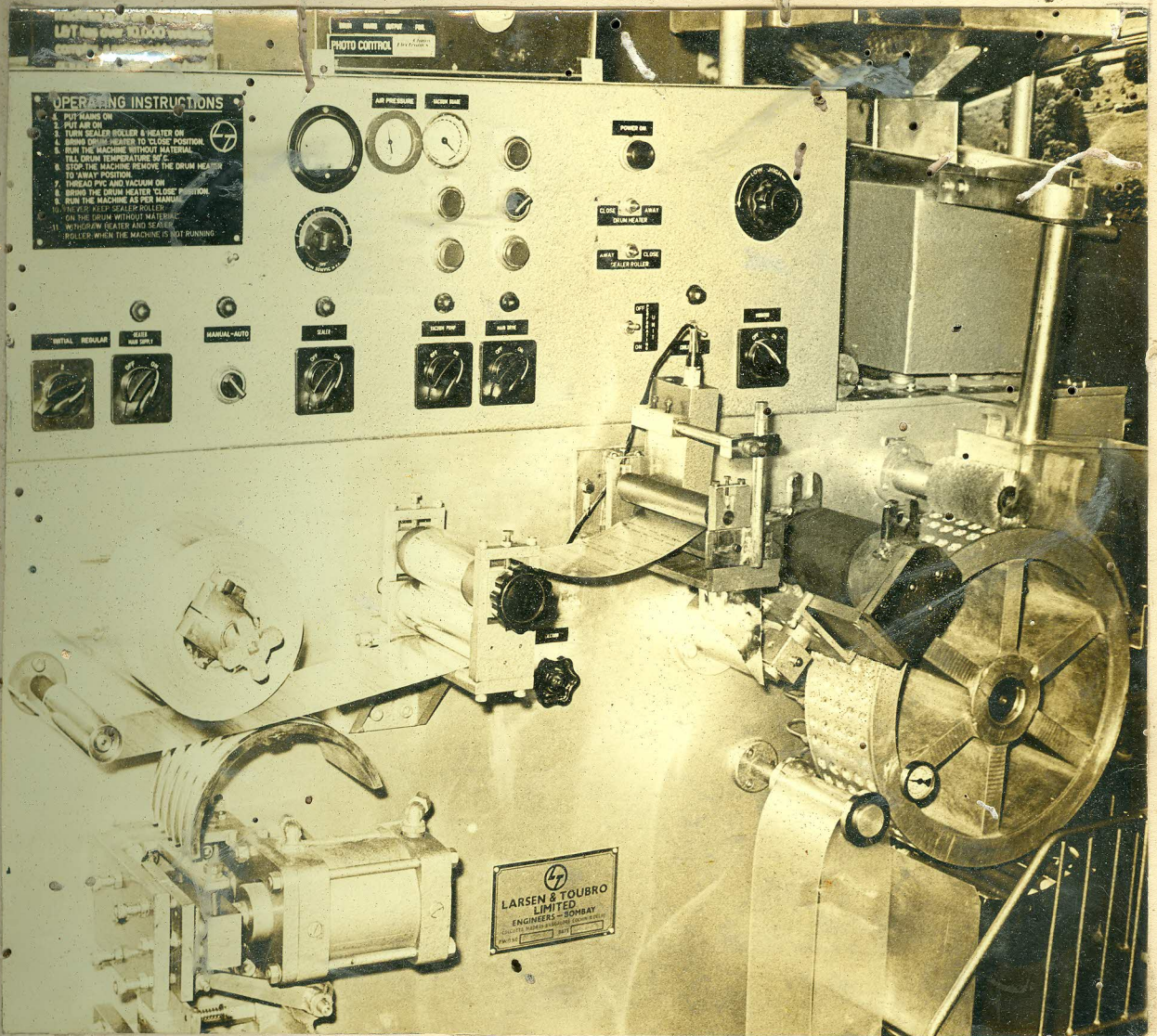
Semi Auto - Machine

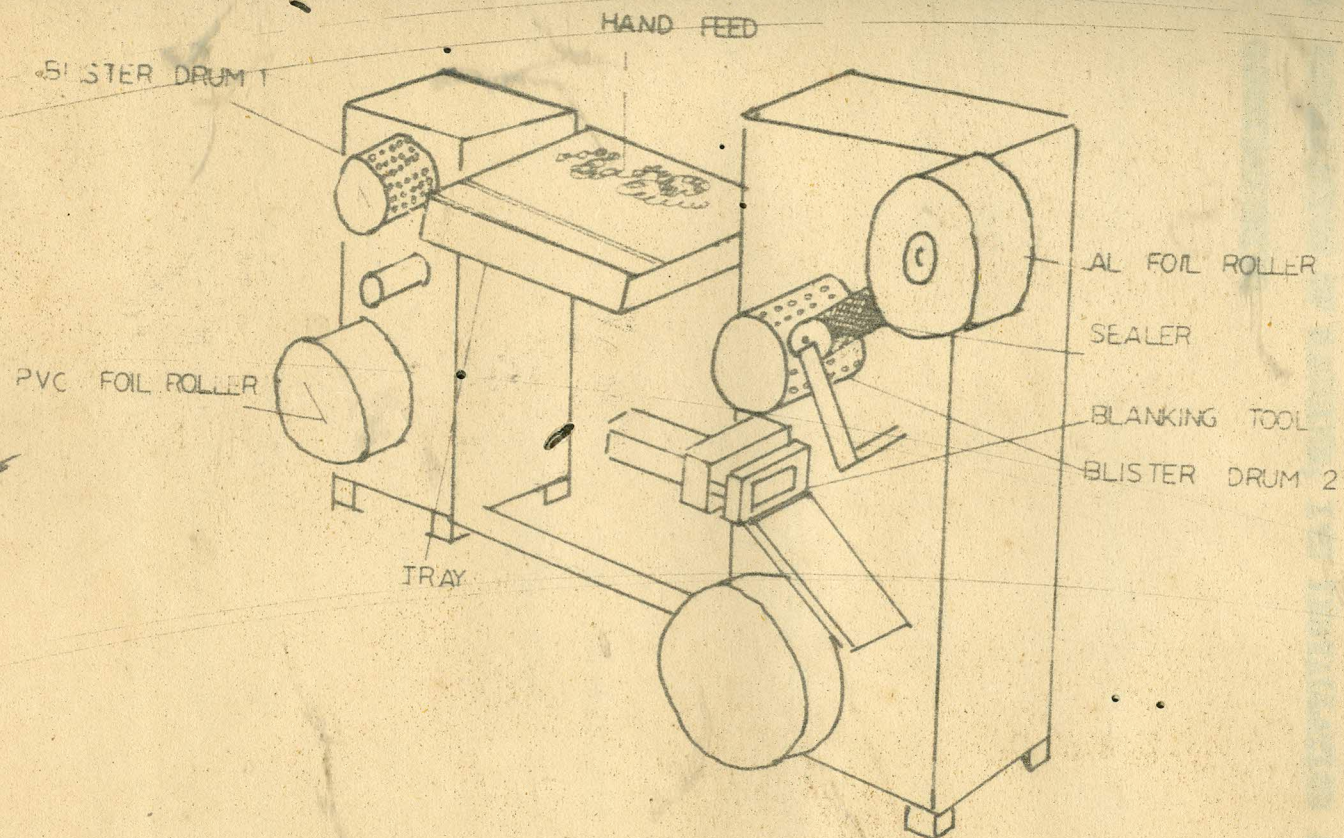
Manufacturer :

PACKART, Bombay

The main difference between fully auto-machine and semi auto machine is that of feeding the tablets. In auto-machine tablet feeding is automatic with help of vibrator and hopper, whereas in semi auto-machine tablets are hand fed. Other operation principles remain same. The semi-automatic machine consists of two drums which have cavities for tablets and inbetween these two drums a big tray containing the tablet is placed.

As this project only deals with the improvements in the fully automatic machine manufactured by Larsen & Toubro the next chapter 2.2 describes working of the same machine in detail.





2.2 WORKING OF BLISTER PACK MACHINE

2.2.1 OPERATION OF MAIN SYSTEM

2.2.2 DIFFERENT TYPES OF DRIVES AND OPERATIONS

2.2.3 FABRICATION OF MACHINE, ITS INSTALLATION AND COMMISSIONING

2.2.1 OPERATION OF MAIN SYSTEM

The main systems of machine are listed as below :

- a) Moulding
- b) Feeding
- c) Seaming - Heat binding
- d) Trimming
- e) Rectifying slip of printed pattern (optional)

a) MOULDING (Refer Photograph ^{3 4})

D 2

Blister forming drum is 45 cm in diameter and made up of aluminium thick rolled plate, which contains blister. The drum is directly connected by means of a disc chamber to the vacuum pump and compressor line.

The area of this blister forming drum is divided into two parts

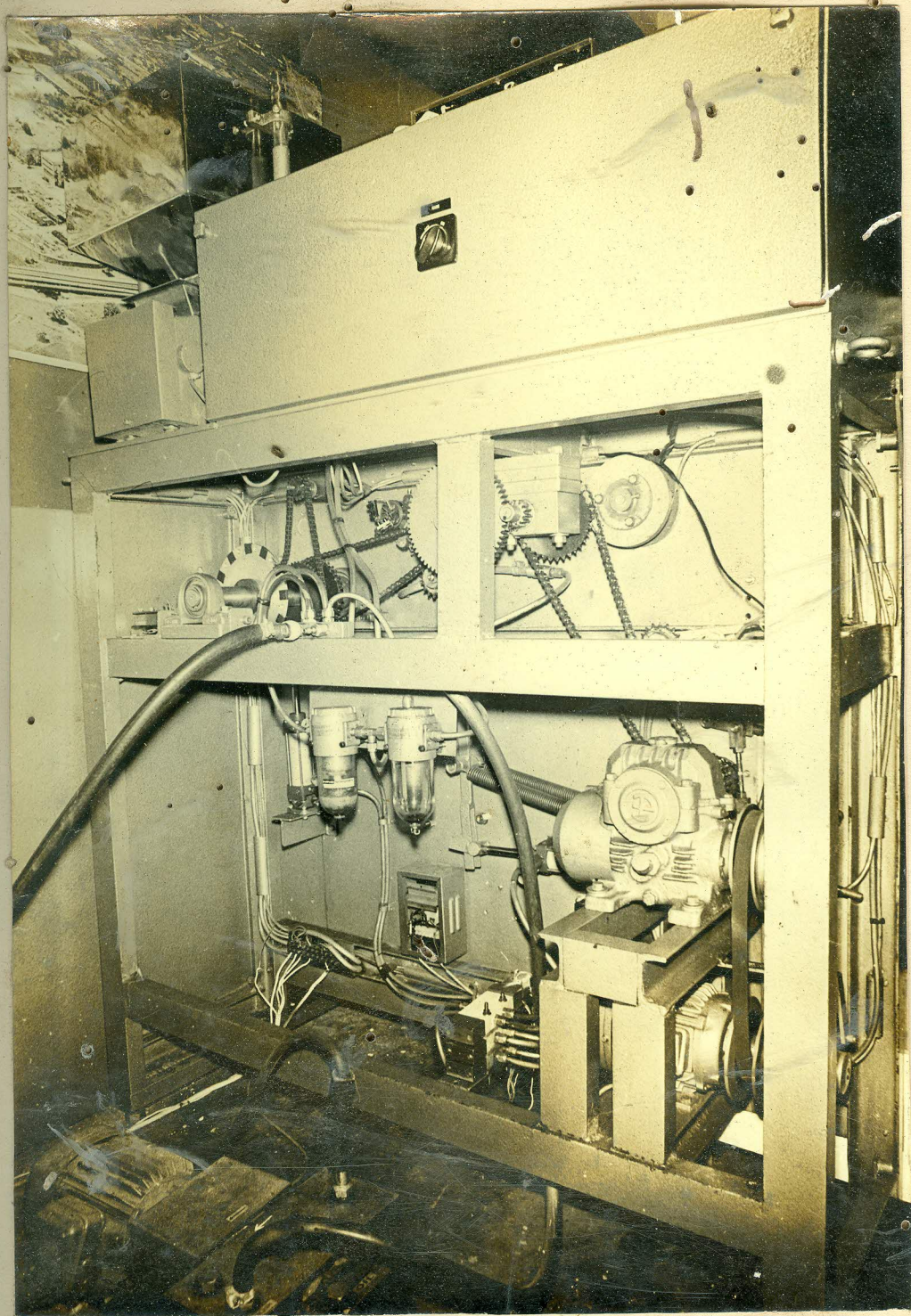
- 1) Vacuum zone - for creation of blister
and
- 2) Zone for compress air - for injecting out formed blisters

