

DESIGN OF MOBILE PETROL PUMP

A product design **Pproject III** report
by

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Contents

1. Introduction.	5	4.4 Finalizing the arrangement for securing the area while dispensing	
1.1 Scope of the project.		4.5 Power arrangement for pump.	
1.2 About the sponserer.		4.6 manufacturing	
1.3 Working of a gasoline dispenser		4.7 Final product specifications	
1.4 Possible application of the mobile fuel dispensing unit.			
2. Data collection and data analysis.	10	5. Finalization of product organization	44
2.1 function structure		5.1 Exploring product organization	
2.2 Visit to Bharat Petroleum Corporation LTD.		5.2 Position of Hydraulics (pump, meter)	
2.3 Visit to Jet Airways.		5.3 Position of the display nozzle and hose	
2.4 Study of existing similar products			
2.5 Petroleum rules		6. Concept generation	55
2.6 Visits to Villages		6.1 Product form	
2.7 Diesel Purchase Model for Villagers		6.2 Final Product form options	
2.8 Proposed service plans			
3. Design brief.	26	7. Final Concept	61
3.1 Design brief.		7.1 Product description.	
		7.2 Final product features.	
		7.2 Final product form.	
4. Exploration of technical specifications	29	References	69
4.1 Finalizing tank dimensions.		Annexure	70
4.2 Selection of chassis.			
4.3 Ideas for securing the dispensing area.			

Approval Sheet

The product design project titled
"Design Of Mobile gasoline dispenser"
by Pravin S. Padale is approved for the partial
fulfillment of the requirement for the Post gradu-
ate degree in Industrial Design.

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CHAPTER 1

INTRODUCTION

1.1 Scope of the project.

The design of the mobile petrol pump is an innovative idea to serve rural population of India. The petrol-dispensing unit can be a part of vehicle or a transportation medium, which will carry a sufficient amount of gasoline. The challenge in the design is about the storage of the gasoline and about interface and dispensing module of the pump. Traditionally in the existing petrol pumps, the storage tanks are located below the ground but with new solutions, they will be above the ground, so this is another safety issue that need to be considered. The interface issue is that how one or two person can operate the whole dispensing system, right from refilling the tank and dealing with the customers. Because we are talking about making the stationary pump into a mobile unit which has space constraints as well as lot of layout and dispensing issues. The places where the designed unit starts dispensing also matters, as the terrain and changing locations puts some constraints for dispensing units. The day and night conditions have to be considered as illumination can be a issue for night dispensing of gasoline. Besides this the system cost is another issue that must be considered. Therefore, the design needs to consider all such factors before it takes a saleable product form.

This is an entirely new product concept. There are lot of similar products are available in foreign market but they are with limited applications. In Indian market no such product exists till to this date.



Fig. 1.2a



Fig. 1.2b



Fig. 1.2c



Fig. 1.2d



Fig. 1.2e

1.2 about the sponsorer.

This project is sponsored by **MIDCO** (mercantile industrial development company Ltd.) located in Mumbai. This company manufactures the petrol pumps for gasoline and diesel fuel dispensing. The main works is at Ahmadabad. There are two types of the pumps, the mechanical pumps and electronic pumps. Also there is difference in capacities. The heavy duty pumps are of 80 LPM and normal duty pumps are of 40-50 LPM capacity. (Fig 1.2a to 1.2e)

1.3 Working of a gasoline dispenser

The figure at right shows the schematic of the pump organization on the petrol pump. A electric motor is used to drive the pump. The belt drive is provided from motor to pump. Pump has a suction input which is connected to the underground tank. The output of the pump is then provided as an input to positive displacement meter. The output of the meter is then connected to the dispensing nozzle. Thus petrol is pumped by a pump from underground tank to the customer's vehicle passing through a meter. The output of the meter is provided to the registers which show the quantity of the fuel dispensed.(Fig. 1.3)

