

electric geyser
diploma project
bhaumik b
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Electric geyser. - Diploma in ID.

design of electric geyser

diploma project

submitted in partial fulfilment of the
requirements for the postgraduate diploma
in industrial design

by

bhaumik bidyabijay

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industrial design centre

indian institute of technology

bombay

1972

guide

prof nadkarni s

co-guide

shri athavankar u a

approval sheet

diploma project entitled

electric geyser

by bhaumik bidyabijay is approved for the
postgraduate diploma in industrial design

guide

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my acknowledgements to

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1. introduction

using hot water is probably as old as the human civilisation itself. we get the evidence of use of hot water for bath in the "hamamas" or the public baths of old civilisations. since then hot water is accepted as a "preferred luxury" for man.

coming to the present, electric geyser has become a "fair necessity" mainly because of the odd hours for a bath or wash which is quite common for urban man. also the use of shower is so widely accepted for its function and economy, that the old, time consuming method of heating water first, and then mixing it with cold water to a proper temperature for a bath is done away with, wherever it has become possible.

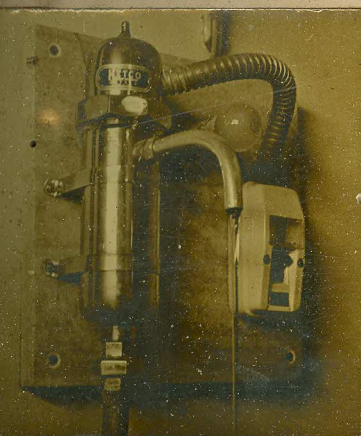
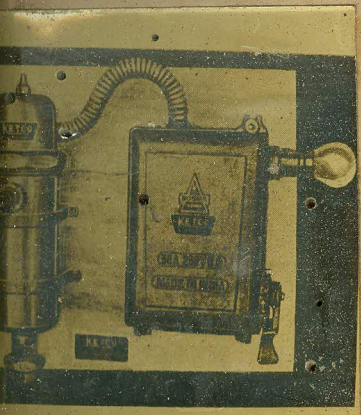
now there are two types of geysers available, which can have the possibility for shower connections. first is the storage type, which has the advantages of proper shower connection, multiple taps low wattage and higher safety. but it is gradually becoming prohibitive for its high cost, difficult maintenance, large area requirement, and difficulty in installation.

the second is called the instant type electric geyser. this is getting wide acceptance primarily for its low price, small space requirement and ease in installation. but it has the draw backs of lesser electrical and mechanical safety and difficult shower connection.

naturally a product is needed which can have most of the advantages of both, mainly electrical and mechanical safety, shower connection, low price, lesser space requirement and easy maintenance.

2. problem statement

to design an electric geyser mainly for domestic use with special considerations on flexibility of use, safety, appearance and economy.



3. information

3.1 existing products

there are four major manufacturers of instant type electric geysers in bombay. all of these use the same heating principles, i.e., dipping a pair of metal plates in water and passing current through the water. the electric current passing through the water heats it up. the body has to be earthed to prevent shock.

3.2 market

3.2.1 almost all the brands of instant type geysers cost around rs.160.00 for 1 - 3.5 kw to rs.220.00 for 1 - 6 kw plus taxes. this does not include the price of tap or shower attachment. a good tap costs rs.10.00 to 15.00 and shower attachment costs about rs.25.00 extra. the storage type costs between rs.500.00 to rs.2000.00 depending on capacity.

3.2.2 instant type geysers have a much greater demand in the indian market. one medium manufacturer, ketco, makes about 30,000 pieces per annum and is still unable to cope up with the demand.

3.2.3 the maximum demand is for the 1 - 3.5 kw range.

3.2.4 among the other types of electric water heaters, the mostly used is the immersion heater, which has the advantages of being the cheapest and very consistent, but the disadvantages of handling problems and impossibility of shower connection.

3.3 user

3.3.1 the power of 3 kw is satisfactory, for shower baths for climates like that of bombay where the minimum day temperature does not go lesser than 20°C.

3.3.2 but for places like northern and eastern india, power requirement is much high. it is about 12 kw for delhi region and 8 kw for calcutta region.

3.3.3 instant geysers, at present, are mostly used as first collecting hot water in a bucket, and then mixing to a proper temperature for bath or washing. a shower attachment will be preferred.

3.3.4 there is a problem of splashing of hot water because of the high level of water exit of the geyser. this problem is often solved now by fitting a polythene tap tube down to an appropriate level.



3.3.5 there is a general complain about the appearance of the geysers, particularly from the conscious customers.

3.3.6 the temperature of water is controlled by controlling the water inlet.

3.3.7 maintenance and replacement is not quite easy, even for the people who prefers to do so themselves, partly because of improper communication and distribution. the dealer has to informed for maintenance and replacement,

3.4 manufacturer

3.4.1 relevant data was not available on how the capacities are determined.

3.4.2 having different bodies for different capacities could not be justified.

3.4.3 instant type geyser goes out of order more frequently than the storage type. for ketco brand, the trouble is only scale formation on the plates or wearing out of the plates. average life of the plates is about one year, depending on the use. for other brands of instant type geysers, the trouble

is also with electrical fittings. ketco geysers receive minimum complaints.

3.4.4 the body gives shock when the earthing fails.

3.4.5 there is no problem of electrolysis.

3.4.6 spare parts are available.

3.5 architect

3.5.1 the usual mounting height is about 160-170 cms, that is the head height. this is to avoid direct touching of the geyser because it is hot when under use.

3.5.2 the geyser is usually placed just above the dedo height.

3.5.3 instant type geyser is in general preferred to the storage type partly because of its low price and partly due to the space shortage.

3.5.4 installing instant type geyser is

fairly simple. when it is mounted inside the wall for concealing, a cover is provided.