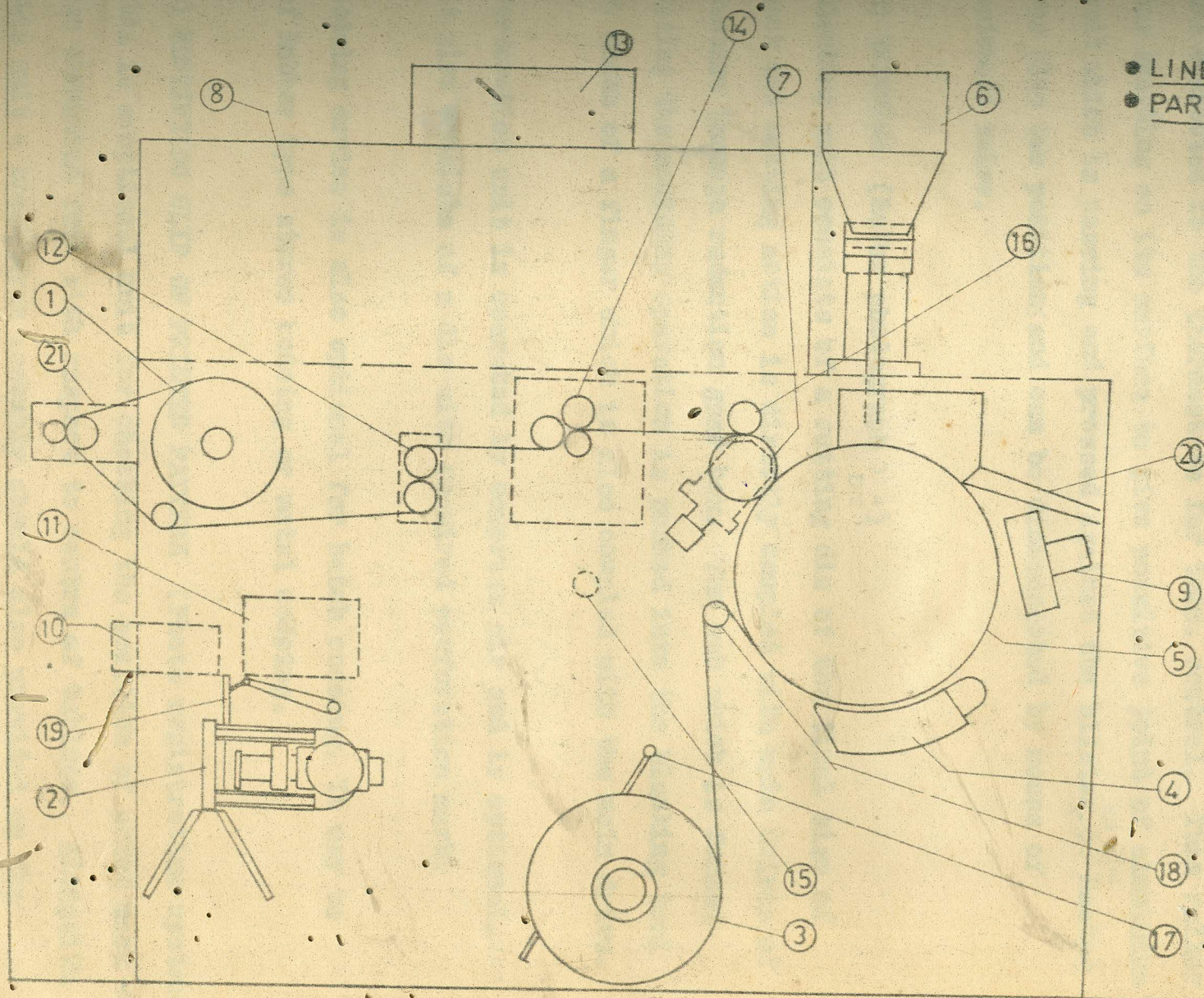
Electric heater is directly placed below the drum and has alternate connections for varying the output. Heater can be swung away from the drum when required, by means of solenoid valve.

b) FEEDING (Refer photograph ^{3 4})

D 2

Main hopper which is made up of stainless steel and placed over the vibrator and pill size checking unit, which is also connected





21	RUBBER CODING DEVICE
20	CHUTE FOR TABLET REMOVAL
19	STRIP FEEDING FINGER ASSY
18	PVC GUIDE ROLLER
17	PVC GUIDE BAR
16	HYLAM PRESSURE ROLLER
15	AIR INJECTION VALVE
14	PRINT MARK SENSING ARR.
13	PRINT MARK CONTROL UNIT
12	FOIL BREAKING UNIT
11	PERFORATING DEVICE
10	BATCH CODING UNIT
9	COOLING FAN
8	CONTROL PANEL
7	SEALER ROLLER
6	MAIN HOPPER
5	BLISTER FORMING DRUM
4	DRUM HEATER
3	PVC ROLL
2	BLANKING TOOL
1	FOIL ROLL
NO.	DESCRIPTION

to secondary hopper by means of a pipe. The secondary hopper is made up of transparent 8 mm thick Acrylic and covers $1/5^{th}$ circumference area of blister forming drum.

c) SEAMING (Refer photograph ^{3 4})

D 2

Sealer heater is a cylindrical roller consist of a heating coil ^{ring} and connected to the thermostate for temp. control. This roller has knurling on its surface to give positive joint of aluminium foil which is passing and pressed against the blister ^{ed film}. Heater has also two positions and can be disconnected by means of solenoid valve.

d) TRIMMING (Refer photograph ^{3 4})

D 2

Blanking unit consists of a cutting die of the final size of pack and cutting action is directly coupled with main drives of machine through reduction gear box. The web which is formed during the moulding operation is pushed into the blanking tool by means of a finger, which is also coupled with the main drive.

Perforation unit is operated by compress air and is optional. ^{led} It also consists of a die with required perforation mark.

Codeing device is also optional for batch codeing. It may be of Rubber type stereo codeing or metal codeing.

e) RECTIFYING SLIP OF PRINTED PATTERN (Photo registration system)

This is an optional unit for checking the position of print mark on the aluminium foil with respect to centre of tablets. Alongwith this unit a break drum assembly should also provided on the

front of machine for making correction automatically.

(see annexure 2 for more details and working)

2.2.2 DIFFERENT TYPES OF DRIVES AND OPERATION (see photograph ^{3 4})

D3

- a) Mechanical drive
- b) Vacuum operation
- c) Compressed air operation

a) MECHANICAL DRIVE

Motor of 1440 R.P.M. and 1 H.P. with variable speed changing unit is directly coupled with Gear box, where first speed reduction of 20:1 takes place. The Gear box is directly connected to finger and blanking tool. From Gear box, by means of sprocket and chain, drive is given to secondary gear box where the speed is further reduced and from there to the Blister forming drum and cleaning brush. Final drum speed is 8 R.P.M. but can be varied too as low as 3 R.P.M.

b) VACUUM MOULDING OPERATION

One flexible pipe is connected from vacuum pump outlet to blister forming drum inlet, for forming the blisters, the pressure required for forming the blister is 0.7 kg/cm^2 .

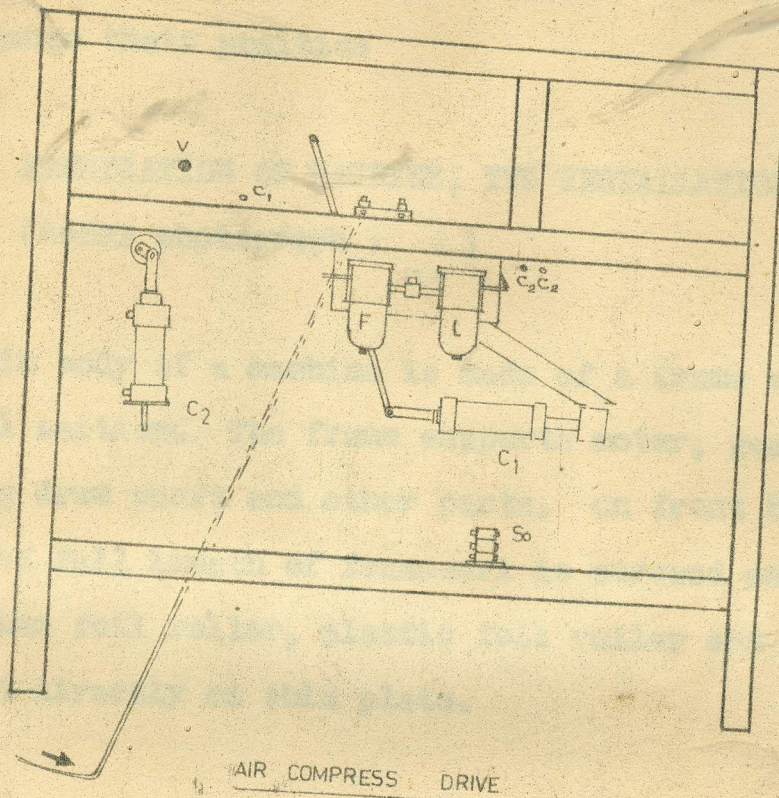
c) COMPRESSED AIR OPERATION

Compressed air drives are connected to following units to perform their operation :

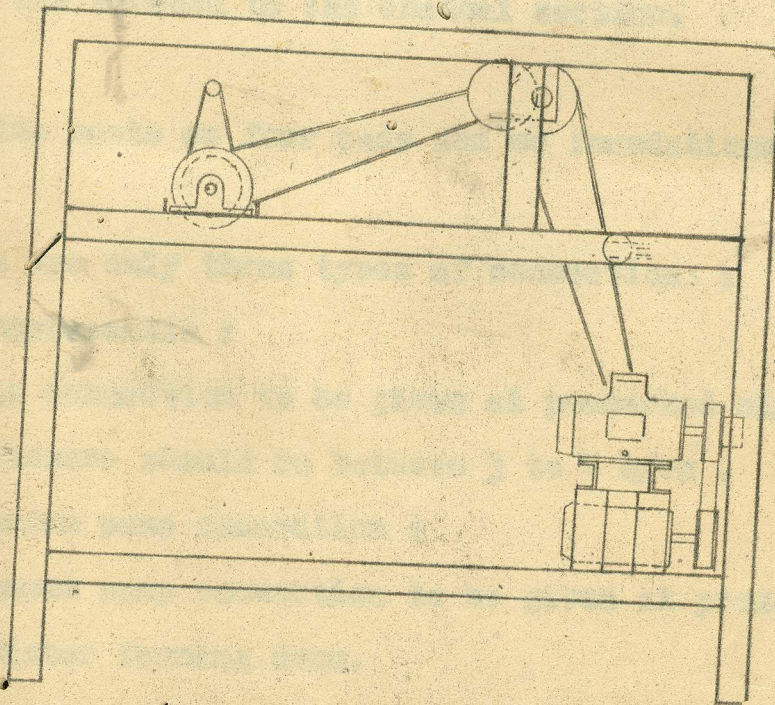
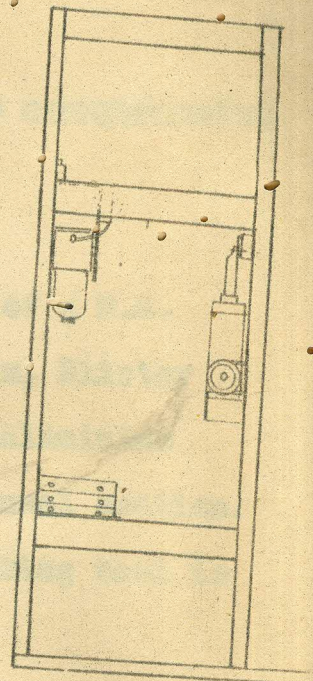
1. Perforation unit

DRIVES

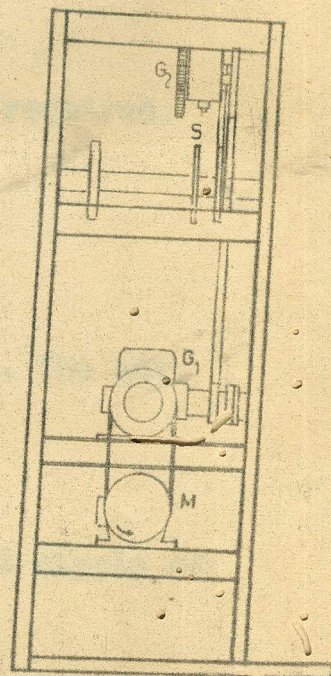
D 3



AIR COMPRESS DRIVE



MAIN DRIVE 1:10



2. Ejection of blister and film
3. Solenoid valve operation for sealer and drum heater to change their position

2.2.3 FABRICATION OF MACHINE, ITS INSTALLATION AND COMMISSIONING (Refer photograph 3 4)

D 4

The main body of a machine is made of a frame work of a M.S. Channel section. The frame supports motor, gear box, Blister forming drum shaft and other parts. On front 8 mm aluminium plate of full length of framework is screwed on channel section. Aluminium foil roller, plastic foil roller and blanking tool is mounted directly on this plate.

Back and sides are closed with sheet metal access panels and they are screwed to the channel section.

Machine rests on four pads and no foundations is required.

There are only three types of connections :

1) Compressed Air :

Air connection to be given at premarked nipple. The air pressure should be between 3 to 4 kg/cm².