Fig. 1

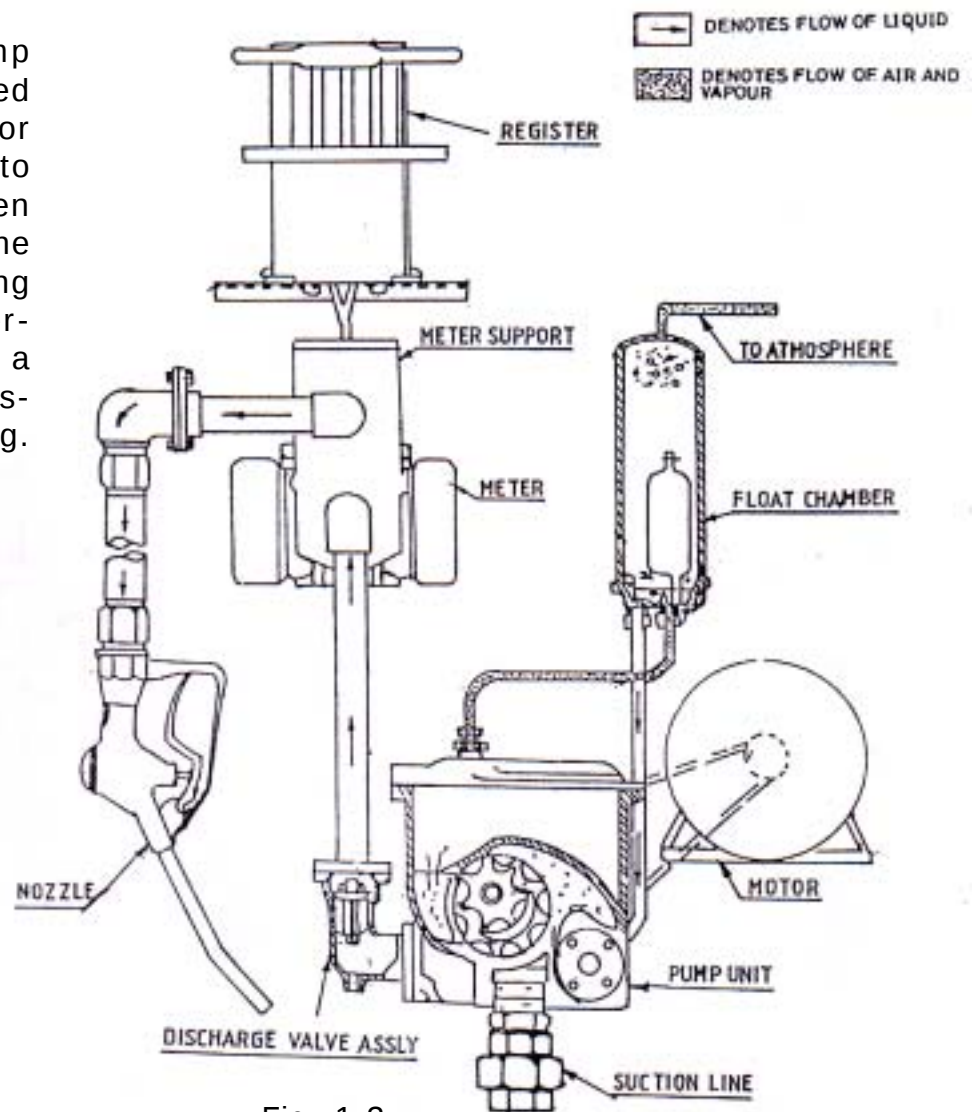


Fig. 1.3

1.4 Possible application of the mobile fuel dispensing unit.

The various possible applications that are possible, is mentioned below.

1. Supply at the farm - pumps and remote areas where power is fuel based. (Fig. 1.4)
2. Gen-sets located in villages or remote areas. (Customer can call a mobile unit for filling of the fuel.
3. Other users from villages or remote areas who can purchase a small quantity in plastic containers/ cans from a mobile which keeps on traveling.
4. Industries who have their own diesel power gen-sets.
5. Vehicles on the road that needs immediate fuel can make a phone call to mobile unit.
6. As a mobile petrol pump for villages, covering two-three villages and having certain duration in week or so at particular place for petrol dispensing service.
7. As a kerosene dispenser for villages.



