DESIGN AND DEVELOPMENT OF MNX STARTERS
PROJECT-1

Vacation project

Larsen and toubro ltd

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INTRODUCTION

An experience with a product refers to an effective, ergonomical, and aesthetic reactions of the people while seeing or interacting with it.

All the products that belong to same category have identical technical performances and consumers base their choice on the pleasure a product will give. Companies have come to realize that purely technology driven design does often not fit with real user needs and concerns. Industrial design which has effective concern towards the user is prevalent .

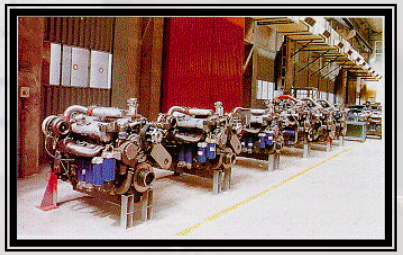
About the company

Larsen & Toubro Limited is a leading, multifaceted organisation with a reputation for technological excellence and strong customer orientation. For over five decades, the Company has established leadership in most of its major areas of activity - manufacture, project management, construction, shipping and services sector. The diversified activities are structured into independent Operating Groups. L&T have 11 business groups for manufacturing and marketing to its range of products in each business groups.

Operating groups of larsen and toubro limited

Group :1

Diesel equipment

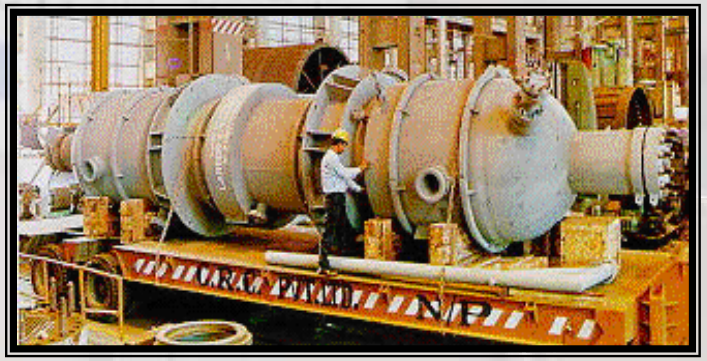


Land moving and earth moving equipment

GROUP II: -

The business activities of Group II

- Heat Transfer Equipment like



Urea Stipper

- Chemical Plants and Systems
- Oil and Gas Special Projects
- Hydrocarbon & Related Projects
- Cogeneration and Captive Power
- Cement and Allied Machinery

GROUP III: -

(ELECRICAL BUSSINESS GROUP)

- Switchgear contracts
- International business of ACBs & MCCBs
- Switchgear standard products
- Petrol pumps
- Contactors
- starters

GROUP IV: -
(EUTECTIC PRODUCTS & WELDING SYSTEMS)

GROUP VI: -
Rubber processing machinery
Plastic processing machinery

GROUP V: -
(CEMENT)

GROUP VII: -
(SHIPPING)

GROUP X: -
ENGINEERING, PROJECT AND EQUIPMENT

GROUP IX: -
INFORMATION SYSTEM DIVISION

GROUP XI: -
(CONTROL & AUTOMATION)

INDUSTRIAL DESIGN DEPARTMENT

WIDE RANGE OF PRODUCTS SATISFYING USER

DESIGN METHODOLOGY

TASK:
To design a starter casing (enclosure) for D.O.L current motors.

ANALYSIS:

What is a starter?
“A starter is an electric controller for accelerating a motor from rest to normal speed”

Introduction:

The basic problems I starting 3-phase induction motors are created by the starting torque and the starting current peak. The starter is the important connecting link between the motor and the electric supply system.

In order to start and speed up, the motor must develop a torque larger than the sum of the load torque and the frictional torque. Some times a starting torque larger than the rated torque is necessary (as drilling machines, rolling mills etc.). The total starting time of the driving system is the function of the difference between the motor torque and the total resistant torque during the transitory process of speeding up, and this starting time can often affect the technological productivity.