2) Vacuum pump connection :

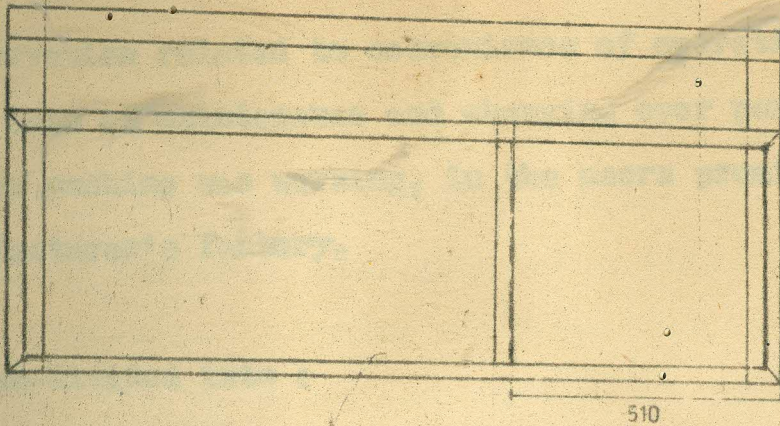
Vacuum pump connection to be given at premarked nipple of Blister forming drum.

3) Electrical connection :

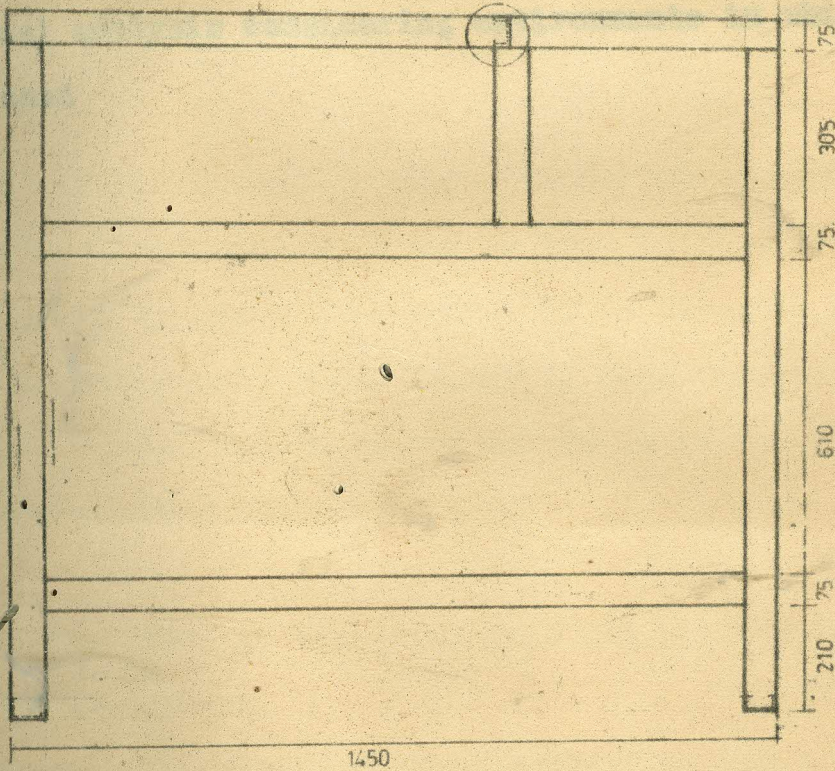
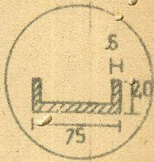
Main 440 V. 3 phase 50 cycle connection to Control Panel and other electrical parts.

STRUCTURAL DETAIL.

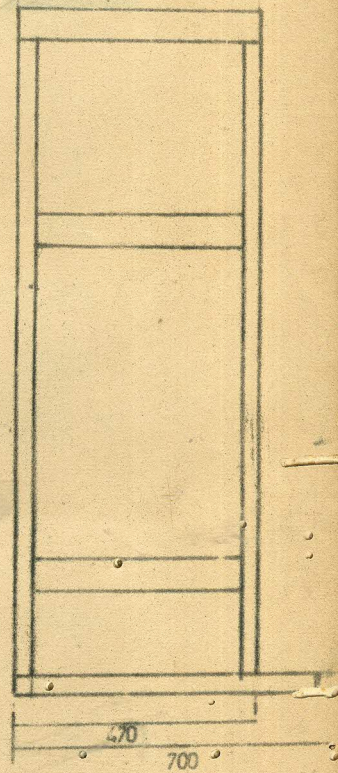
D. 4



TOP VIEW



FRONT VIEW



SIDE VIEW

3. ANALYSIS

The observation related to convenience of operation (Ergonomic) safety, ease of maintenance and changing over parts was being made when machine was working, in the users premises as well as in manufacturer's factory.

It is sub-divided into :

1. Users difficulties
and
2. Visual analysis considering environments in which machine is used

3.1. DIFFICULTIES OF USERS

1. Height of control panel (Refer photograph 5)

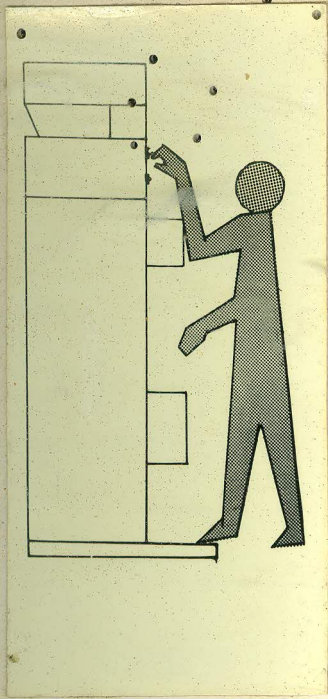
The top part of the control panel of the machine is as high as 220 cm. so average Indian operator (156 cm) has difficulties of reaching the controls. Many parts of machine like P.V.C. foil roller, Aluminium foil roller and brake drum assembly are projecting out by a 30 cm and some of this are moving and heated parts. So operators has to be very carefull and to stand sufficient away when operating controls. He has to stretch his arm in a odd position for operating different controls.

2. Height of Photo control unit (Refer photograph 6)

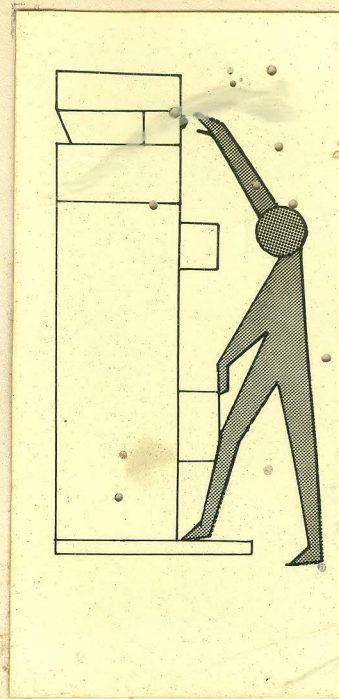
As this is an optional unit and no room is provided in the control panel to place this unit. It is directly place on the top of control panel, which itself is high enough for easy operation. Total height is 240 cm. So it is inconvenient to initially set this unit.

3. Initial setting of Aluminium foil and Plastic foil rollers (Refer photograph 7)

The frequency for changing these rollers is about 40 to 50 min. of continuous machine operation. The setting of P.V.C. roller on machine is inconvenient due to P.V.C. foil roller holding device height. It is not suitable for seating or standing operation and the operator has to take an odd bending posture.



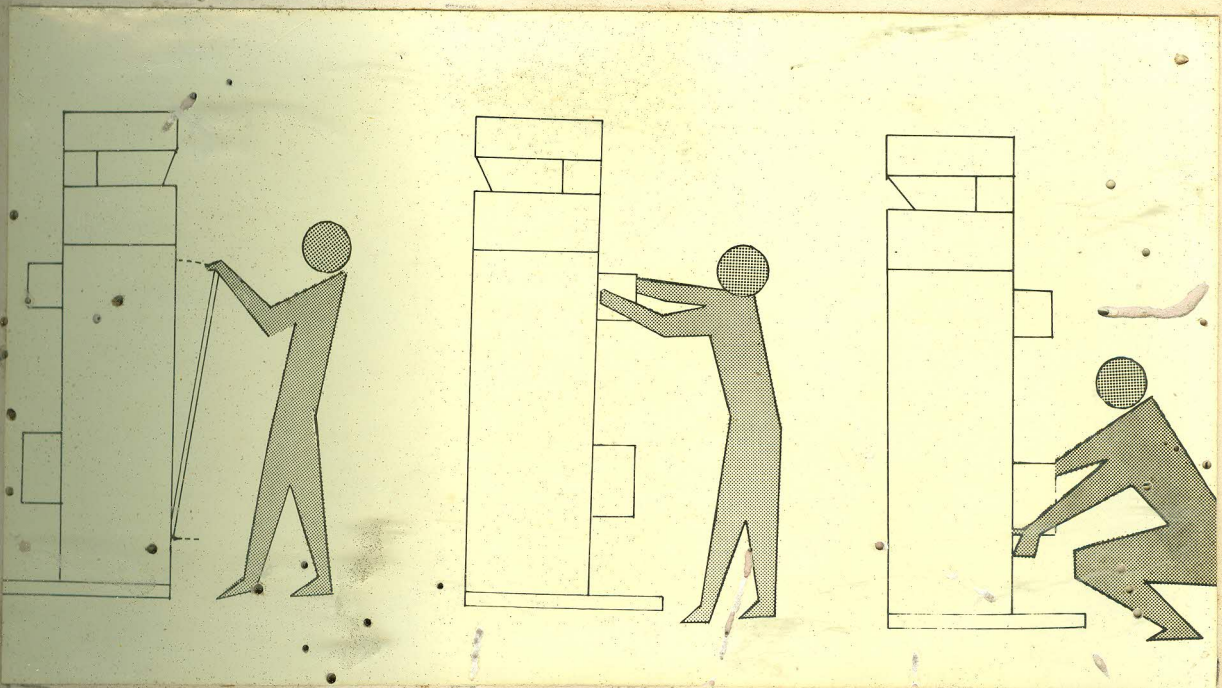
p 5



p 6

p 8

p 7



● 4. Tablet feeding (Refer photograph 9)

The opening for feeding the tablets into hopper is as high as 240 cm above the platform of machine. The frequency of feeding tablets in hopper is about 20 to 30 min. of continuous machine operation.

A stool or height increasing device is required for feeding tablets in hopper which reduces the stability of operator, particularly when he is expected to manure big cartoon weighing 20 kg.

● 5. Maintenance problem for control panel

The whole unit is box type and there is no easy access for maintenance of electrical connection. The knob and other controls panel are on front and box is 45 cm deep and at a height of 210 cm so stool is required for maintenance purpose, which reduces mobility in doing work and increases time unnecessarily.

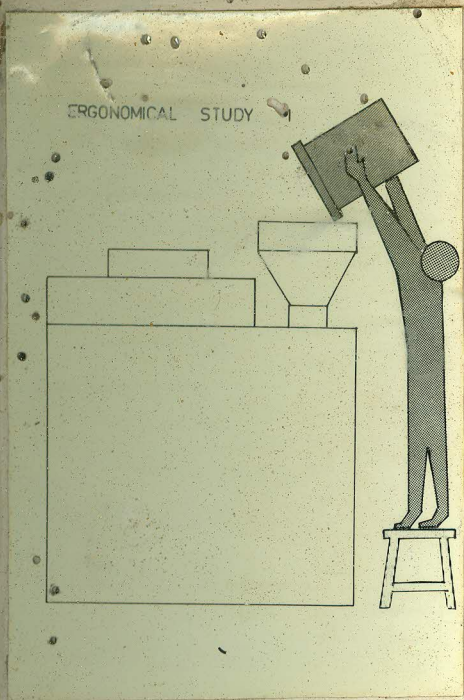
● 6. Access to Brake drum (inside) (Refer photograph 10)

The components in the inside space of machine are unevenly distributed in small pockets. The various components are randomly placed and some are crowded in such a way that you can not reach them easily. Access to the inside of brake drum assembly is obstructed by gear box and electrical connection.

● 7. Lubrication of moving parts

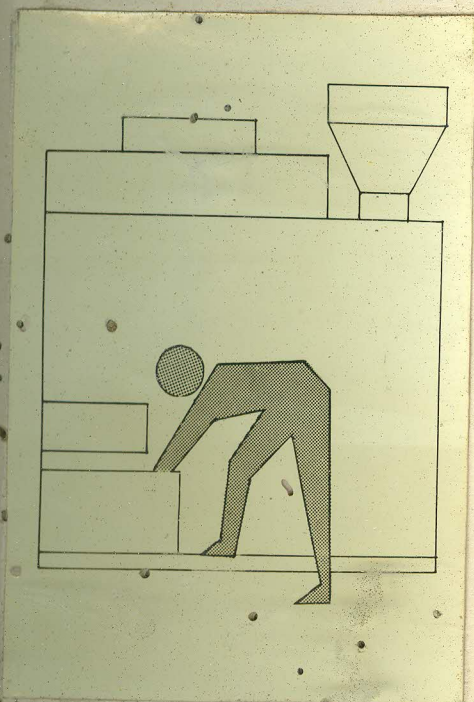
11

Some of the moving parts required lubrication like gear box and sprocket, which is not easily done due to crowded area.