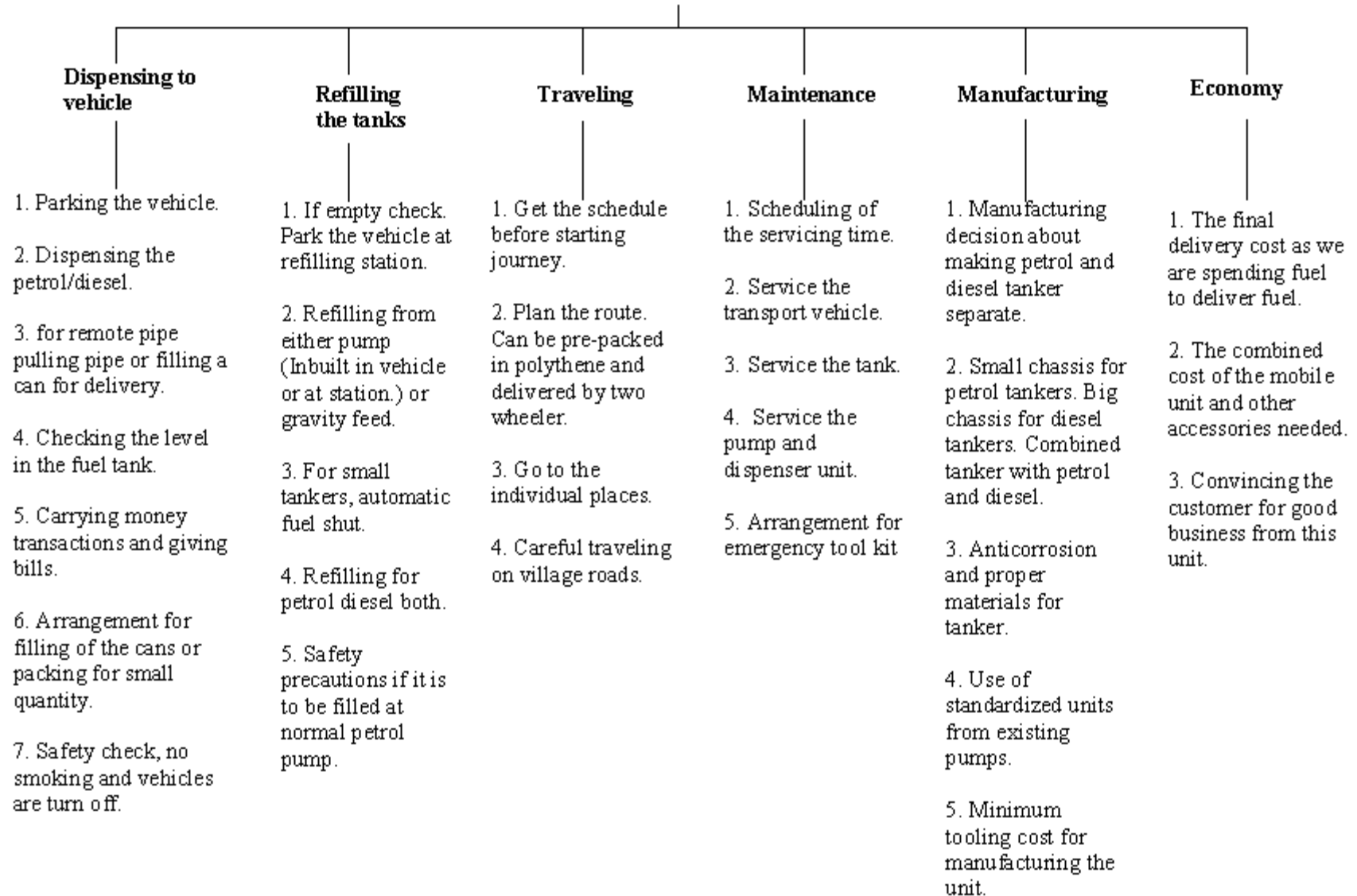
Fig. 1.4

CHAPTER 2

DATA COLLECTION AND DATA ANALYSIS

FUNCTION STRUCTURE

MOBILE PETROL PUMP



2.2 Visit to Bharat Petroleum Corporation LTD.

After visiting to BPCL officers it is found that,

1. Minimum six meters of distance from any side is required from the dispensing nozzle for safety reasons. This precaution is because the persons standing near the nozzle may not take safety measures and as petrol is highly flammable, it might catch fire.
2. There are few standard designs available for tankers. These designs also can be used.
3. Ideal capacity of the tanker for our project should be @ 10kl. The rural area might consume @ 2 to 3 KL of petrol per day and 7-8 KL of diesel for a day. Hence the capacity of the 10kl. If the tank is made bigger then safety measures has to be of that scale. If the size is made smaller then economy has to serve its purpose.
4. The mobile unit should be made totally independent, that is it should refill the tank from the oil company station directly. Else it will consume time and energy for filling from the normal petrol pump. However both the refilling option is a good idea.
5. A careful consideration and detailed approach should be there for refilling of the tanks.
6. Standard designs use the tank filling from the top side. This can be useful and also the lorry can directly fill up from any oil company dispensing point.
7. There can be an issue regarding the metering of the fuel. In normal cases the fuel meter is checked and installed on site but in our case the meter will

be traveling on the rural road. So due to shocks it may affect the performance of the meter. So there needs to be an arrangement to prevent this.

8. He also explained about carrying fuels. For petrol the villagers carry it in bottles and cans which may be dangerous. The design of container also needs to be declared safe by the explosive department. For diesel they can carry it in cans as it is not flammable.
9. He talked about other safety rules that one must follow. That is the customer must turn off the vehicle when he comes in the premises of six meters radius (normally which needs to be fenced.), also no smoking, and parking the mobile unit near electric pole. One must take care to communicate this. Or a system should be so that which will convey these rules to customer as well as the operator of the pump.
10. Any new design needs to be approved by the explosives department.
11. Generally electric motors are avoided near the petrol tank and for pumping of the flammable fuel as it may give rise to sparks.



Fig. 2.3a



Fig. 2.3b



Fig. 2.3c



Fig. 2.3d



Fig. 2.3e

2.3 Visit to Jet Airways

Jet Airways has one fuel bowser. This bowser is used to carry diesel fuel to the aircraft equipments and ground equipments on the Santa-Cruz airport. This is much more similar product to the mobile petrol pump. This has a diesel tank of 2600 liters of capacity. The tank is mounted on a TATA 407 chassis. Tank is connected to pump and fuel metering unit. In-between the driver cab and tank, the meter display is provided. Another extra hand pump is installed near the display incase the regular pump fails. The regular pump gets its power from a TATA 407's engine. A powered takeoff gear is used for driving the regular pump. The body is skid mounted over chassis. They follow a monthly maintenance schedule for pump and there is also separate schedule for vehicles maintenance.(Fig. 2.3a to 2.3f)