Classification of the starters:

Manual and magnetic starters-

Starters range in complexity form simple manual across the line devices to more sophisticated controllers permitting proper starting and stopping with minimum disturbance to the system or adverse affect on the drives equipment. In the smaller motor sizes manual starters are available. This type of starters requires that the operator furnish the necessary operating force. When the starting and stopping are relatively infrequent, manual starters can provide a satisfactory installation. However the modern trend is toward the use of the magnetic motor starters in which the operating force is furnished by electromagnetic action .This prevents the remote operation of the motor by means of a push button from a convenient location. When a motor is part of an integrated control process requiring starting and stopping is response to process variables such as flow, pressure, and temperature, magnetic control is a necessity.

Working with the starter:

-Starting a motor is done by pushing the button of the starter. User can not identify whether or not the power supplied, until the machine gives the auditory feed back. There is need for the visual indicator to indicate the same.

-If the machine starts to generate humming noise and the starting gets aborted one of the main reason may be the failure in the 3-phase current. It is a assiduous process to figure out the location of the failure.

-The worker starts checking the out going 3-phase currents, R-Y-B, form the starter. As one phase fails every thing fails, machine will generate humming noise. It is necessary to have a visual indication for 3-phase current which can be individually recognized. This reduces the round about checking process.

-Besides just starting the starter must be user-friendly and ergonomically compatible.

-The enclosure is not ingress protected to a considerable grade. (IP-45)

- The enclosure is a typical geometric primitive with visually boxy look. And the screws of the housing are visible from the front

DESIGN BRIEF

• To create a new identity for the D.O.L (Direct On Line) starter.
• To realize un-identified, unmet needs in using MNX starters.
• To improvise the IP (Ingress Protection) level and make it fittest in the market with added features.

RESEARCH/SURVEY/DATA COLLECTION

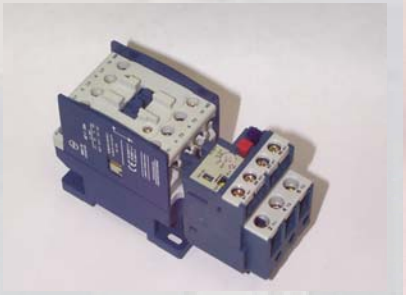
RESEARCH:

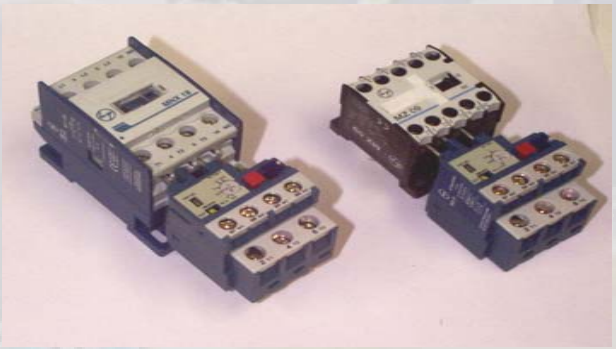
What is MNX starter…

A MNX starter is for the industrial purposes. And are used for the all kinds of machinery

Components in the enclosure

- contactor
- relay





USER SURVEY:

User groups- shop floor workers

Questionnaire

- what is his experience working with the starter
  - -comfortable
  - -ok
    - -It could be some thing else
- How he identifies ON/OFF
- What could be the better way of identification according to him?
- General breakdowns that occur with starters.
- Attacking the problems and rectifying procedures
- Switching it ON.

USER STUDY:

Observations:

Power indication by visual indicator (bulb)- they are very much needed for the starters operating the complex machines such as spot welding, high speed press, jig press and other huge moving assemblies. They should be conveniently readable form a distance.

Present status

There exists both type of starters with and with out indicators. The one with indicators doesn't have them integrally. They are projecting out of the starter as if it is a foreign body.
Indication through auditory feed back- one way of getting feed back is through the machine itself which is produced when it starts.
If the machine is quite away from the starter it's very difficult to identify whether or not the machine started.

Breakdowns
Machine is switched on and the starting got aborted.