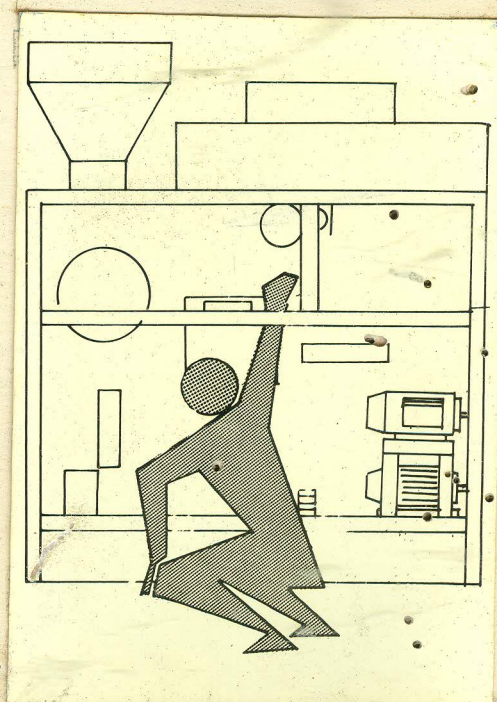


p 9

p 11



p 10



● 8. Opening of backside of machine (Refer photograph 8)

The machine back side is closed with a full 150 cm x 120 cm. big sheet metal single cover, which is screwed to the frame, so two persons are required to open the cover. This also creates the problem of finding space for putting it to aside when work is going on.

The components of different systems are so distributed that one cannot find inlet and outlet of electrical and air connection. These wires and pipe connections are suspended and not clipped.

● 9. Variac control and selector switch position

Variac control for brake drum and selector switch for heater are not placed in the control panel. They are randomly placed on the machine front.

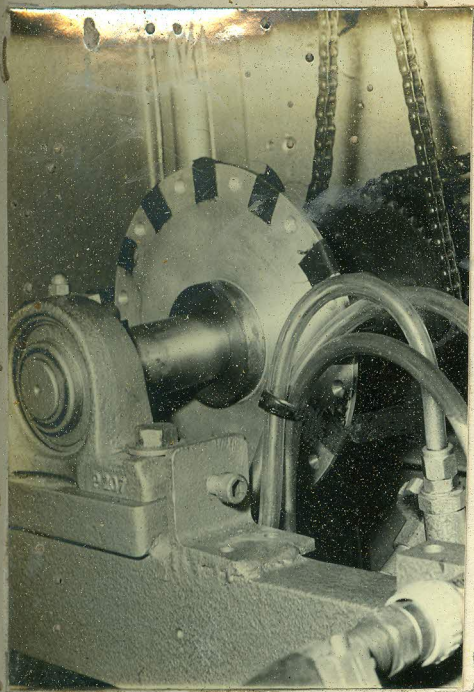
● 10. Air pressure indicator 12

As there is no indication for compress air pressure on the control panel, so one has to use trial and error method for judging the air pressure or wait for more time to check ^{whether} the pressure is built up to the requirements of operation.

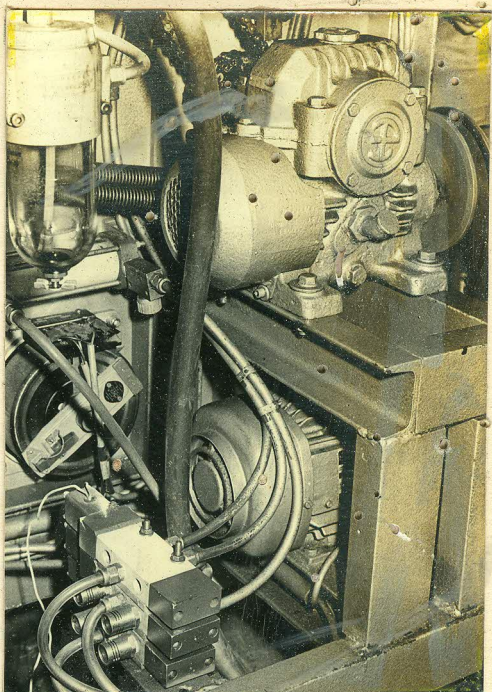
● 11. Problem of changing of parts

Since the pack size does not remaining same for various sizes and layouts of tablets, so Blister forming drum has to be changed when the centre of tablets on drum changes the print mark checking synchronisation disc has to be removed.

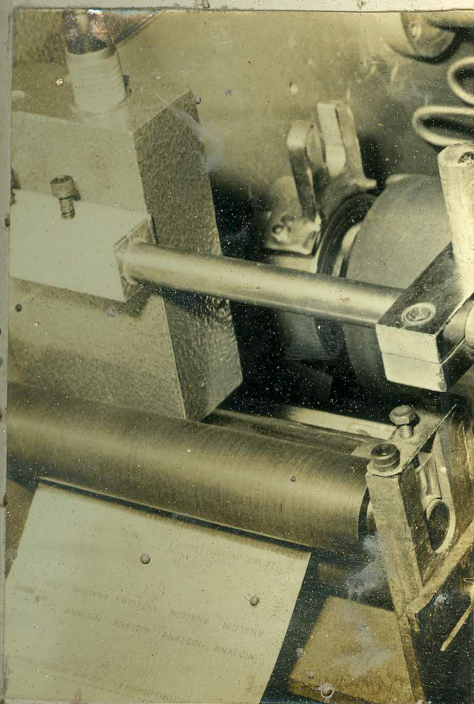
In present machine, when you are changing the size of pack,



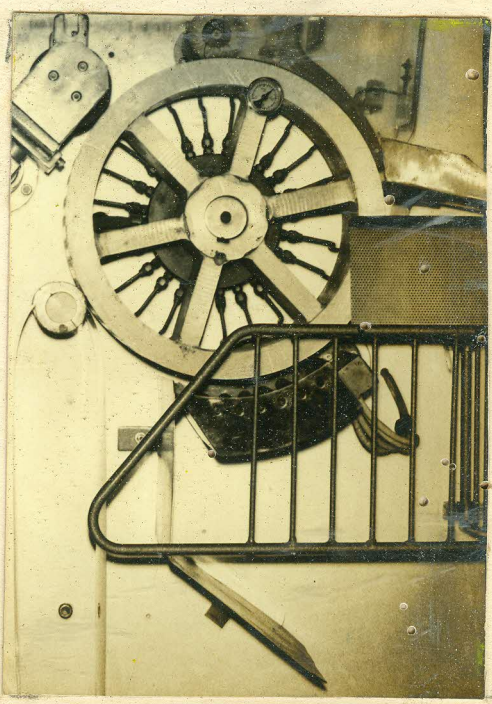
P 12



P 12



P 14



P 13

^{synchronization}
 you have to change disc which is fixed to shaft of the Blister forming drum. Since the shaft is rotating in a self-lubricating bearing, to change the disc the shaft and bearing have to be also removed. This increase time and operation.

● 12. Safety Guard (Refer photograph 13)

The moving parts and heated parts are partly guarded to avoid any minor accident. i.e. drum-heater and fan are exposed.

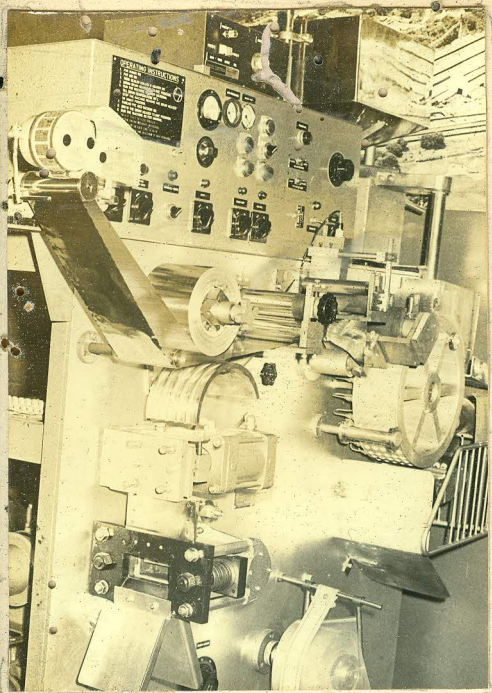
^{operator}
~~Heater~~ is exposed to ^{Heater} ~~operator~~ when it is swung away from drum so there is a chance that a minor accident can take place.

● 13. Emergency control for safety

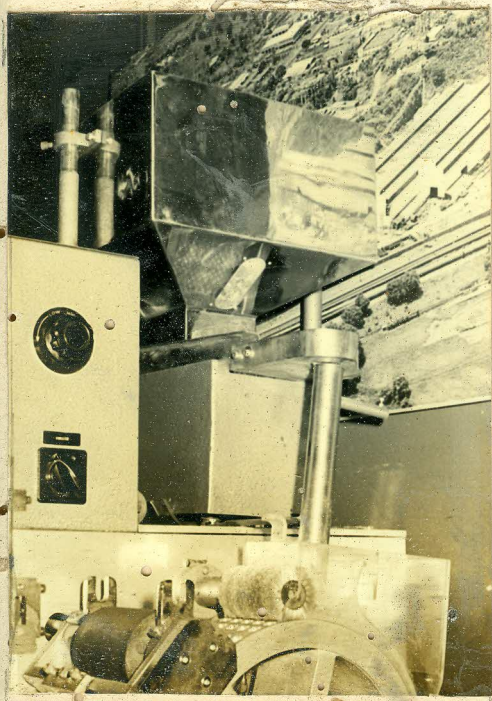
There is no emphasis on emergency controls which are conveniently accessible for quick shut-down.

3.2 VISUAL ANALYSIS

- 1. The product as a whole does not fit into the clean environments of pharmaceutical industries.
- 2. The machine should^{be} able to project an image of cleanliness and precision but number of parts which are projecting out like roller, blanking tool make machine look complicated.
(Refer photograph 14)
- 3. The green Hammertone colour is not suitable for pharmaceutical industries.
- 4. The photo-sensitive unit looks like an added unit.
- 5. The logo on machine ^{is} ~~are~~ not properly placed and is not noticed. ^{is}
- 6. Control panel makes machine look more heavy as it is placed on the top of machine. The knobs are randomly arranged and no standard graphic system or pattern is followed. (Refer photograph 15)
- 7. The fan near ~~the~~ drum heater looks out of place and can be replaced by some other device of air blowing.
- 8. Unit like blanking tool, finger are themselves very crude to look at.
- 9. Plastic film roller tensioning device is very crude.



p 15



p 14 2

4. DESIGN APPROACH

It is decided to redesign the machine without changing any technical aspect of operation and merely concentrating on convenience of user (Ergonomic) for operation, maintenance and safety.

Also attempt is made to improve fabrication and thus giving new look to machine and more rational reorganisation of assembly of components in cabinet.

The problem has been divided into three main areas :

1. Geometric Reorganisation of given systems which can solve the ergonomical and maintenance problem.
- 2..Functional improvements of some component.

4.1 REORGANISATION

1. Reorganisation of components of machine

A) Reorganisation of front

B) Reorganisation of inside system of machine

Both are interdependant on each other.

2. Redesign of control panel.

● 4.1.1 (A) Reorganisation of Front

The elements on the front side are relocated with ideas of increasing convenience and operator safety.

The control panel is taken away and located as independant unit. More detailed discussion is documented in 4.1.2.

The heights of blanking tool and plastic film roller are now raised to 65 cm. However, this will only change the linkage length and not the mechanism.

The aluminium foil roller and sealer roller are now raised to 115 cm. which will be convenient for observation and maintenance in standing working posture.

The drum heater and moving Blister forming drum, which are partly covered are now being fully covered by means of sliding guard, fabricated out of glass ^{fixed} in Aluminium frame work, to ensure the safety of operator.

The vacuum pump which is placed outside the machine, now, is placed inside the machine and sufficient room is made available. The waste tablets collecting box now becomes integral part of machine. This above all reduces the area of 8 mm thick aluminium plate and expected to reduce cost.

● 4.1.1 (B) Reorganisation of inside system

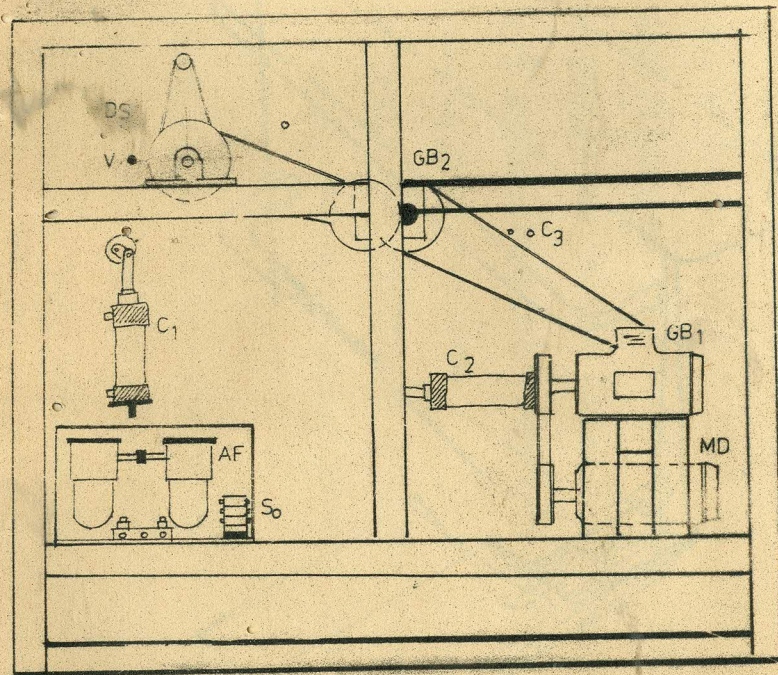
The components in the backside area which were concentrated in small pockets are relocated. The system and its components are now being regrouped and localized evenly in available cabinet space like: compress air inlet chamber, filter and solenoid valve are now grouped together and placed in such a way that they can be fabricated independently. The rectifier is shifted to control panel and secondary gear box is relocated for easy access to lubrication.