Fig. 2.3f



Fig. 2.4a



Fig. 2.4b



Fig. 2.4c



Fig. 2.4d

Fig. 2.4e



Fig. 2.4f



2.4 Study of existing similar products

2.4.1 water bowzers

Water bowzers exist since long time with us. Normally water barrels with wheels are used to store and carry the water. New versions are with trolley and arrangement to attach it with vehicles. They and lot of other fuel bowzers are made separately on a trolley because they can sell it as separate unit which can be towed to a vehicle.(Fig. 2.4a and 2.4b)

2.4.2 Aero-plane and fuel bowzers

the airplane browsers are one of the closest example to mobile petrol pump. This also delivers the flammable fuel. the fuel bowzers are basically meant for dispensing of non flammable fuels but they do use sometimes for dispensing of gasoline.(Fig. 2.4c and 2.4d)

2.4.3 Oil and petroleum tankers

this category of product are also close to the 'mobile petrol pump. The difference is that the mobile petrol pump will be equipped with the fuel metering and pumping possibility. However there is good possibility of borrowing features from these tankers to the mobile petrol pump.(Fig. 2.4e and 2.4f)

2. 5 Petroleum rules

Approval of containers

(1) Containers exceeding one litre in capacity for Petroleum Class A and five litres in capacity for petroleum Class B or petroleum class C, Shall be of a type approved by the Chief Controller.

(2) Where the approval of the Chief Controller is sought to a type of container not Previously approved, an application together with copies of drawings thereof to scale Showing the design, materials to be used, the method of construction and capacity of The container together with two samples containers and a fee of **rupees one thousand** For scrutiny shall be submitted to the Chief Controller.

(3) Nothing in sub-rules (1) and (2) shall apply to containers in the possession of the defense Forces of the Union.

Containers for petroleum Class A.-

(1) Containers for petroleum Class A shall be constructed of tinned, galvanized or externally rust proofed sheet iron or steel and be of a type approved by the Chief Controller, Provided that glass bottles of a capacity not exceeding 2.5 litres and of a type Approved by Chief Controller can be used as a container for laboratory chemicals classified as petroleum Class "A".

(2) The containers shall be so constructed and secured as not to be liable except under circumstances of gross negligence or extraordinary accident to become defective, leaky or insecure in transit and they shall be kept in

proper repair.

(3) The containers shall have well-made filling aperture which shall be fitted with well-fitting and secure airtight screw plugs or screw caps or other caps.

(4) Containers made of sheet iron or steel shall have the following thickness of metal, namely: -

Capacity of Container exclusive of the free space minimum thickness in mm. Prescribed in sub-rule (6) of sheet iron or steel

Not exceeding 10 litres - 0.443 (27BG)

Exceeding 10 but not exceeding 25 litres - 0.63 (24BG)

Exceeding 25 but not exceeding 50 litres - 0.80 (22BG)

Exceeding 50 but not exceeding 200 litres - 1.25 (18BG)

Exceeding 200 but not exceeding 300 litres - 1.59 (16BG)

(5) The capacity of any container, other than those approved by the Chief Controller for specific purposes, shall not exceed 300 litres.

(6) An air space of not less than 5 percent of its capacity shall be kept in each container.

(7) The container shall bear a stamped, embossed or painted warning exhibiting in conspicuous characters the words "Petrol" or "Motor Spirit" or an equivalent warning of the highly inflammable nature of the petroleum.

(8) Nothing in sub-rules (1), (3), (4), (5), (6) and (7), shall apply to containers in the possession of the defense Forces of the Union.

Containers for petroleum Class B and Class C

(1) Containers for petroleum class B or petroleum class C shall be constructed of steel or iron and are of a type approved by the Chief Controller.

(2) An air space of not less than 5 percent of its capacity

shall be kept in each container for petroleum Class B and not less than 3 percent of its capacity in each container for petroleum Class C.

(3) Nothing in this rule shall apply to containers in the possession of the Defense Forces of the Union.

Empty receptacles

All empty tanks which had petroleum Class A or petroleum Class B and empty containers which had petroleum Class A shall, except when they are opened for the purpose of filling or cleaning and rendering them free from petroleum vapour, be kept securely closed until they have been thoroughly cleaned and freed from petroleum vapour.

Repairs to receptacles

(1) No person shall cause to be repaired or repair by the use of hot work any tank or container which had petroleum unless it has been thoroughly cleaned and freed from petroleum and petroleum vapour or otherwise prepared for safely carrying out such hot repair and certified, in writing, by a competent person to have been so repaired.

(2) The certificate required under sub-rule (1) shall be preserved by the repairer for a period of at least three months and produced to an inspector on demand.

Prevention of escape of petroleum

All due precautions shall be taken at all times to prevent escape of petroleum into any drain, sewer, and harbor, river or watercourse or over any public road or railway line.

Prohibition of employment of children and intoxicated

persons

No child under the age of eighteen years and no person who is in a state of intoxication shall be employed on the loading, unloading or transport of petroleum or in any premises licensed under these rules.

Prohibition of smoking, fires, lights, etc.

Unless expressly provided in these rules, no person shall smoke and no matches, fires, lights or articles or substances capable of causing ignition of petroleum shall be allowed, at any time in proximity to a place where petroleum is refined, stored or handled or in a vehicle's carriage or vessel in which petroleum is transported.