3.5.5 the whole arrangement of geyser, shower and the corresponding controls should preferably be made in the form of a panel for best use and fitting to environment.

3.6 ergonomist

3.6.1 the temperature of the water for bath should be around $40 - 45^{\circ}\text{C}$, which slightly more than body temperature, 37°C . this will stimulate the blood cells under the skin.

3.6.2 the output from shower should not be less than 5 lits/min. for a comfortable bath.

3.6.3 the controls should be placed between the heights of 100 cms and 160 cms.

4. analysis of the existing product

4.1 make ketco

manufactured and marketed by krishna electricals
and trading co. bombay.

4.2 capacity

3 ranges 1 - 3 kw rs.155/-

 3.5 - 5 kw rs.170/-

 1 - 6 kw rs.220/-

safety valve for connection to shower

rs., 25/-

taxes extra.

4.3 functional analysis

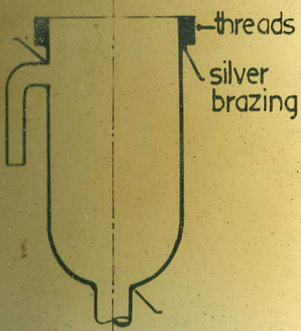
4.3.1 principle

the pair or pairs of electrodes which are of
stainless steel plate (18 guage) for soft
water and of carbon plates for hard water,
are electrified. current passes through the
water because of its obvious impurities and
is heated up. the body, which is of brass,
has to be earthed for safety.

4.3.2 part analysis

4.3.2.1 marble slab

poorly polished. used for holding the geyser and the switches. it is drilled and tapped nut inserts are put and retained by sulphur. on these nuts the geyser and switch holders are screwed up.



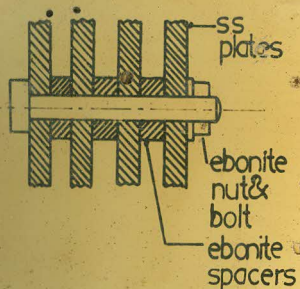
4.3.2.2 body

pressed 14 guage brass sheet. on this a separate brass ring, which is threaded outside, is brazed. the bottom and side are drilled, for fitting the inlet and outlet pipes respectively. the inlet and outlet pipes are also brazed and tested for leakage. then the whole body is electroplated.

4.3.2.3 electrodes

14 guage stainless steel plates for soft water and carbon plates for hard water. 3 or 4 number of plates are there, depending on the capacity. they are pushed into a brass holder which also serves as the connecting point, and then are tightened by a side screw. the electrodes are held in position by ebonite spacers and screws. capacity of a particular geyser can be changed in its range by chang-



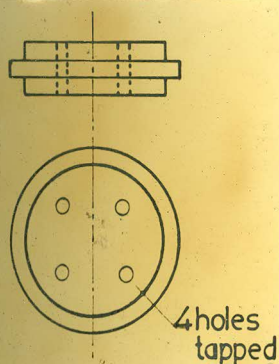


ing the connections to the plates.

connections between	1 - 1	3 kw
	1 - 3	2 kw
	1 - 4	1 kw
	1,3 - 2,4	6 kw

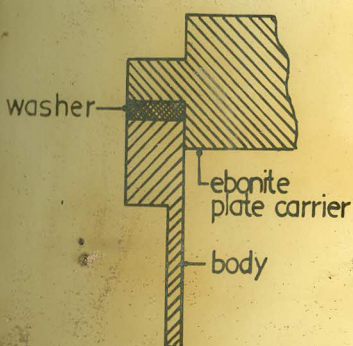
4.3.2.4 electrode holder

made of ebonite. the ebonite is directly tapped to hold the brass electrode holders, in case of smaller capacity. for higher capacities, bush type inserts are used for this purpose. this ebonite cap has two steps at the periphery for retaining.



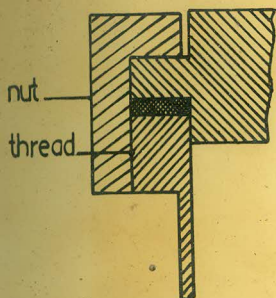
4.3.2.5 washer

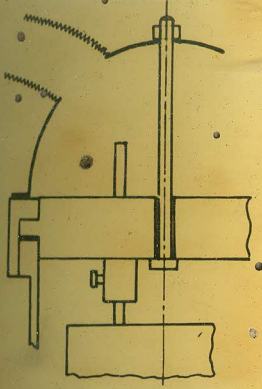
this is made of special high temperature resistant rubber. this is placed in between the body and the ebonite cap type electrode holder. the purpose is to make the geyser leak proof.



4.3.2.6 nut

this is also made of brass. the outside is hexagonal. the inside is stepped circle and is threaded on the bigger diameter. the nut is screwed to the body and in the process of tightening the ebonite cap is pressed tight on the body via the washer by the step.





4.3.2.7 top cap

this is 32 guage pressed brass. this is fixed on the geyser by tightening a nut on a stud passing through the ebonite cap. this is got a hole at one side to allow the connecting wires to pass. it serves two purposes. first the earthing of the body. the metallic wire cover leading to the main switch from this cap makes a direct metallic contact between the geyser body and the main switch, which is earthed. so the body is also earthed automatically. the second purpose is to cover the naked terminals.

4.3.2.8 main switch

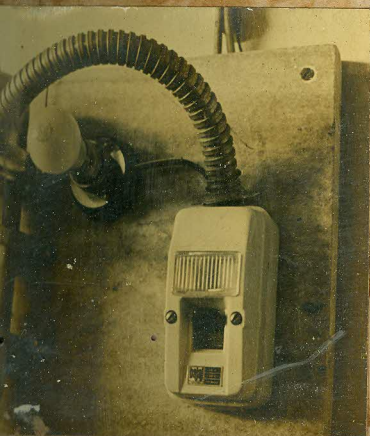
it is the classical cast iron box type switch. the capacities for domestic types varies from 230 v 15 amps to 30 amps.