Reasons:
• Due to lack of power supply at the upstream– so visual indicator is needed to identify that.
• Due to the failure in any phase of the 3-phase current- so the indicators which can recognize 3-phases individually are needed. intermediate)
• Due to no power supply at the down stream- no proper indication at that end.

Rectifying actions
• Checking the down stream
• Checking the up stream
• Check the mains
• Check the 3-phase current.

Man-Machine-Interface

Machine needs to be switched ON and OFF frequently based on the purpose. This is a repetitive process and man gets in to the interaction very frequently with the machine. The push start button really creates the boredom to the user.
Many starters of push button start type have its switches on the upper portion.

While starting the user rests his fingers completely on the top of the casing and uses his thumb to push the button. It s the action done at the sub-conscious level. The user got addicted to that habitual action.

The user feels quite in comfort while starting with finger alone without touching any part of the starter.

Though it is a momentary action, it is emphasized at the psychological level.
Reluctance –due to inconvenience
Boredom and becomes mundane
Ergonomically inconvenient and strenuous.

Feedback from shop floor workers
E .S. Parab-MCCB section
R.K.Raval-maintainance
Kotki-Production .

DESIGN SPECIFICATIONS

TARGETTED BY THE COMPANY:

- POWER INDICATION
- 3-PHASE INDIVIDUALLY RECOGNISED
- VOLTMETER
- AMMETER
- HP-RATING INDICATION
- 25-30MM CIRCUMFRENTIAL CLEARENCE
- PAD-LOCKING
- AUTO RESTART
- REMOTE OPERATION
- IP-56

SPECIFICATIONS BASED ON THE OBSERVATIONS AND USER FEED-BACK:

• A visual indicator for recognition of the current flow through the starter when switched on.

• Starter must have 3-phase indicator.

• Housing must be done with no screws visible form the front.

• The configuration of the housing must be done without allowing the hole (for screw) to drill in to the inner volume.

• Auto cutoff of the power with in 15 min from the starting to avoid the idle running of the machine.

• The design must have a feature which facilitates the hand to rest on it and push the button in side. Ergonomical enhancement and compatibility.

CONCEPTUALIZATION

Designing according tot the user profile-Classification based on the features:

Economic version or the basic version (EX)

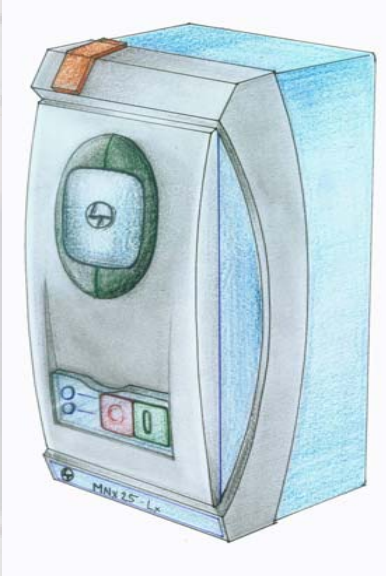
- Power indicator
- IP-55
- Pad locking
- Clearance of (25-30)mm
- Ergonomic compatibility

Deluxe version (DX)

- LED display
- Voltmeter
- Ammeter
- individually 3-phase recognition
- Padlocking

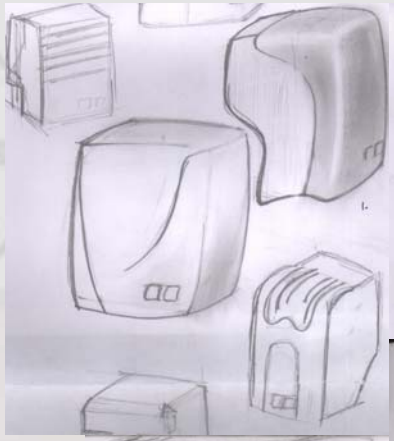
Luxury version (LX)