The motor and gear reduction box are reoriented to face inside, to increase the possibility of access to pulleys for speed variations.

The secondary gear box is also shifted down as shown in D 5
Skeleton diagram for easy lubrication and access to brake drum assembly behind, is now more easy.

This Reorganisation leads to a simpler frame structure as shown, which will avoid one inbetween structural member and creates more Visual Separation between areas of mechanical drives and areas of compress air drives.

BACK SIDE OF M/C



DS - DRUM SHAFT

GB1-2 - GEAR BOX

C1 C2 C3 COMPRESS AIR INLET

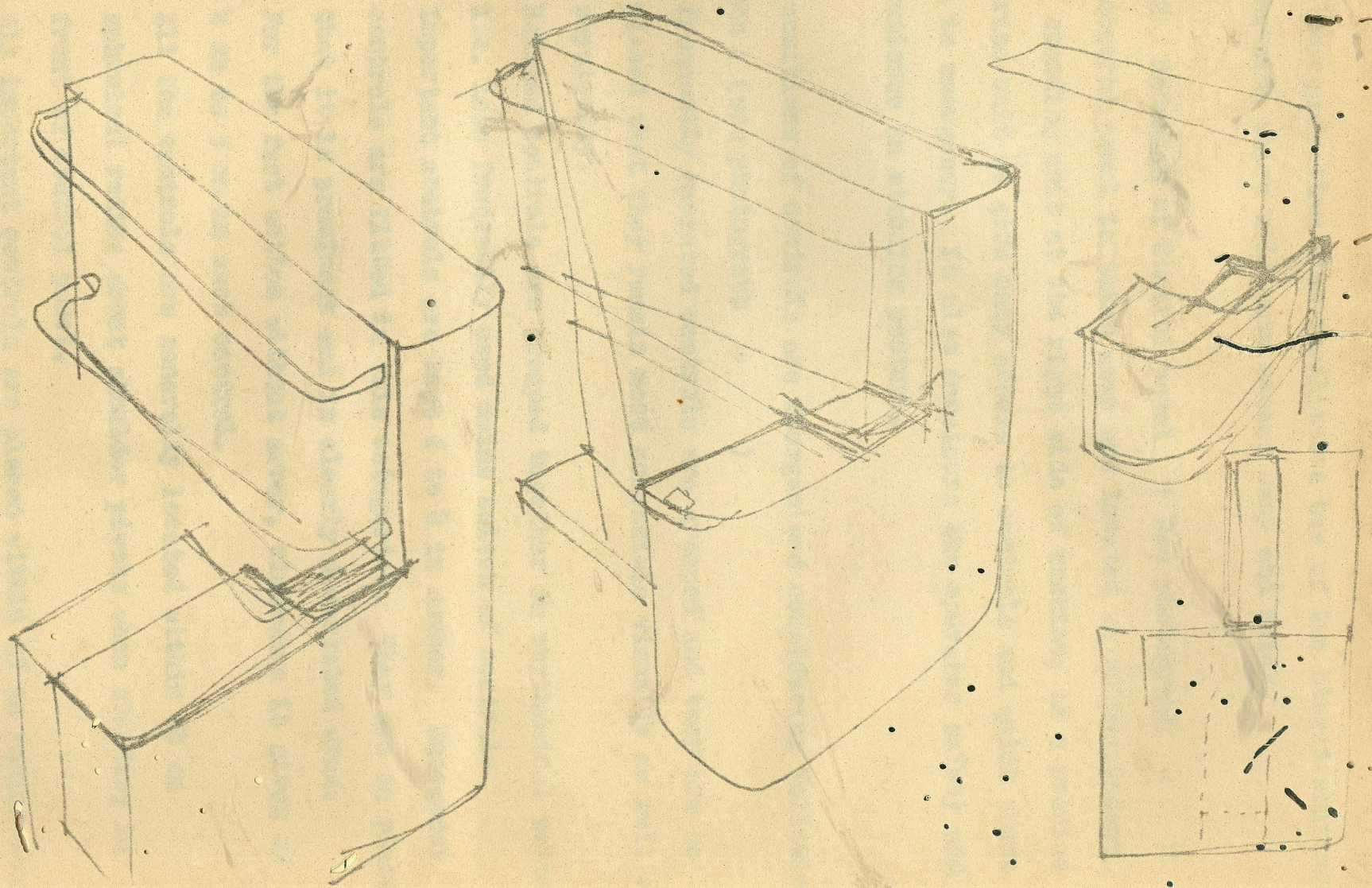
AF - AIR FILTER

Sv - SOLONOID VALVE

MD MOTOR

D.5.

DESIGN APPROCH



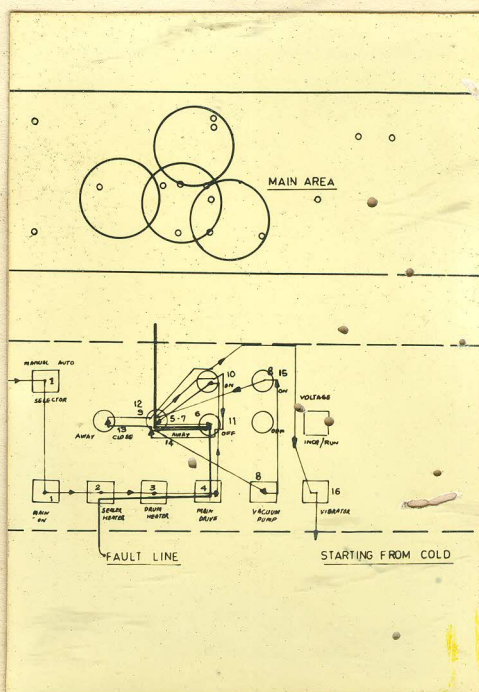
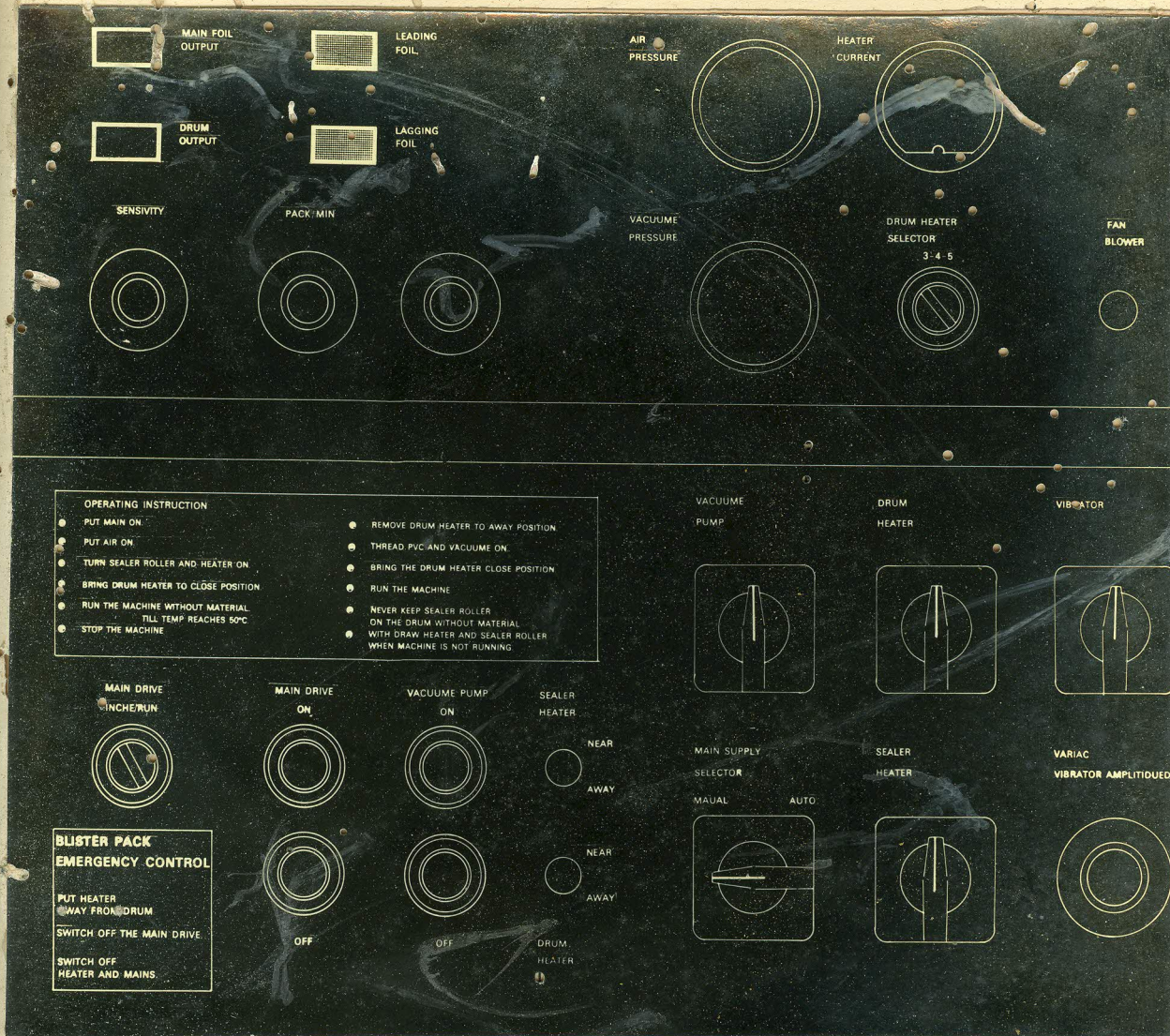
This reorganisation also facilitates use of two hinged shutters on backside which will make access easy and quick.

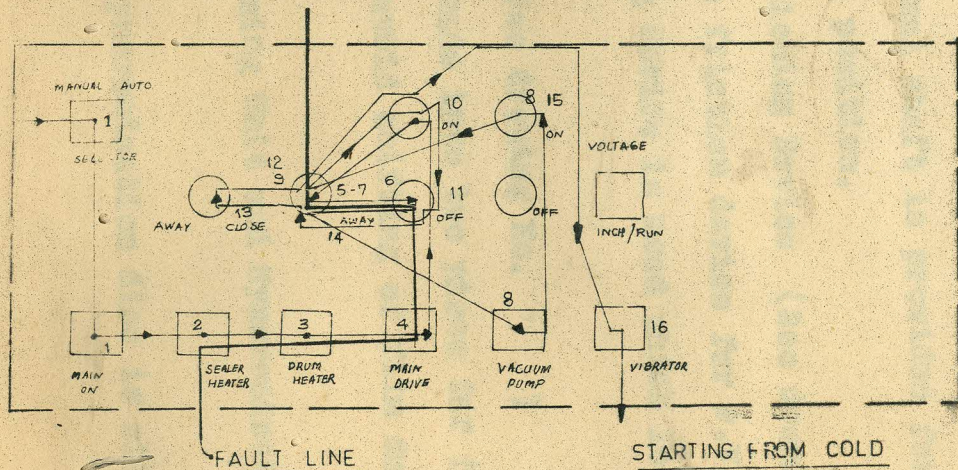
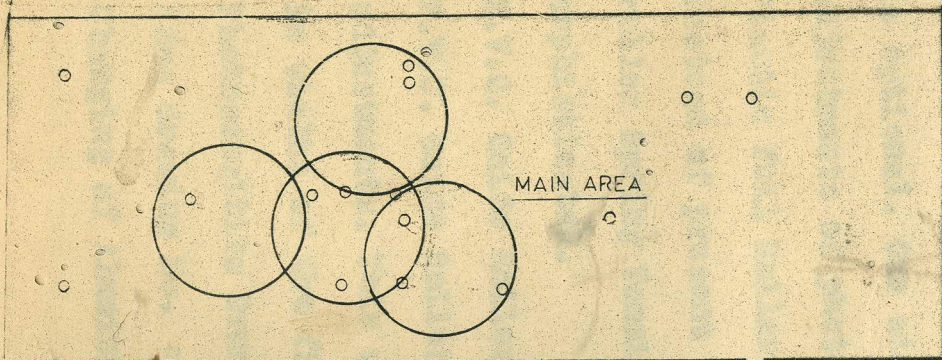
● 4.1.2 Redesign of Control panel (See photograph ¹⁶_{D 7})

The control panel is taken away and located as an independent free standing unit at the right side of machine, as a precise separate unit ^{to} give easy access to controls and quick shut down in emergency. It also considers the operator safety and convenience in standing posture.