4.3.2.9 indicator lamp

this works on a parallel connection in the circuit, which shows that the main is on. this is just a 25 w lamp mounted on the main switch.

4.3.2.10 safety valve

it is an optional item, fitted on the pipe line when the geyser is directly connected to



shower. the function is that if by mistake the outlet of the geyser is closed and the switch is on, this will give a whistling signal in the event of a high pressure rise, which is obvious for the steam pressure in the geyser. but even after this whistle if the geyser switch is not put off, an accident is quite likely.

4.4 ergonomic analysis

4.4.1 electrical safety

ketco geysers do not usually get complaints about electrical troubles. but in general, there are complaints about instant geysers that they start giving shocks after some time of use. this happens due to improper earthing.

4.4.2 mechanical safety

the problem of mechanical safety is not much important when the geyser is not connected to shower. but when it is connected to shower,

the existing design is very much unsafe. if by mistake the outlet is closed and switch is on, the whole unit may burst. the safety valve which is provided for this purpose, gives a very unsatisfactory performance. it only gives a whistle before unit blows off. and the proper safety valve for this purpose is very costly, it is about rs.70.00.

4.4.3 tap

the tap is usually fitted at a very high level. it is also having an uncomfortable grip.

4.4.4 switch

the cast iron switch box, which is usually fitted, requires unnecessarily high force, which is difficult particularly for girls to apply.

4.4.5 psychological factor

the psychological feelings over the product is also not quite healthy. it may repulse the user.

4.5 formal analysis

the overall appearance is quite crude. the form with its electroplatings and marble slab mounting does not fit to the environment of the bath room at all. the cast iron switch appears rather ugly. the concept of formal integration is not at all considered. the pipe joints also looks very much naked and crude.

4.6 cost analysis

the exact cost break-up of the product was not given by the manufacturer. however, the following cost break-up was arrived at

body	rs.30.00	
heating plates	rs.30.00	
switch	rs.15.00	
mounting	rs.15.00	
ex-factory cost		rs.90.00
marketing,		
overhead and		
profit	rs.70.00	
total		rs.160.00

5. hypothesis.

5.1 the geyser should be connected to shower.

5.2 mechanical safety must be ensured.

5.3 electrical safety must be ensured.

5.4 the capacity should be capable of heating up 5 lit/min. of water from 20°C to 45°C.

5.5 the positioning of controls should preferably be made flexible.

5.6 the product must be made simpler for easier assembly, maintenance and replaceability.

5.7 the appearance must be improved so as to fit into the environment and a better consumer reaction.

5.8 the cost should be competitive.

6. design decisions

6.1 capacity

from the survey conducted in bombay, it is seen that 3 kw power is satisfactory. but a higher power is certainly needed for the climate of northern india. alternately, a system of storage can be developed which could keep down the power requirement to 3 kw, which is desired. for safety and economy in cable layout. however, flexibility for making the geyser with a higher capacity is kept open.

6.2 material

possibility for replacing the existing material for body, i.e., brass is explored both for the purpose of reduction in cost and betterment in appearance. for this purpose, mild steel, cast iron, ceramics and aluminium are considered. considering the high demand, die cast aluminium is the best suited material for the body. though pressure die cast body is economic in the long run, however, flexibility is left open for small entrepreneurs to go for gravity die casting.

6.3 heating plates

the materials are kept the same, i.e.,

stainless steel for soft water and carbon plates for hard water. having a number of plates to make combinations for different capacities in the geyser is not justified when the flexibility is not open to the user. the user uses for one capacity only. so only a pair of plates is decided to be provided.

6.4 electrically safety

electrical safety is thoroughly ensured by proper earthing. the metal body is directly earthed.

6.5 mechanical safety

different possibilities are explored for keeping down the possibility of bursting. these include thermostatic cut off, automatic pressure release, drawing out the water, etc. drawing off the container while not in use proves to be the safest of all. this also enhances the electrical safety, because if there is no water, there is no current passing between the plates. one tap operation performs both the purpose of letting in the water while in use and draining out the water when the tap is closed.

6.6. controls

the positioning of controls, i.e. the tap

and the switch is kept flexible. the switch can be mounted on the common switch board and the tap can be mounted at any convenient place and height.

6.7 the form is decided to be rectangular for better appearance, and is painted white or pastel colour for best environmental fitting. the pipe joints are decided to be covered.

7. synthesis and communication

7.1 concept

7.1.1 principle

the basic principle of heating the water remains the same, that is, a pair of plates are dipped in water and then are connected to the terminals of the electric supply. the electric current passing through the water heats of the water. this principle has much to commend because of its simplicity.

in the proposed design, the container is partitioned. water is getting into one compartment from the bottom, passing through the plates, getting heated up and then is going to the next compartment. in this compartment, the outlet pipe is connected to the bottom through which the heated water is going out. the spacing between the plates is 2 mm.

7.1.2 simplicity

the design is made very simple in many aspects. the form has been made much simpler by reducing the whole geyser to one unit which is to be mounted directly on the wall. and, visually no joints and fittings are seen

in the unit. Structurally, a considerable reduction in the number of parts and simplification in the assembly has been achieved. this is further discussed in economy, 7.1.7.

7.1.3 range flexibility

7.1.3.1 though the design has been done for a power of 3 kw, but the same unit could be easily adopted for a considerable higher power which may be necessary for commercial uses like in hospitals or restaurants, or for colder climatic regions. this will not require additional, investment. the capacity will be increased only by increasing the number of plates. other detail will remain necessarily the same.