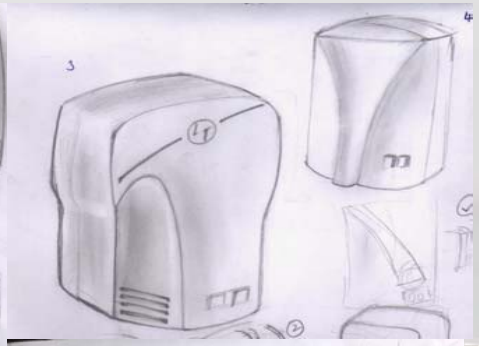
- LCD display
- Auto restart
- Auto cutoff
- Remote
- Touch-screen start
- Faulty alarm
- Timer
- Pin lock

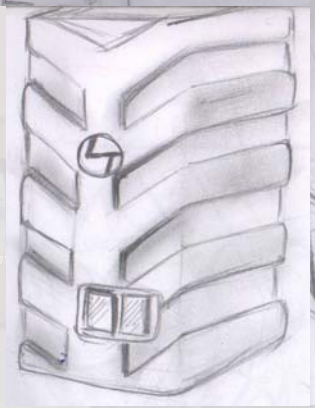


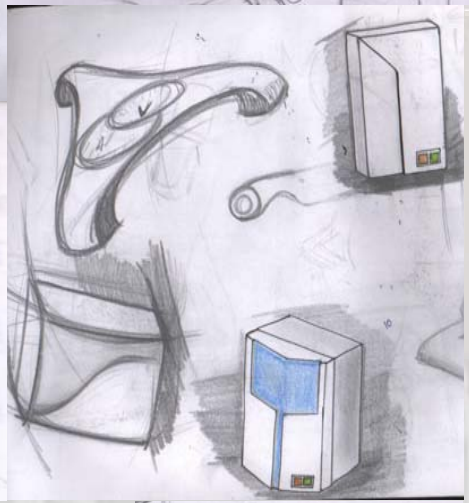
Suitable solutions

Form exploration







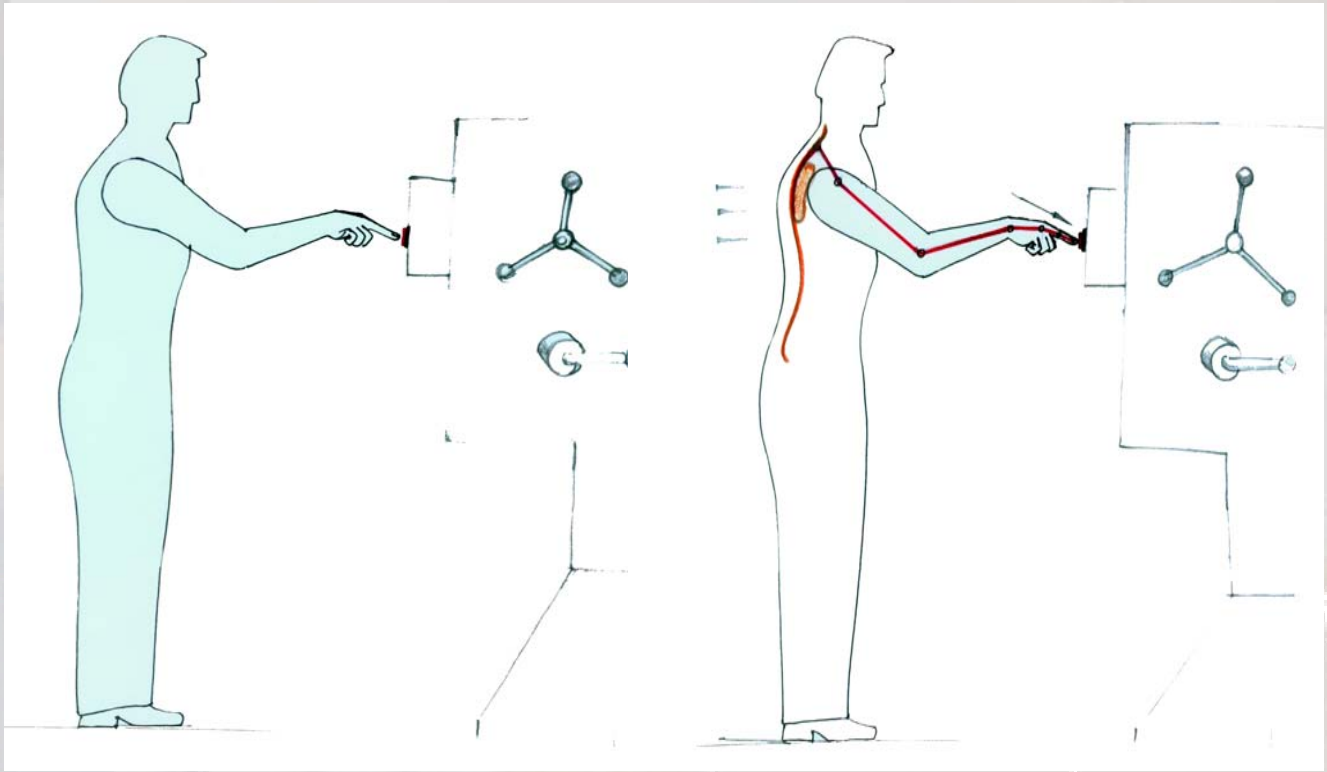


Preferred and suitable solution
Working drawings

ERGONOMICS AND SAFETY:

Based on the user feedback the following observations are made:
The user is habitualised to take some support to rest his fore palm for switching on the starter.

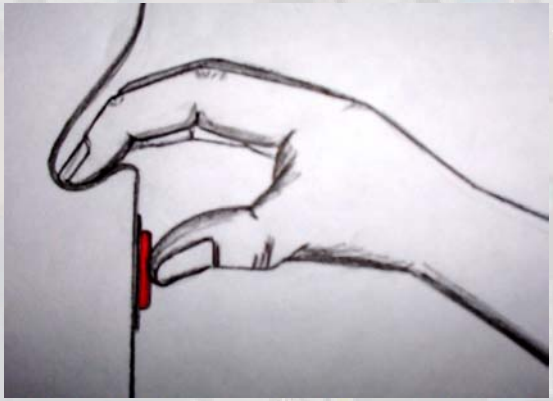