Special precautions against accident

(1) No person shall commit or attempt to commit any act, which may tend to cause a fire or explosion in or about any place where petroleum is refined, stored or handled, or any vehicle's carriage or vessel in which petroleum is transported.

(2) Every person storing petroleum and every person in charge of or engaged in the storage, handling or transport of petroleum shall at all time. -

- (a) Comply with the provisions of these rules and conditions of any license relating thereto;
- (b) Observe all precautions for prevention of accident by fire or explosion; and
- (c) Prevent any person from committing any act referred to in sub-rule (1)

Prohibition of smoking, fires, lights

No person while engaged in loading or unloading or trans-

porting shall smoke or carry matches, lighters or other appliances capable of producing ignition or explosion.

Restriction on loading and unloading by night

Petroleum shall not be loaded into, or unloaded from, any ship, vessel or vehicle between the hours of sunset and sunrise, unless.-

(a) Adequate electric lighting is provided at the place of loading or unloading and the provisions of Chapter IV are complied with; and

(b) Adequate fire-fighting facilities with personnel are kept ready at the place of loading for immediate use in the event of a fire.

Tank Capacity

(1) In this part, “the tank forming part of a tank vehicle” shall be deemed to include any number of tanks on the same chassis and any limitation herein specified on the capacity of a tank shall be construed so as to permit of the tank containing the quantity specified under varying degrees of temperature.

(2) The net carrying capacity of a tank shall be 97 per cent of its gross carrying capacity in the case of petroleum Class A and petroleum Class B and 98 percent, in the case of petroleum Class C.

(3) The net carrying capacity of a tank truck or a tank semi-trailer shall not exceed 25 kilolitres of petroleum except in case of air-craft refueller in which case it should not exceed 50 kilolitres and the net carrying capacity of any tank trailer should not exceed 5 kilolitres of petroleum.

(4) The maximum safe carrying capacity in weight of petroleum that can be carried in a tank vehicle shall not exceed the difference between the unladen weight of the vehicle and the maximum gross weight permitted for the class of vehicle under the appropriate transport regulations.

Restriction on other use

Tank vehicle meant for the carriage of petroleum in bulk shall not be used for any other purpose except when so authorized by the Chief Controller in writing.

Tank Vehicles

(1) every tank vehicle used for the transport of petroleum, in bulk on land shall be built, tested and maintained in accordance with the requirements laid down in the Third Schedule and be of a type approved in writing by the Chief Controller :

Provided that the Chief Controller may under exceptional circumstances to be recorded in writing, waive any of the requirements of the Third Schedule. This will, inter alia, include approvals for trials of better quality vehicles that will contribute to enhancement of safety of petroleum transportation by road under Indian conditions.

(2) The tank shall be fabricated and mounted on the vehicle chassis by a manufacturer approved by the Chief Controller. Such a manufacturer shall apply to the Chief Controller for approval with particulars of facilities and competent persons available with him and a scrutiny fee of rupees five hundred. The tank fabrication and mounting drawings in quadruplicate for each type of tank vehicle, along with scrutiny fee of rupees one hundred shall

be submitted to the Chief Controller for approval. Such approval shall be valid for three years from the date of issue of approval and renewable for further period of 3 years on payment of fee of rupees five hundred.

(3) If the Chief Controller, after receipt of the drawing under sub-rule (2) and after making such further inquiries as he may deem necessary, is satisfied that the tank vehicle or the special safety fittings, as the case may be, meet with the requirements laid down in the Third Schedule, he shall approve the drawing and return to the applicant one copy thereof duly endorsed.

(4) Nothing in this rule shall apply to tank wagons for the carriage of petroleum by rail.

2.6 Visit to Villages

Places visited :

Manakapur,
Hupari,
Rendal

All places are in maharashtra, kolhapur district.

New learning



Fig. 2.6a

- 1) There are @ 25 tractor and 200-300 two wheelers in a village of population 10000-12000.
- 2) Each tractor owner consumes @ 20-25 litres of diesel per day and vehicles consumes 1-2 litres of petrol.
- 3) They purchase fuel everyday because they cant invest heavy amount and make store of fuel for few days.
- 4) Few of the villages, has other improper means of selling petrol. The petrol is packed in ordinary bottles and sold as a red oxide thinner. But infact the villagers are told to use it in vehicles and content of this chemical is large portion of petrol. This is highly dangerous.
- 5) One person goes to the town almost every day on bicycle or with motorcycle to bring the diesel for tractor. This takes almost a 2 - 3 hours time normally with bi-cycle.