The positions of controls are reorganised considering following points : (see photograph ¹⁶)

1. Frequently operated controls are grouped and they are so placed that they remain most accessible visually as well as physically.
2. Related controls are grouped together in rhythmical pattern i.e. less frequently used mains switch of controls
3. Important controls are kept 6 to 8 in number. Emergency controls are fitted in this categories. They are so placed that it is prominent and in clearly demarketed area.
4. For the fast action without error, clearance is given of 4 cm to 5 cm in each control.
5. All the controls are generally located within 60 cm ^{er} spherical radius, about shoulder pivots, when standing in front of control panel.
6. All important controls are placed within 35 cm radius, about the elbow pivots for quick access.
7. The control level is kept between 90 cm to 100 cm which is





LARSEN & TOUBRO BLISTER PACK CONTROL PANEL

OPERATING INSTRUCTION

PUT MAIN ON.

PUT AIR ON.

TURN SEALER ROLLER AND HEATER ON.

BRING DRUM HEATER TO CLOSE POSITION.

RUN THE MACHINE WITHOUT MATERIAL.

TILL TEMP REACHES 50°C.

STOP THE MACHINE

REMOVE DRUM HEATER TO AWAY POSITION.

THREAD PVC AND VACUUME ON.

BRING THE DRUM HEATER CLOSE POSITION.

RUN THE MACHINE

NEVER KEEP SEALER ROLLER

ON THE DRUM WITHOUT MATERIAL

WITH DRAW HEATER AND SEALER ROLLER

WHEN MACHINE IS NOT RUNNING.

between shoulders and waist height, in standing position.

This reduced hand movements during operations of controls lead to symmetry of motion and avoid waste motion and detouring around the controls.

4.2 FUNCTIONAL IMPROVEMENTS IN COMPONENTS

● Hopper : (See drawing No. 4)

Hopper form is changed and the height is reduced to make feeding of tablet easy and without stool. It is covered by stainless steel plate all around. It has one shutter at the back for access to vibrator.

● Brake Drum - Print Mark Checking Unit (See drawing No. 5)

The brake drum and print mark checking assembly is combined into one unit. This makes fabrication simple and entire unit is optional. One additional shaft is provided for finer adjustments of photocell position.

● Plastic Foil Roller Tensioning Device (See drawing No. 6)

Instead of present crude friction device for P.V.C. foil roller, Spring Tensioning device is used which looks more sophisticated.

● P.V.C. Guide Roller (See drawing No. 7)

P.V.C. Guide Roller is made into two pieces for film width adjustments. This will avoid shifting of film due to change in widths of the film.

● Photosensitive Drum Sensing Unit and Synchronisation Disc (See drawing No. 8)

Changing of Aluminium Synchronisation disc is eliminated by means

of providing drill holes for various centre of tablets by changing the radial distance of holes from the centre.

A sensing unit can be laterally shifted to pick up signals from optional distances of tablets centres. This minimises the change over time considerably.

● Safety Guard (see drawing No. 9)

The special sliding safety guard is designed to protect operator from heated and moving parts of machine front side. It also increases the visual appeal of machine.

● Manufacturing Aspect

● Machine Fabrication

Load bearing structure is mainly made up of frame of a M.S. channel section. They are welded to make a body (Refer drawing No. 1 2) Motor, Gear Box, Pump, Shaft are fitted on this.

On this framework, from front side 8 mm Aluminium plate is being fixed with screw, rollers, brake drum and cutting dies are directly fitted on Aluminium plate. The rest of the parts are made up of 20 gauge sheet metal and assembled in such a way that it minimises the joints.

● Control Panel Fabrication

The bottom ~~parts~~ of control panel is 18 gauge sheet metal (refer drawing no. 3) They are folded in such a way that besides becoming a self supporting structure they give clean appearance.

Lthe

The top parts of control panel is fabricated using 'C' section of 20 mm x 20 mm and sheet metal of 18 gauge. The parts containing emergency controls and other knobs are hinged out so that it gives access to electrical connections, as well as controls together, during maintenance.

Visual Consideration - Graphic and Colour

The colour which is selected is suitable for pharmaceutical industry and go^{es} with environments of industries.

Colour sample is given on opposite page. Background on which the controls are mounted is black, to reduce the importance of less frequently used main switches and increase the importance of emergency controls and important displays.

The graphics on control panel is printed/method of silk screening. The Panel is divided in four areas, so four screens~~is~~^{are} made, when in future, if there will be change in organisation of control panel, it is possible to do this with minimum cost and waste. /by

Two alternatives are suggested for Silk Screening :

1. Silk Screening may be directly done on the Control Panel.

Or

2. A reverse Screening is done on transparent Acrylic Sheet and that sheet^{is} then fitted to control panel.

5.

FUTURE IMPROVEMENTS

1. Drum heater needs to be designed according to I.S.I. specification. (As I.S.I. specifies radiant heating instead of direct heating of plastic film)
2. A photo sensitive device detecting the amount of tablets in hopper can be designed for fully automatic operation and shut down of vibrator.
3. A mechanical means or electrical sensing device can be design to avoid and detect the breaking of aluminium foil which creates the maintenance problem of sealer heater.

APPENDIX

List of industrial establishment where the Blister Pack Machine was studied in detail :

1. Larsen & Toubro
Powai, Bombay.
2. Pack Art
Chakala, Andheri.
3. German Remedies
Chakala, Andheri.

ANNEXURE - I

MORE DETAILS ABOUT BLISTER PACKAGING

Blisterpacks and other formed sheet plastics have become a major new force in packaging. They provide packagers with many fresh and original approaches based on novel or functional constructions and with greatly enlivened display and self-selling characteristics. New materials, equipment, techniques and innovations in the use of thermoforms are also enlarging opportunities.

Much of the interest in thermoforming centres around the type of package referred to as a blisterpack, bubblepack or dome pack. Plastics stock, either in separate sheets or from a roll is fed into a vacuum forming machine, where it is heated until it softens. Then it is pulled by vacuum into a cavity mould or cover a profile mould. The heat-seal blister package has tremendous unusual appeal and wide usage on the basis of functional and economic advantages.

It is important before designing the mould which would be used to give the finished product, that a thermoforming material is selected, and used, which will allow the manufacturer, added scope in their approach to product presentation, and enable them to have a novel approach to the design of the package or blister. It is possible to utilize opaque sheets as well as clear or other colours which would then bring out more clearly, advantages which are in the product, at the same time combining the use of other materials in plastics. For instances, printed boards in the final presentation.

The positive advantages are obvious; presentation, pilferproof, protection from the elements, timesaver for the purchaser, more sales for the producer and depending on the grade of materials used, protection to the product itself.

The vacuum forming method of producing blisters, main advantage is in its complete flexibility, versatility, and the utilizing of cheap moulds with the ability to produce economically short runs; even on such equipment as high speed continuous, it is possible to have a quick mould change. With vacuum forming equipment it is possible to fit readily, ancillary operations after the forming of blisters such as filling or loading, sealing to card utilizing either heat, staples or contact adhesive, and finally separating into the units which are selected.

What is a Blister Pack ?

A blister pack is a combined construction of heat formed transparent bubble or blister, usually shaped to follow the contour of the article or articles being contained, sealed to a suitable backing card to completely encapsulate the said article or articles and designed initially as a preventive package to combat pilferage in our modern system of open store selling. Blister packaging has long since departed from its original concept and is now universally used as a combined showcard/showcase construction. Not only does it deter pilferage, but provides an amazing variety of options for easy opening, dispensing, re-use, and protection.

Why use a blister pack ?

The blister pack is ideal for point-of-sale promotion, since its

card backing offers scope for advertising; the transparent bubble covering the product draws attention to its advertising message. Further, the pack can enhance the appearance of the contents, it ensures full visibility, and in our society today this means greater consumer appeal. Its use nowadays in many instances is imposed as conditional for goods ordered on manufacturers by the larger retail stores, supermarkets, etc. and it is possibly the most widely used and adaptable of all carded packs.

Materials used in Blister Packaging

1. Polyvinyl Chloride (PVC)
2. Cellulose Acetate
3. Cellulose Acetate Butyrate (CAB)
4. Cellulose Propionate
5. Biaxially Oriented Polystyrene

General remarks about Materials for Blister Packaging

Cellulose acetate was probably the first material used for blister packaging but it is now losing out to less expensive materials such as PVC and oriented polystyrene. Cellulose acetate butyrate gives the strongest blister but the high cost of this sheet limits its use. Ease of forming, sealing, and general handling make PVC undoubtedly the most popular sheet used today. Its main advantage is that supplies are available from a number of sources.

Furthermore, in the blister industry the majority of users find that vinyl based adhesive coated cards used with PVC give less problems.

Most manufacturers who blister pack their merchandise, purchase pre-made blisters and also the cards ready printed. The packs are then filled and assembled by the manufacturer of the product.

Forming a Blister

The majority of blisters are produced by the vacuum forming process, using the drape forming technique and positive or male forming moulds. This process is simply that a mould containing single or multiple impressions is raised into a hot sheet of plastics, which is then simultaneously drawn tightly to the shape of the mould by vacuum. A short cooling period for setting is necessary before removal of the formed sheet.

Blister Design

Two most important features to consider when designing blisters are :

- a) Stackability - to enable a multiple of sheets to be cropped at each cycle of the cutting machine for speedy production, and to create as little volume as possible, should storage be necessary.
- b) De-nesting - to allow the user to separate each blister as quickly as possible, thereby minimising the number of operators involved in the filling and sealing of the blisters.

If these factors are taken into consideration, then the subsequent blister sealing operation can be speeded up considerably. The easiest shapes for thermoforming are those of true conical or spherical configuration, having no vertical walls to obstruct the down-ward flow of hot plastic sheet as it is being drawn into position by vacuum.

Continuous Blister Packing

The PVC to be pressure formed (vaccum or air) is taken off a reel, pre-heated and finally formed as heat is applied to the film making it pliable. The vac^uum then presses the film into the mould creating a pack into which the product is loaded. The formed blisters or bubbles are filled either semi or fully automatically. After a short control run, the sealing foil or backing is affixed.

The final operation consists in punching out finished packs. Specific requirements such as rounded corners, slits or perforations to facilitate detachment of packs from each other are possible.

Accessories for such units normally include feed systems which are semi or fully automatic depending on product. Additional equipment requirements are photo-electric print registration, impression unit for lot numbers, dust suction unit and conveyor belt or other arrangements for connecting to cartoning unit. The forming station requires compressed air or an independent vaccu^um pump unit.

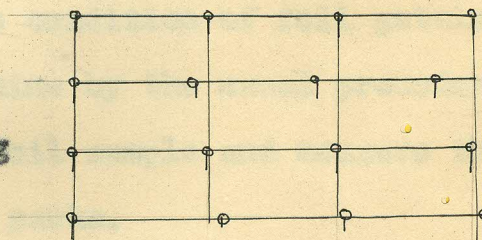
PHOTO ELECTRIC REGISTRATION SYSTEM

Photo registration is a system to co-relate the two electrical signals, one that of the Drum and other that of the aluminium foil. The drum signal is given by the eye mark disc and this signal corresponds to each pack on the drum and is consistent. It is monitored and shown on the photo registration facia as drum signal. The other signal that of aluminium foil is reflecting type and every time the print mark is sensed the signal is given by the meter adjoining to drum signal meter and is identified as foil signal.

There could be three distinct combinations of the two signals. Drum signal is consistent and equispaced. The foil signal can lag/overlap/lead with respect to the drum signal. as shown in the figure.

Drum Signal

- Case I. Foil signal lagging
Case II. Both signals overlapping
Case III. Foil signal leading



CASE I. Foil signal lagging as compared to drum signal. It means that the foil is falling shorter than the PVC and correction is required. This correction is done by energising the brake which provides stretching effect to the foil till the foil signal overlaps the drum

signal. As soon as the overlapping takes place the brake will be released and the indicator lamp will go off on the control panel. There is a variac to adjust the amount of braking required to do the necessary rectification. The amount of braking should be such that :

1. No wrinkles appear on the foil over the sealer roller.
2. The time for which the brake is on, is minimum.

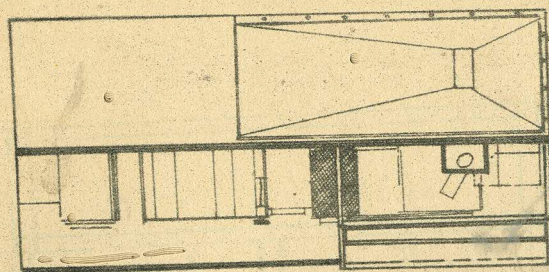
Adjustment of the brake variac should be within 25 - 40% depending upon the amount of correction required.

CASE II Overlapping of drum and foil signals - That means the foil and drum signals are registering simultaneously, so no braking is required.