Ergonomically the effort exerted on the push buttons is considerably good as the direction of the force and the body has to move in the same direction despite the push buttons offers resistance in the opposite side.
Added to this the user has to lean forward if the resistance is more. This results in the exertion till the spine. The operating loop encircles the whole body which results in the boredom and reluctance when operating. This has an psycho physiological affect on the user.

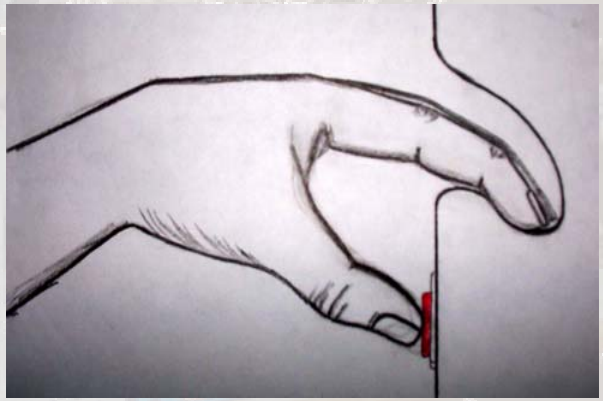


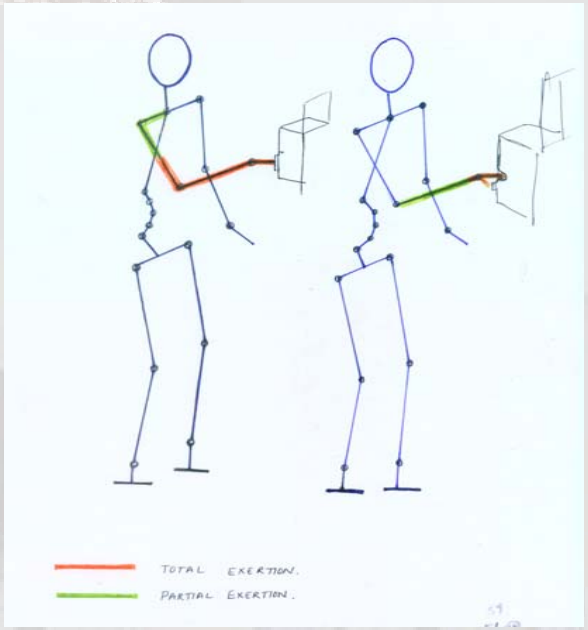
Concept generation

If the arrangement shown in the figure is provided in the design, the loop of operation completes with in the forearm itself.