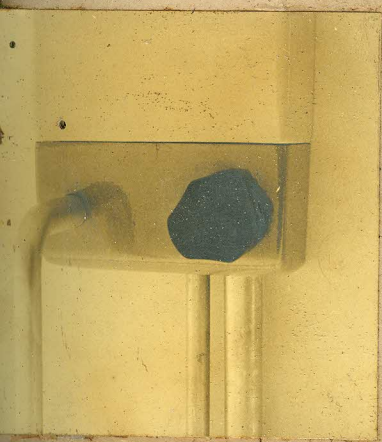
7.1.3.2 the same design can be easily extended to a non-pressure storage type geyser with no sacrifice in safety. an insulated vessel mounted at a lower level than the main unit will convert the system to a non-pressure type storage geyser. for best utilisation, the system can be mounted at a high level, with a thermostatic valve and a little change in the design pressure type storage geyser can also be made.

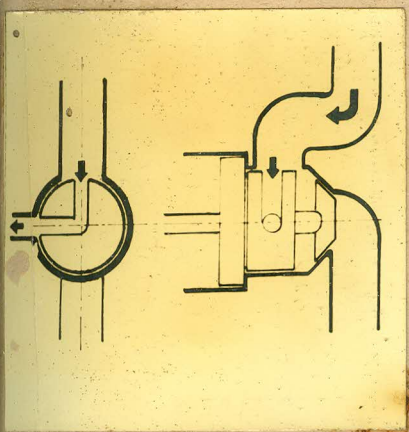
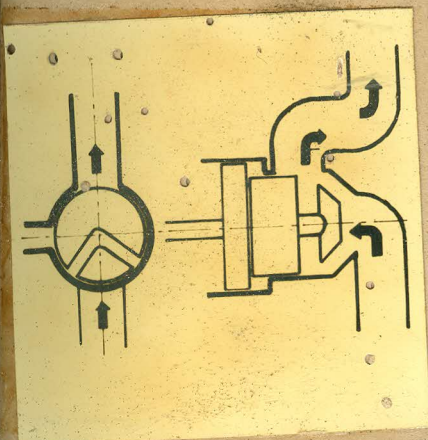
7.1.4 Shower connection

the unit can be directly connected to shower without any additional attachment. for having connection to both shower and tap with hot and cold mixing, we need a two-way tap in addition, which will divert the mixed supply either to the shower or to the tap. this whole arrangement can be made in the form of a panel, where there will be three controls. first, the tap for the inlet to the geyser which will also control the hot line, second the cold line tap for mixing and third, the two way tap to divert the mixed supply to the shower or the tap as per the need.

7.1.5 safety details

7.1.5.1 electrical safety is taken care of perfectly earthing the body. the indicator lamp shows to whether the line is on with water content in the container. the water content of the container will drain out when the tap is closed. so, even if the switch is kept on, there will not be any current passing through the circuit. also, when the switch is put on and the tap is opened, there will be a gradual increase in current in the circuit, which is very ideal.





7.1.5.2 the question of mechanical safety comes mainly when the geyser is connected to shower. because if there is water in the container, as it is always in the existing design, and the switch is kept on by mistake, water will be continuously boiled and steam pressure will blow up the unit.

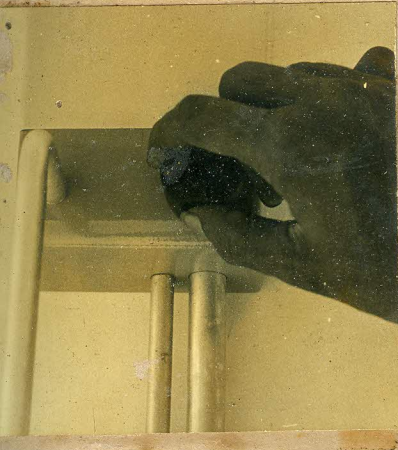
but the additional feature provided in the designed tap will drain out the water content of the container when the tap is closed. the drainage line operates like a snap tap, while the supply line operates exactly as the conventional tap does. this is achieved with a slight modification in the existing design. So, as there will not be any water in the container when the tap is closed, there is no chance left for formation of steam to burst up the unit. this will further enhance the electrical safety also, because no current will pass if there is no water, and a gradual increase in the amperage will take place when the geyser is put on.

7.1.6 mounting flexibility

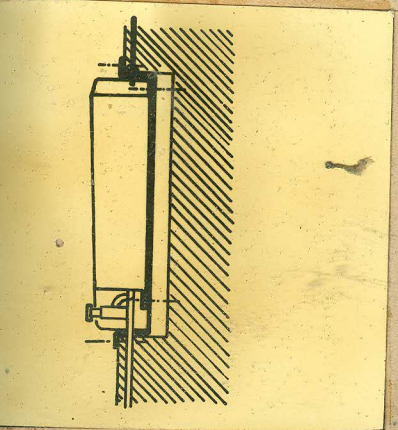
7.1.6.1 the conventional box type mains switch is not necessary because there will not be any water in the container. just an ordinary switch with a fuse will be sufficient

as the switch need be rarely operated. this switch and the fuse can be mounted on the bath room switch board.

7.1.6.2 the tap can be mounted at any convenient place and height. the only constraint is that the tap has to be mounted at a lower level than the main geyser. this, of course will be necessary because the geyser should be mounted at a head height, that is, more than 160 cms, because it will be quite hot while under use. the geyser may also be made available as one unit, along with the tap, and the spout.



7.1.6.3 The geyser can be mounted on the wall in the conventional way, that is, putting inserts in the wall and then screwing up the unit to the inserts.