2.7 Diesel Purchase Model For Villagers

Existing scenario

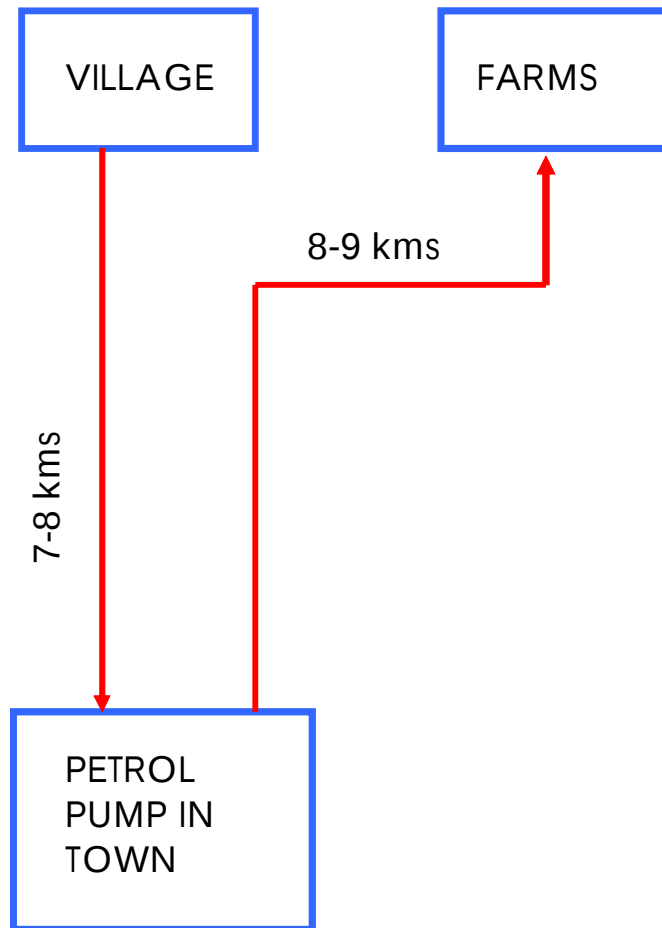


Fig. 2.7a

Scenario with mobile petrol pump

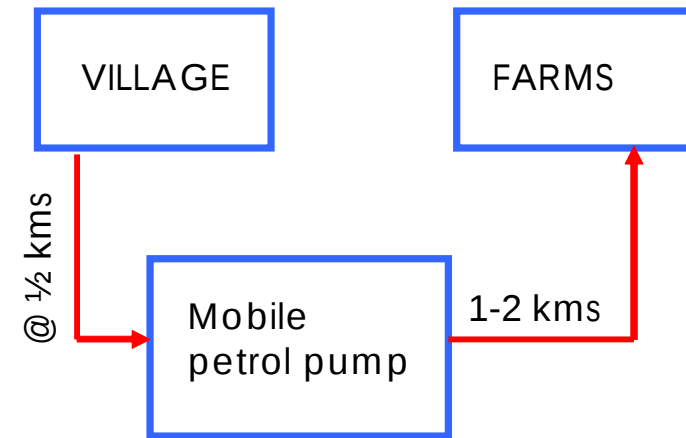


Fig. 2.7b

The expected sale will be around rupees 50000 – 60000 at the end of the day. With this insight another safety issue of cash rises. Because there may be a possibility of stealing and robbery

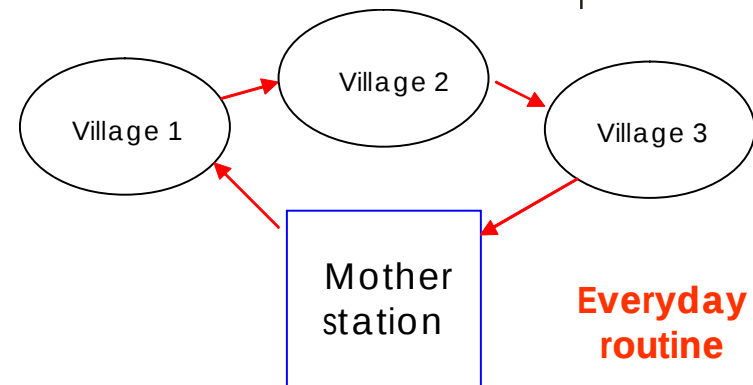
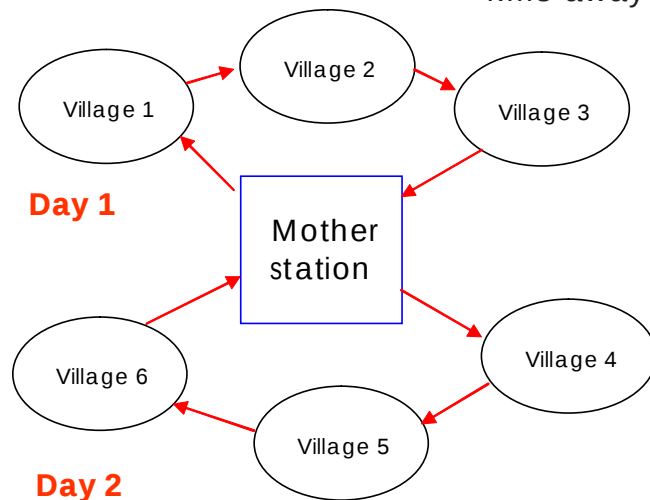
2.8 Proposed service plans

2.8.1 Plan 1

- 1) The vehicle will travel to six villages in two days period.
- 2) It will cover three villages in one day that is mobile unit will come once in a twice days in particular village.
- 3) In each of the village this unit will stay for 3 hours.
- 4) The villages are assumed to be approximately 10 -15 kms away maximum from each other.