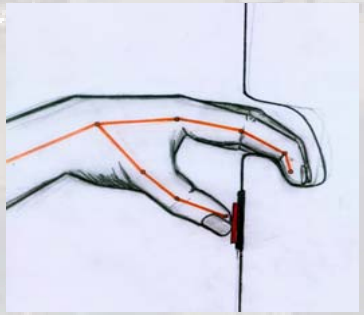
This gives a close control point to the target or the work which results in the
•-precession operation
•-redundancy in strain
•- reduces exertion
•- provides comfort while operating
•- Easy gauging of the travel of the ON button.
• Eventually the length of travel of the ON button is more than the OFF to get start.

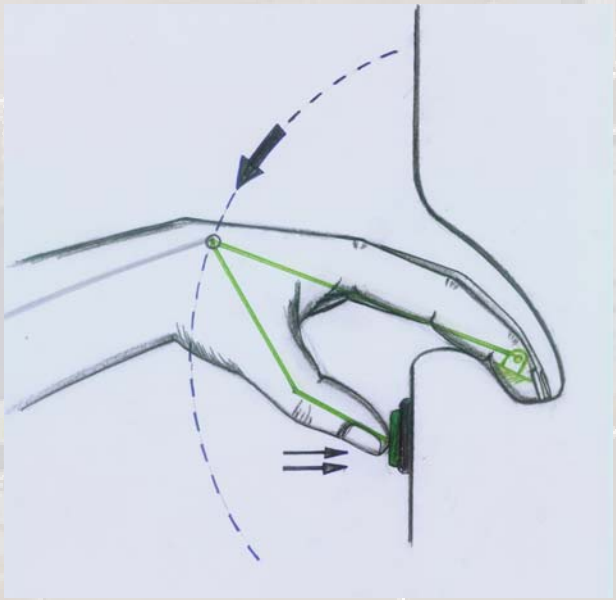






Ergonomically making compatible by providing close control points.





INTERACTION AND COMMUNICATION

"In a product scenario interaction and communication means to put the information across to the user with the effective means, with out complexity and ambiguity "

- Visual indicator for power supply which communicates with the user that "I'M ON"
- 3-PHASE indication.

SPATIAL PLACEMENT

"*Positioning of the product in relation with the other so that it gets in the perfect synchrony with the family*"

INGRESS PROTECTION (IP) STANDRD:

In reference to the INTERNATIONAL ELECTROTECHNICAL COMMISSION.
Classification of degrees of protection provided by enclosures:
Introduction
This standard provides a system for classifying the degrees of protection provided by the enclosures of the electrical equipment. Whilst this system is suitable to use with the most types of electrical equipment, it should not be assumed that all the listed degrees of protection are applicable to a particular type of the equipment.

The manufacturer of the equipment should be consulted to determine the types of the protection available and the parts of the equipment to which the stated degree of protection applies.

The adoption of this classification system, wherever possible, will promote uniformity in methods of describing the protection provided by the enclosure and of the tests to prove the various types of the protection. It should also reduce the number of types of the test apparatus necessary to test a wide range of products.

The type of protection covered by this system of classification is as follows:

Protection of persons against contact with or approach to live parts and against contact with moving parts (other than smooth rotating shafts and the like) in side the enclosure and protection of the equipment against ingress of solid foreign bodies.

Protection of the equipment inside the enclosure against the harmful ingress of water.