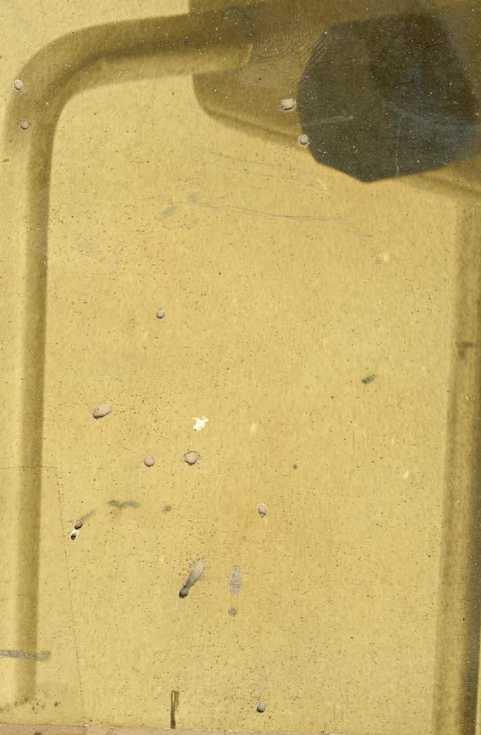
7.1.6.4 the geyser can be mounted flushed with the wall for concealed piping. first a corresponding frame has to be put on the wall. then the geyser is mounted on the frame.

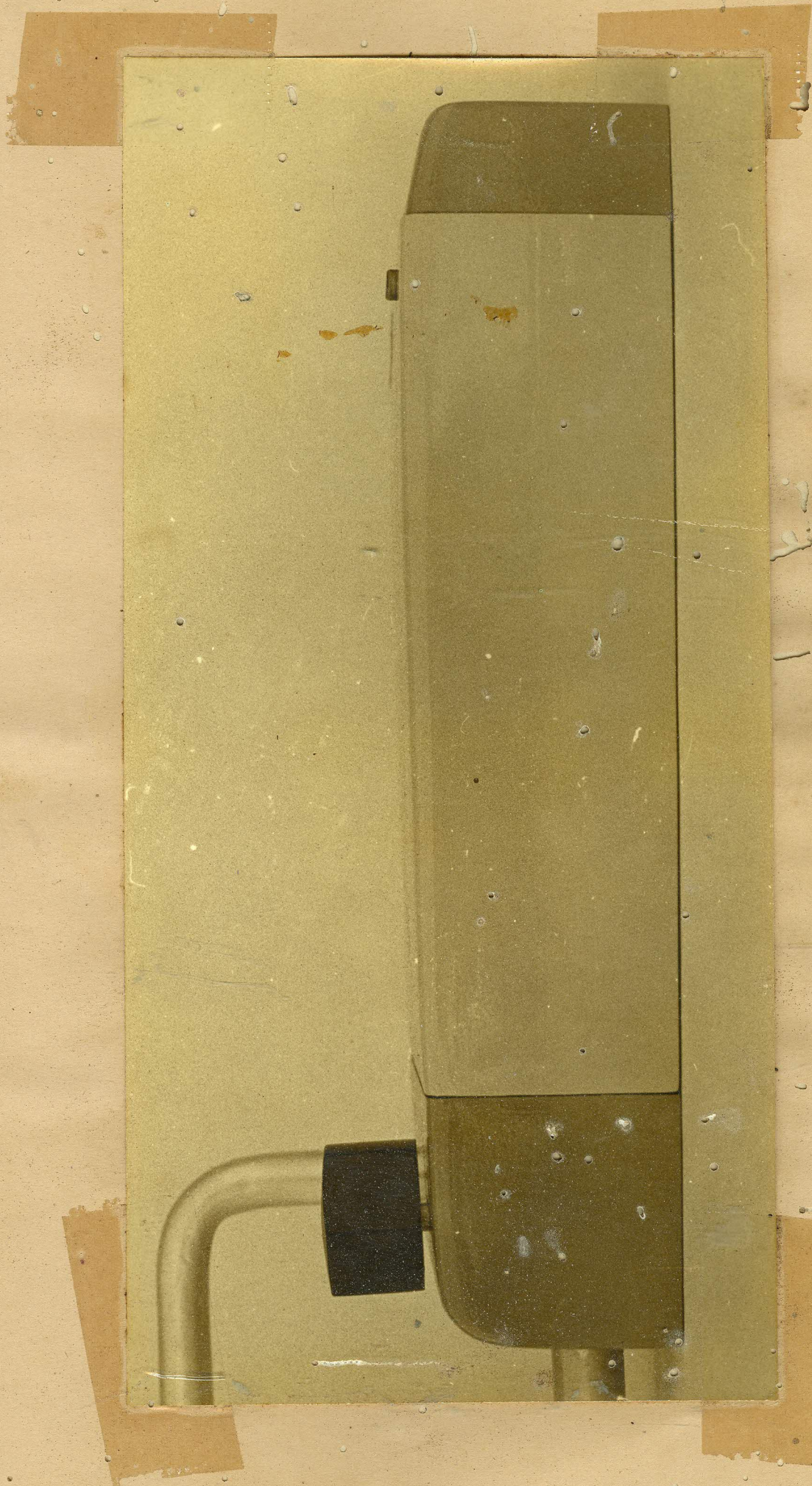
7.1.7 economy

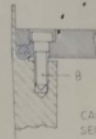
the whole concept is made much simpler, eliminating many of the unnecessary parts. replacing the conventional material of brass for

the container by aluminium economises the product substantially. further, the marble slab for mounting and the safety valve for shower connection is straightaway eliminated. the additional expense in the tap to provide drainage is considerably lower than the cost of the safety valve. the costly switch can easily be replaced by a lower amperage switch. also, overall reduction in the number of parts and the assembly steps are achieved to a great extent. all these will lead to a substantial economisation.

ushna







CARRIER FIXING DETAIL
SEC BB

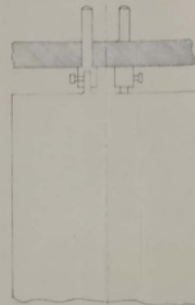
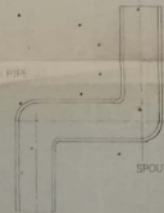
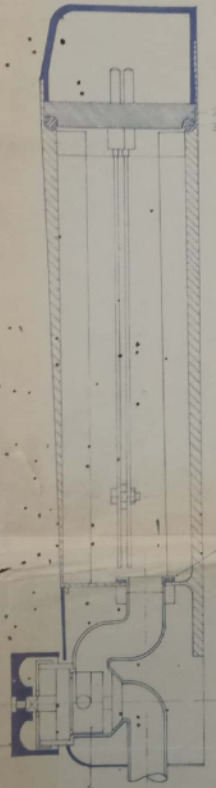