2.8.1 Plan 2

- 1) The vehicle will travel to three villages in one days period.
- 2) It will cover three villages in one day that is mobile unit will come everyday in the village at a particular time.
- 3) In each of the village this unit will stay for 3 hours.
- 4) The villages are assumed to be approximately 10 -15 kms away maximum from each other.



CHAPTER 3

DESIGN BRIEF

3.1 Design brief

Design a mobile gasoline dispenser satisfying following requirements.

- 1) The design of the unit should comply with CCOE rules
 - Arrangement for securing the place with minimum of 6 meters radius from the dispensing nozzle during dispensing.
 - No smoking in secured premises.
 - The vehicle coming near the dispensing point should be switched off.
 - There should be lighting arrangement.
 - Width of the tank should be less than the width of cab.
 - All the materials and specifications should be used according to the norms of explosives department.
- 2) The mobile dispenser should provide sufficient space and ease of dispensing to the operator.
- 3) The mobile dispenser should have a distinguishable identity of its own.
- 4) The mobile dispenser vehicle must be an integrated with fuel dispenser.
- 5) The organisation of the product should be such that it has an integral look.
- 6) The dispenser vehicle must be equipped with fuel meter and pump assembly.

7) The mobile dispenser must dispense diesel as well as gasoline.

8) Tank capacity of 9 KL. The gasoline capacity should be 3kl and diesel capacity should be 6kl

CHAPTER 4

**EXPLORATION OF
TECHNICAL
SPECIFICATIONS**

4.1 Finalizing tank dimensions

The chassis selection was one of the important decisions in the whole product configuration. This in turn was dependant on the specifications of the tank. The strategy was to fit the optimum chassis according to the dimensions and weight criteria of the tank. Consideration of the tank capacity depend on the daily delivery of petroleum. From data collection volume evolved was 9kl. The shape of the tank and construction was kept same as what normally comes with the petrol tankers. The standardized tank helped to reduce the time in design. Besides there was no hassle regarding the petroleum rules for tanks construction and safety.

Tank specifications

- Capacity of the tank = 9000 litres
- Length of the tank = 3660 mm
- Height of the tank = 1450 mm
- Width of the tank = 2135 mm
- Compartments = 3
- Diesel capacity = 6000 litres. (two compartments)
- Petrol capacity = 3000 litres (one compartment)
- Weight of the fuel = 8500 kg

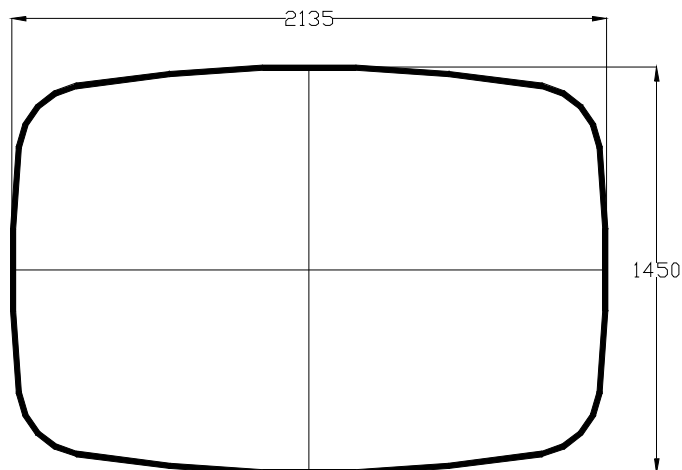


Fig. 4.1a

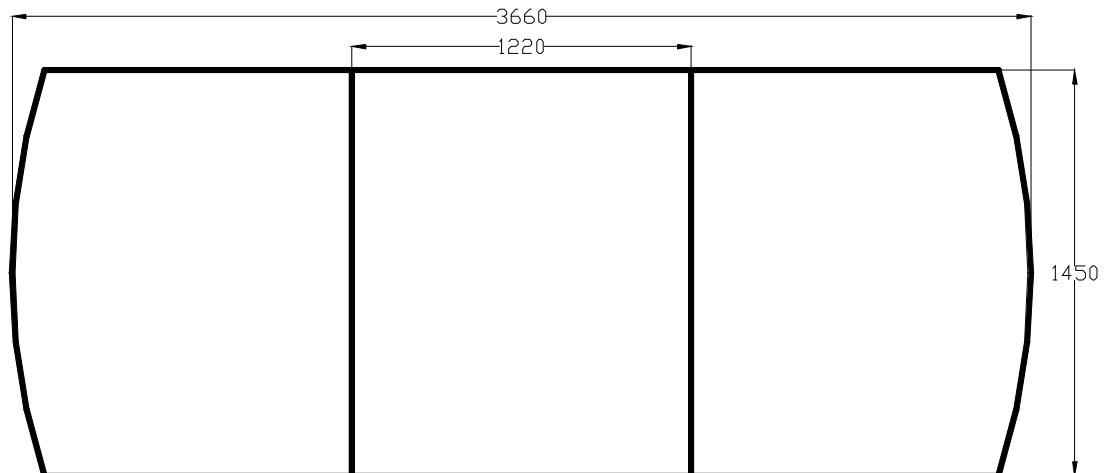


Fig. 4.1b

4.2 Selection of chassis

Requirement for chassis selection.