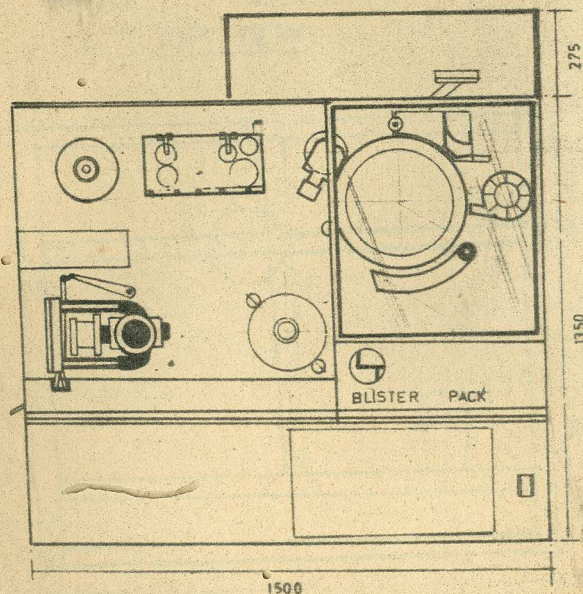
CASE III Foil signal leading as compared to the drum signal - That means the foil is getting longer and longer as compared to the PVC. Such a condition cannot be rectified because as against stretching of foil the machine cannot shorten the foil. This condition will normally not occur. If this condition of foil getting longer persists stop the machine by the usual procedure of stopping and remove the foil sample and measure the print mark distance over 40 packs.

DRAWINGS

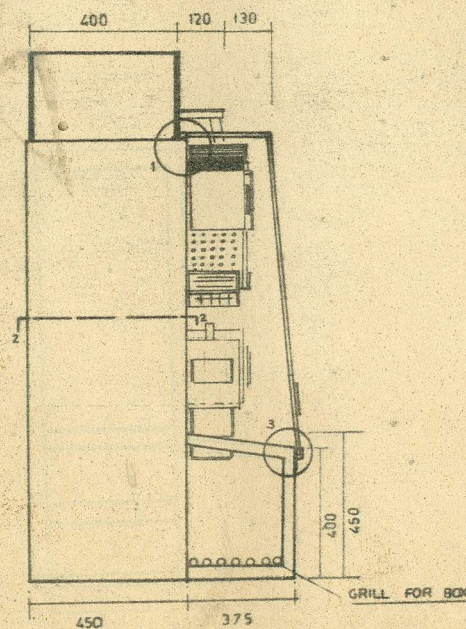
D-1



TOP VIEW



FRONT VIEW



SIDE VIEW (L.S.)

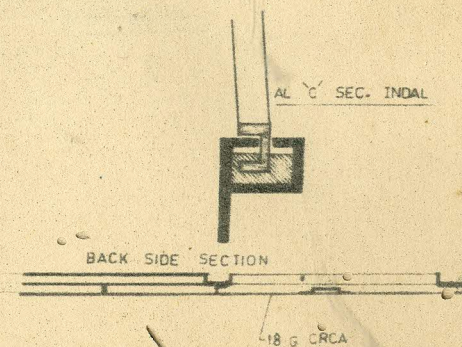
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SECTION 2



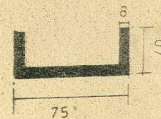
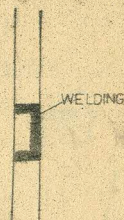
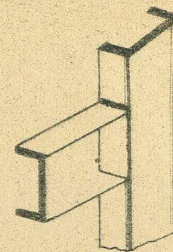
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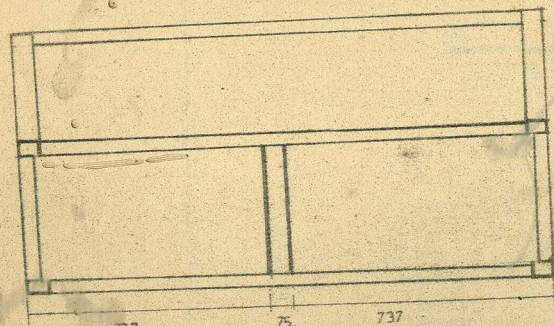
ASSEMBLY OF BLISTER PACK MACHINE		
ALL DIM IN MM	SCALE	1 : 10
M. KOTHARI	762702	
	100	1:1

SECTION - 1

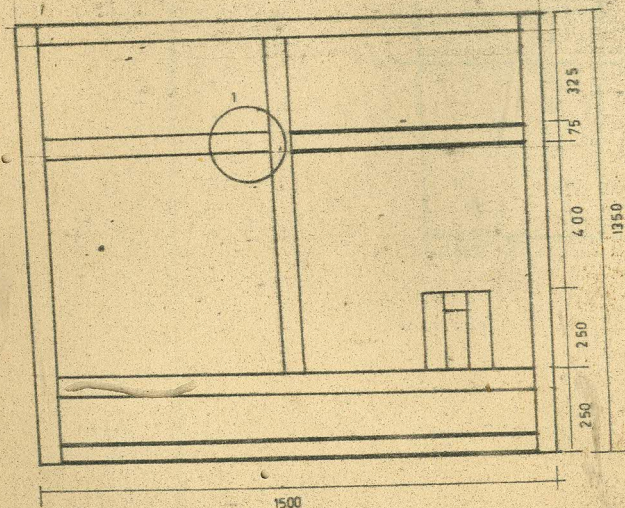
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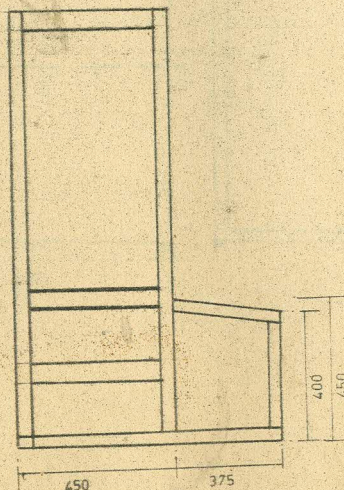
M.S.C. SECTION



TOP VIEW



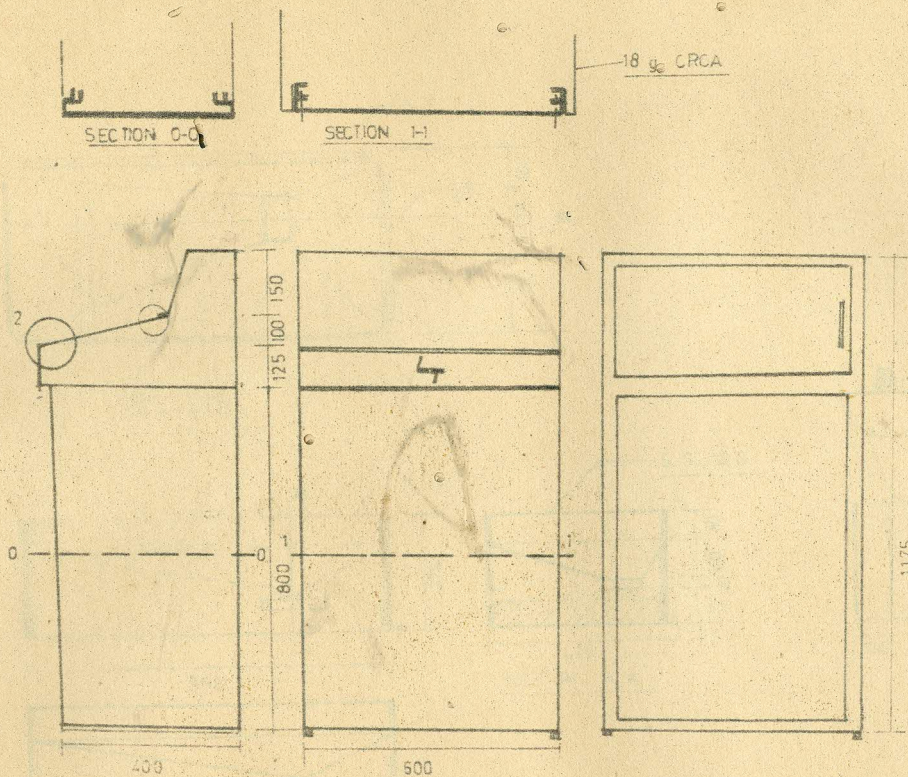
FRONT VIEW



SIDE VIEW

STRUCTURAL DETAIL	
ALL DIM IN MM	SCALE 1:10
M KOTHARI	762702
	100

D 3

CONTROL PANEL

HINGE

16g CRCA

SECTION 2BSW 10
SCREW

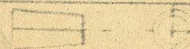
BLISTER PACK MACHINE DRAWING NO. 3

ALL DIM. IN MM

SCALE 1 : 10

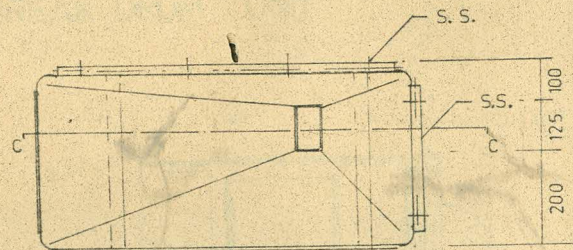
M KOTHARI

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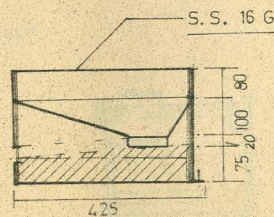
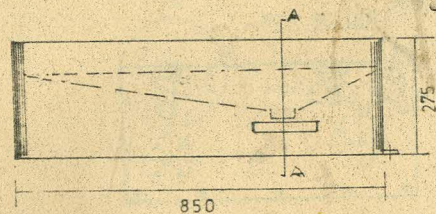


I D C BOMBAY

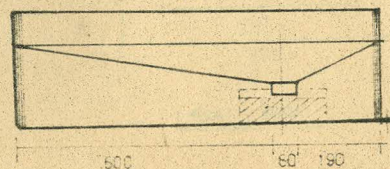
D 4



TOP VIEW

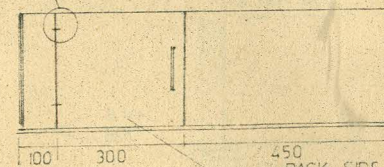


SECTION A-A



SECTION C-C

FRONT VIEW



BACK SIDE OF HOPPER

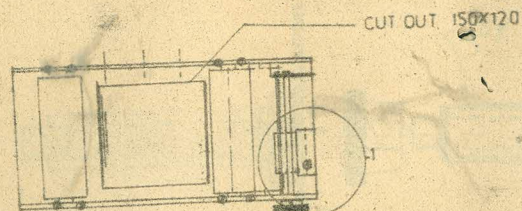
SAVES SHUTTER OF S.S.
AN ACCESS TO VIBRATOR

MAIN HOPPER

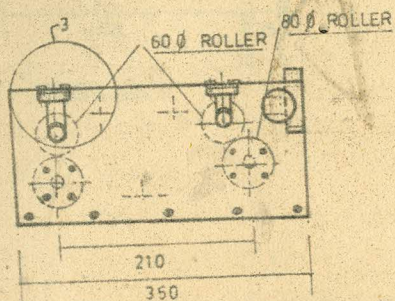
BLISTER PACK MACHINE DRAWING NO. 4	
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M. KUTHARI	762762
	I. D. C. BOMBAY

D-5

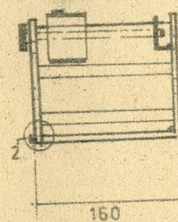
BREAK DRUM UNIT



TOP VIEW

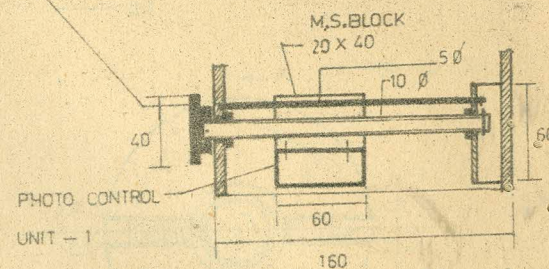


FRONT VIEW

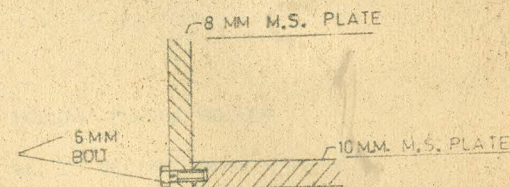


SIDE VIEW

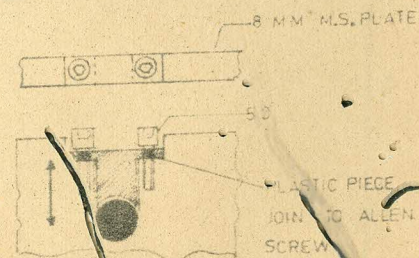
SECTION - 1 BAKELITE KNOB



SECTION - 2



SECTION - 3



BLISTER PACK MACHINE DRAWING NO. 5	
ALL DIM IN MM	SCALE 1:10
M. KOTHARI	762702 1977
	I.D.C. BOMBAY

D 6

TOP PART OF PVC-PRESS FIT

PVC PIPE 50 Ø

SPRING HOLDER

PVC STRIP
50 x 20 x 12

SECTION 'BB'

SECTION 'AA'

140

25
10 6

50 Ø

12 Ø

SPRING 10D-100L

2 HOLLOW PLASTIC ROLLER

AL. 'C' SECTION 20x12x3

ALL OTHERS PART OF M.S.