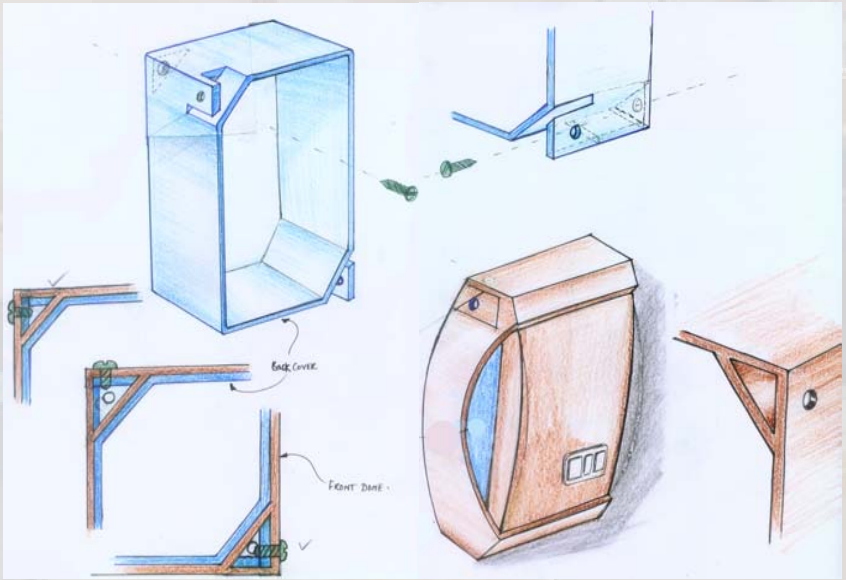
Designation (classification system):

The designation to indicate the degrees of protection consist of the characteristic letters IP followed by the numerals (the “characteristic numerals”) indicating conformity with the conditions stated in tables 1 and 2 respectively. The first numeral indicates the degree of protection described under item a) above and second numeral the degree of protection described under item b) above.Where the mounting of the equipment has an influence on the degree of protection, this must be indicated by the instructions for mounting or the like.

PRESENT STATUS

MNX starters are graded with IP-45
Reason:
Screws that are fitted to the enclosure are from the front. And the holes drilled opens to the inner volume through the front cover. Due to this even though it is gasketted there are fairly good chances for water to sip in .and added to that the holes that were made to the back cover for mounting also allows water inside . Due to the fixing of screws from the front side there is a trial and error for finalizing the front cover fixing.

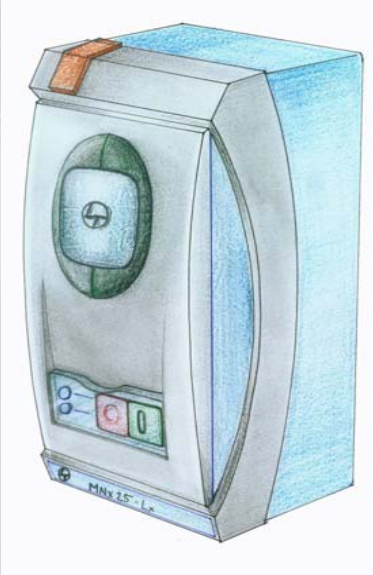
DESIGN OF HOUSING TO RECTIFY THE ABOVE PROBLEM:



The new design features the isolation of the inner volume from the holes that are opening in. Neither the assembling screws nor the mounting screws are connected to the inner volume.
As the assembly is fixed with the countersunk screws there will be a precision in doing so.

WORKING DRAWINGS

Concept sketches



Modeling in rhino

luxury

deluxe

economy

PRESENTATION

The final presentation was made to the following panel of EBG

- G. Anantha narayan -- Vice President
- M.k. Patki -- Joint General Manager
- Chowbal. S.M -- Sr. Manager
- A.V.Tandapanai -- Sr.Manager
- D.Bhattacharya -- Deputy General Manager
- P.Ramachandran -- Deputy General Manager
- T.Das -- Sr.Deputy General Manager

FEEDBACK

- Chosen for only right handed people
- When placed in series it is difficult to approach the screws

ACKNOWLEDGEMENTS

My sincere thanks to Prof. B.K.chakravarthi, the soul responsible person behind this training .

I’m thankful to Mr.subho sanyal, for his guidance and timely inputs through out the project .