PLATE DETAIL



SPOUT

STG. PIPE



SEC XX



SEC AA

10	SCREWS M 3 PHILLIPS	BRASS	2
9	ELECTRODE PLATE	STAINLESS STEEL	2
8	SCREWS M 5	M.S.	4
7	BOTTOM COVER	H.I DENSITY POLYTHENE	1
6	TOP COVER	H.I DENSITY POLYTHENE	1
5	TAP HEAD	H.I DENSITY POLYTHENE	1
4	TAP	BRASS	1
3	O-RING 40	TEMP RESISTANT RUBBER	1
2	PLATE CARRIER WITH INSERTS	EBONITE	1
1	CONTAINER BODY	DIE CAST ALUMINIUM	1
ITEM	DESCRIPTION	MATERIAL	NO OF

DIPLOMA PROJECT ELECTRIC GEYSER

ASSEMBLY

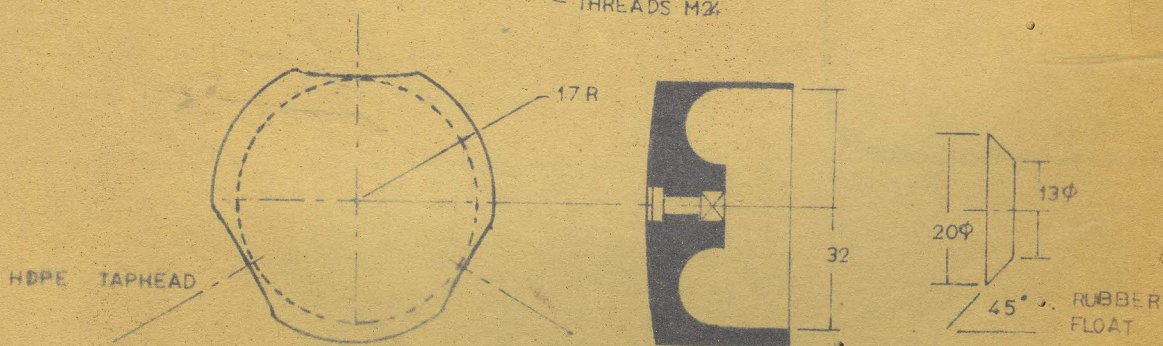
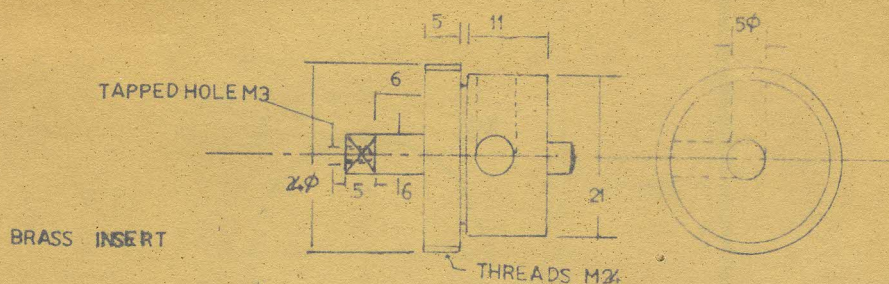
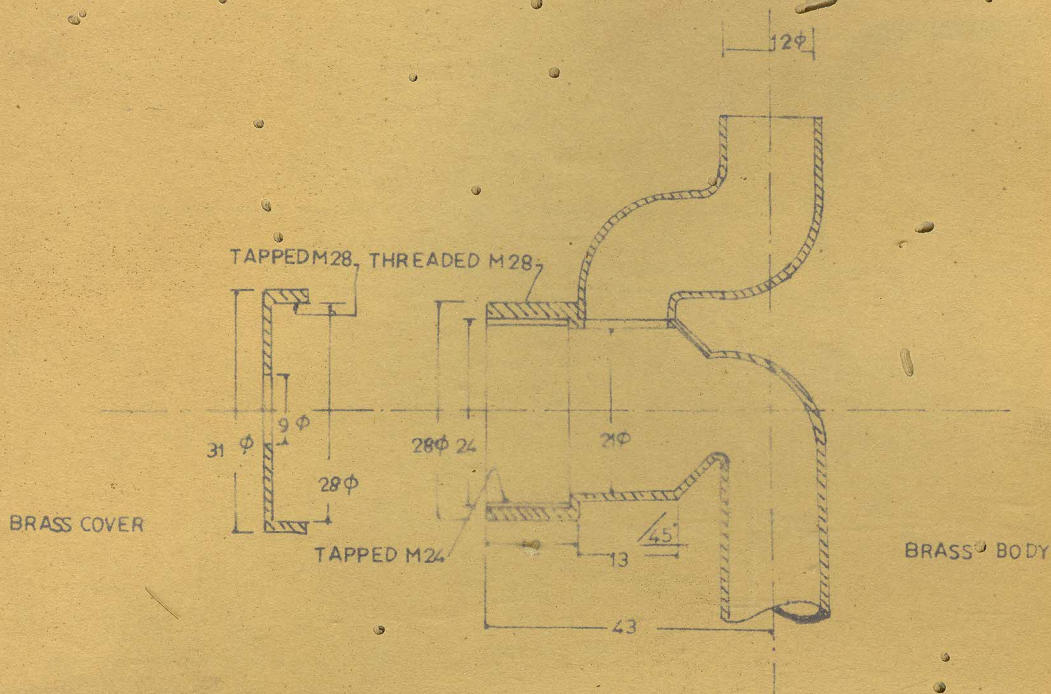
BHAUMIK B
ROLL NO. 5974