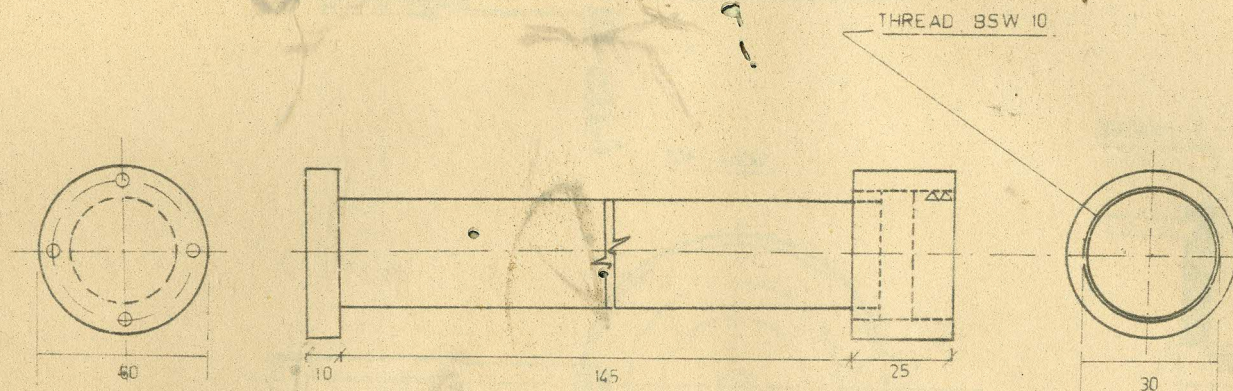
ALL DIM. IN MM.

P V C ROLLER TENSIONING DEVICE

BLISTER PACK MACHINE DRAWING NO. 6	
ALL DIM IN MM	SCALE 1:5
M KOTHARI	762702 1977
I D C BOMBAY	

D 7

PVC GUIDE ROLLER

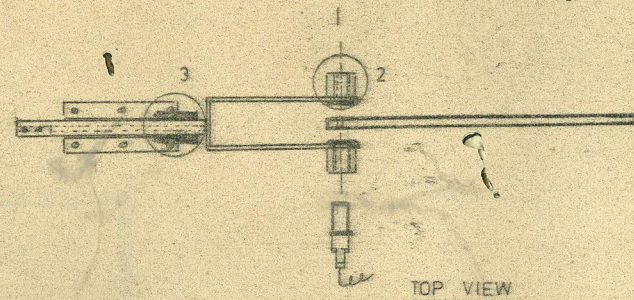


MAT—M. S. PLATED

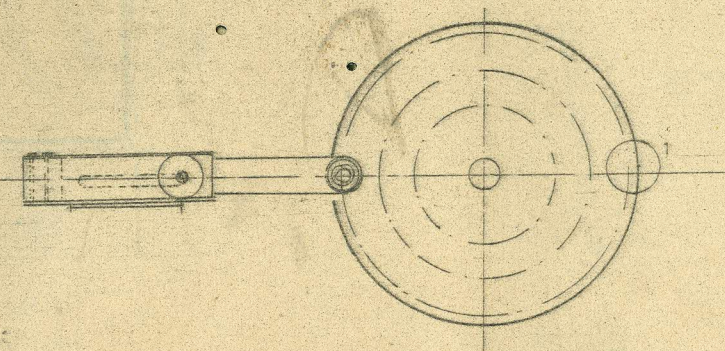
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M. KOTHARI	762702 1977
	10 BOMBAY

D. 8.

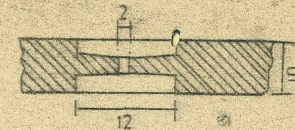
DRUM (PRINT MARK) PHOTO CONTROL DEVICE.



TOP VIEW

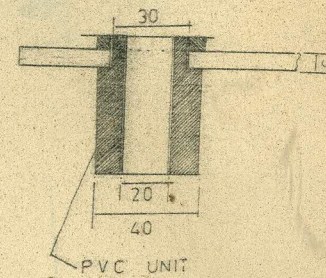


FRONT VIEW

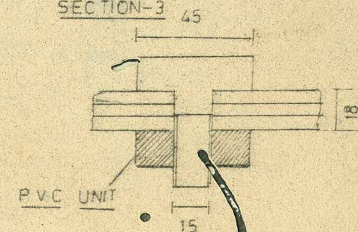


SECTION-1

SECTION-2



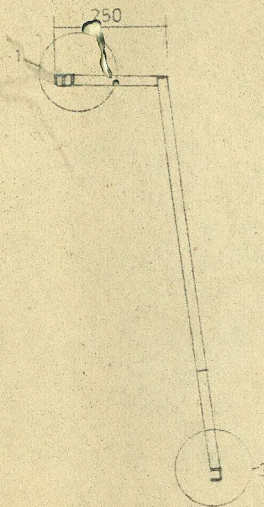
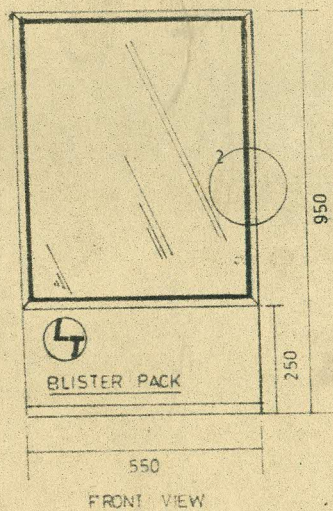
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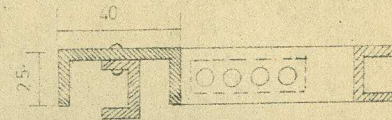
BLISTER PACK MACHINE DRAWING NO. 8	
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M KUTHARI	762702 1977
	I D C BOMBAY

SAFETY GUARD

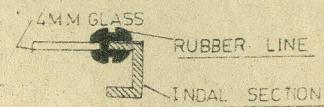
(1 : 10)



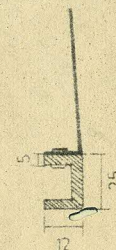
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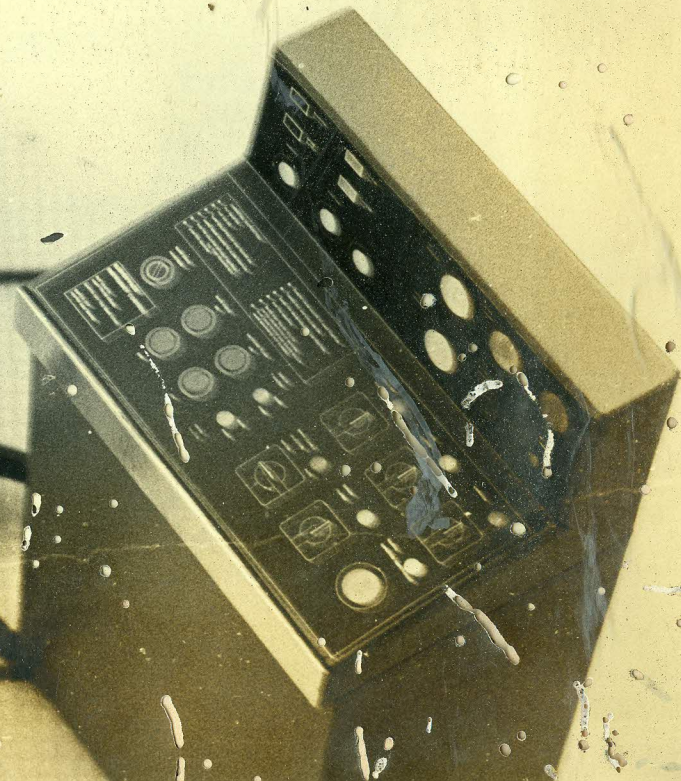
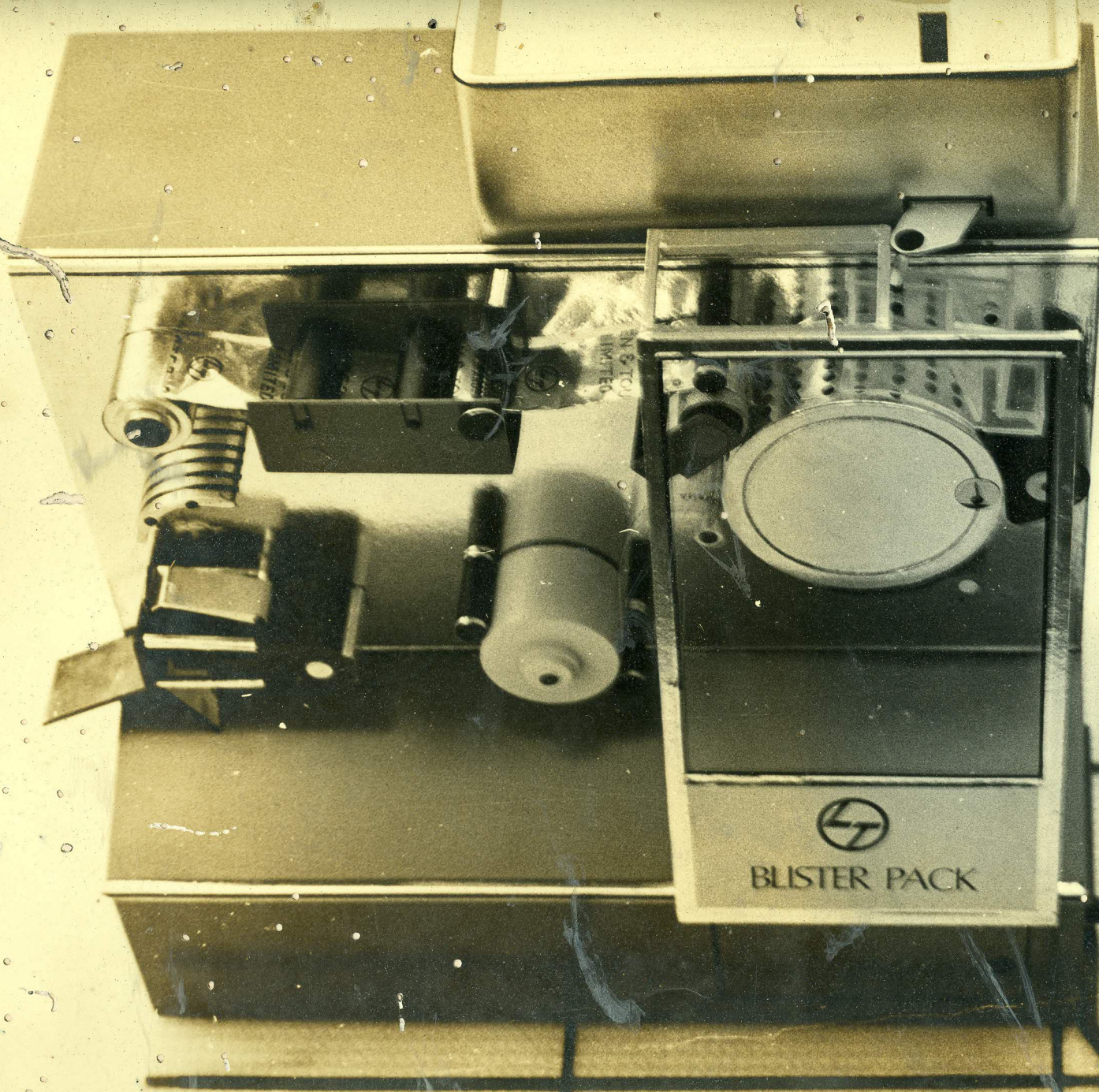
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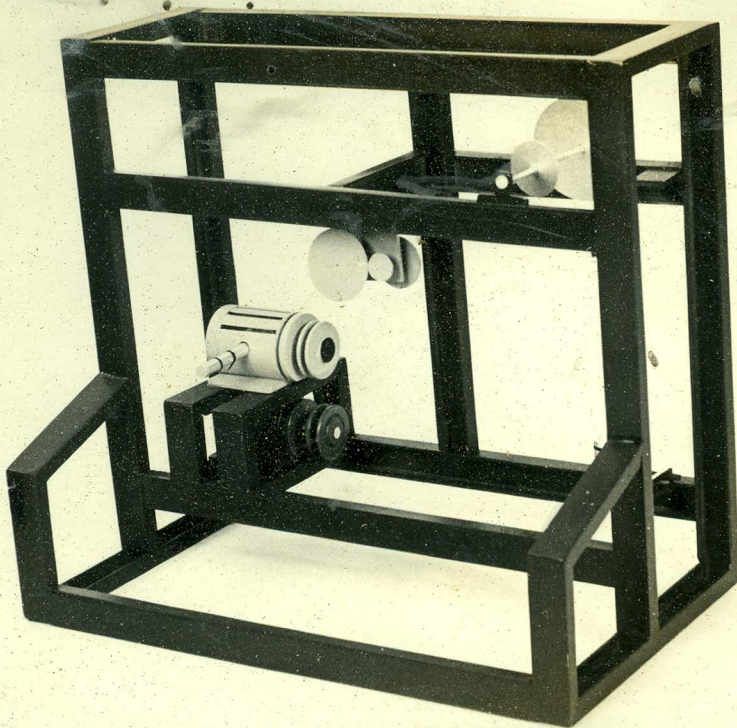


SECTION - 3



BLISTER PACK MACHINE DRAWING NO. 9	
ALL DIM IN MM	SCALE 1:10
M KOTHARI	762702 1977
	I D C 111 MAY





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