SCALE FULL SIZE



DIMENSIONS IN MM

INDUSTRIAL DESIGN CENTRE



DIPLOMA PROJECT ELECTRIC GEYSER

TAP DETAILS

BHAUMIK B

ROLL NO S 974

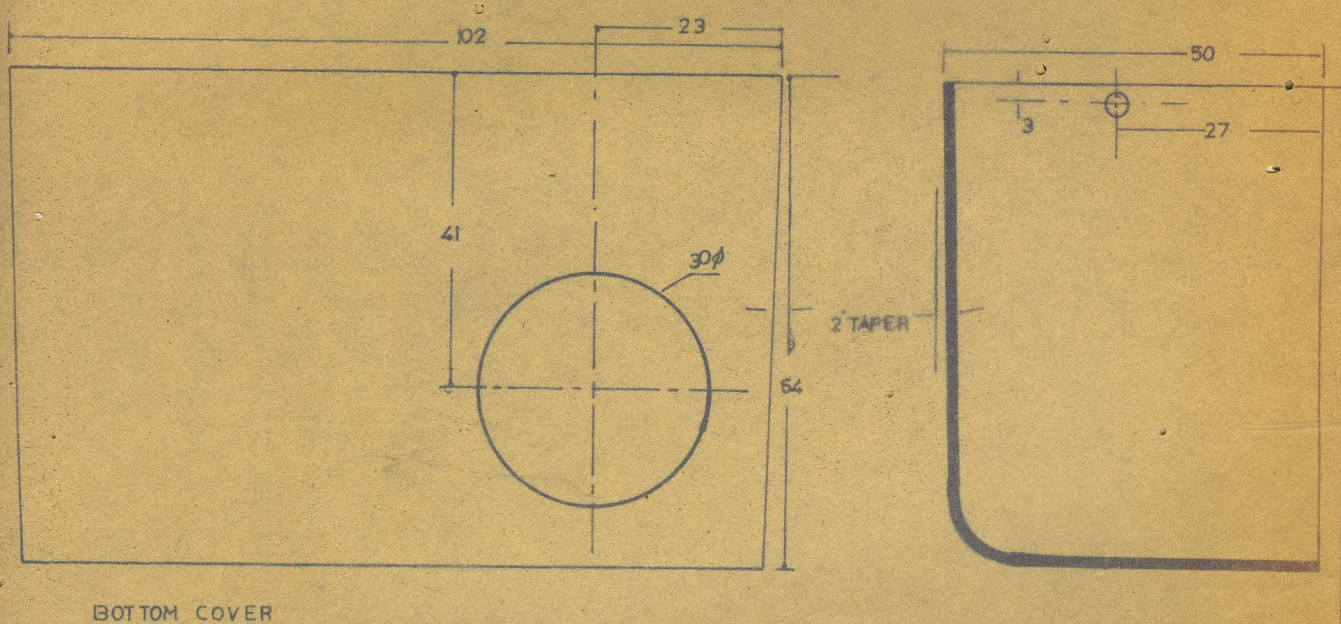
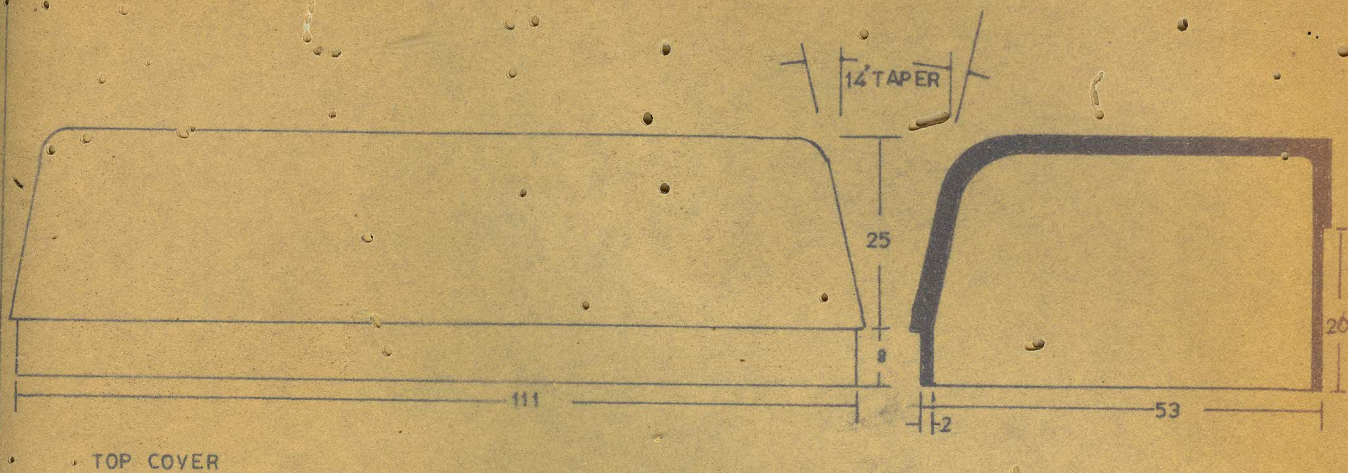
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ALL DIMENSIONS IN MMS

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DIPLOMA PROJECT—ELECTRIC GEYSER

TOP AND BOTTOM COVER

BHAUMIK B

ROLL NO S 974

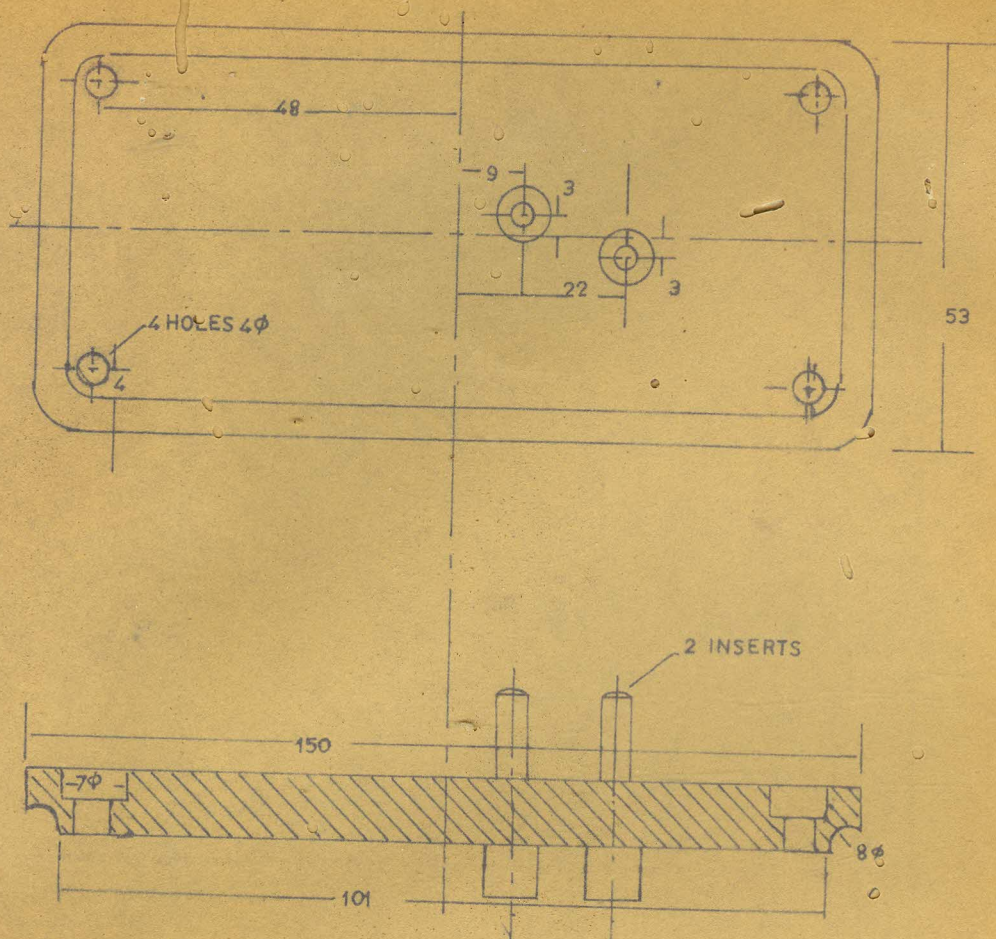
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INDUSTRIAL DESIGN CENTRE



DIPLOMA PROJECT-ELECTRIC GEYSER

PLATE CARRIER

BHAUMIK B

ROLL NO S. 974

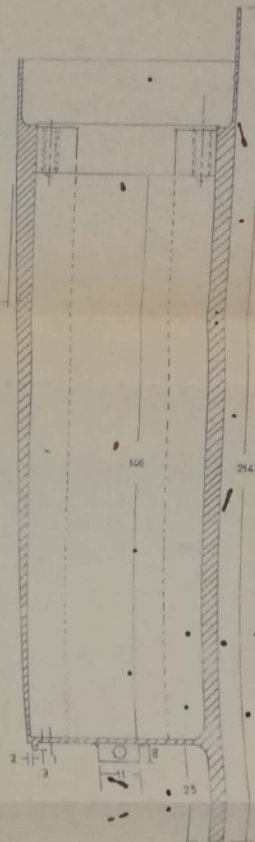
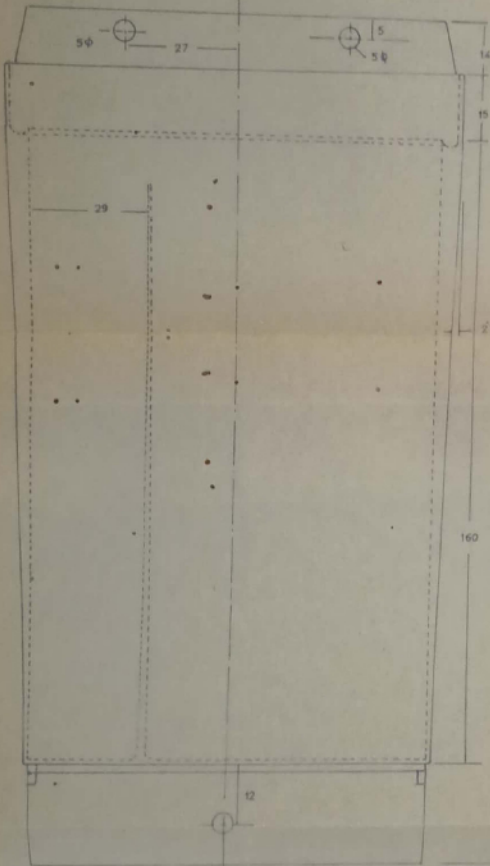
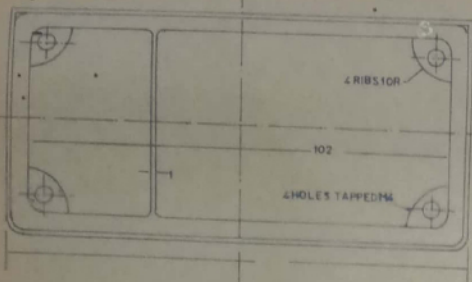
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ALL DIMENSIONS IN MMS



INDUSTRIAL DESIGN CENTRE



DIPLOMA PROJECT—ELECTRIC GEYSER

CONTAINER DETAIL

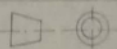
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1971-72

SCALE FULL SIZE

ALL DIMENSIONS IN MM



INDUSTRIAL

DESIGN CENTRE