The chassis needed for mobile dispenser should be optimum for dimensions as well as for weight carrying capacity. The cost, maintenance and availability are other parameters that need to be considered.

Evaluation criteria.

The chassis are evaluated for following criteria,

- The dimensions of the chassis
- The weight carrying capacity of the chassis
- The cab of the chassis

The next page shows the various chassis considered.



After studying different chassis it is found that the following chassis are most considerable for final configuration.

TATA SE 1613

This type of chassis comes with half built driver's cabin. The front body till windscreen is built and at the back it's open. The back body along with the door of driver's cabin can be built on this chassis.



SE 1613 TC/C/EX

This type of chassis comes with built driver's cabin. SE 1613 TC/C is one of the famous models for the dumpers. Whereas SE 1613 EX is new model in this series and form wise much better option.



TATA LPT 1613 TC

This model is best suited to build a complete new body over the chassis. The driver cabin is also open. Designing the cabin with the body would be better for generating an integral and new form.

So this chassis is considered as most optimum option.

Main specifications for TATA 1613 type chassis

Max. Permissible RAW = 10200 KG
Overall length = varies as per model
Front track = 1933 mm
Rear track = 1809 mm
Wheel base = 4225 mm
Overall width = 2434 mm.



4.3 Ideas for arrangement of securing the dispensing area.

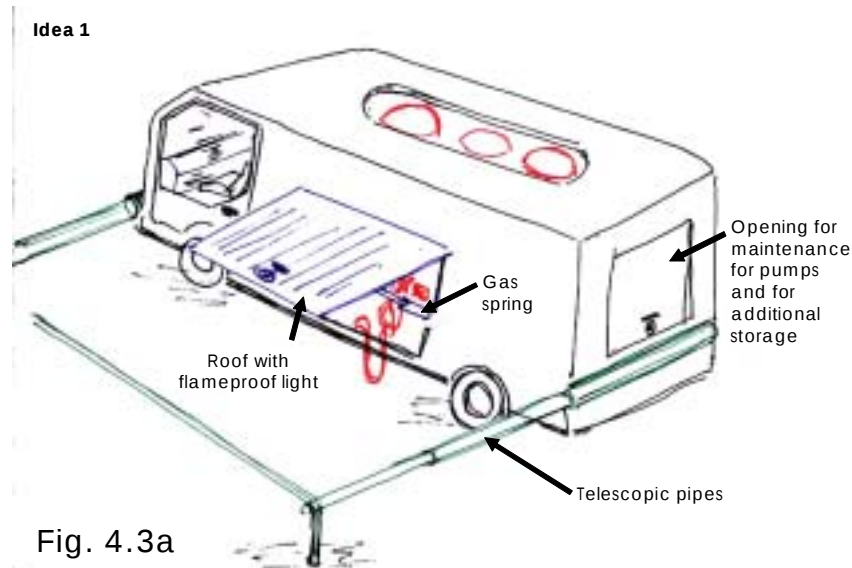
The area of dispensing is important through safety point of view. There needs some arrangement for securing the area. The arrangement should be very easy to operate. The various approaches for this are

- 1) Securing device fitted on the vehicle.
- 2) Securing device independent to the vehicle.
- 3) Using the existing secured premises.

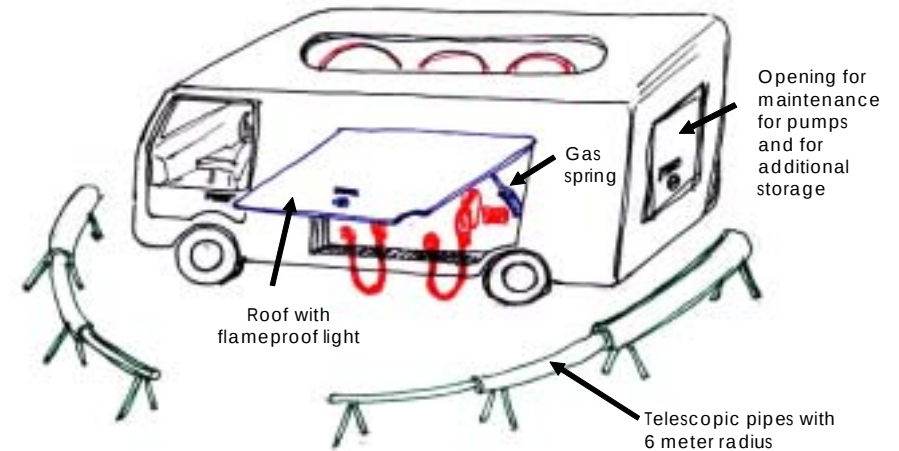
The figures on this pages explains the first two approaches.

4.3.1 Ideas for securing the dispensing area

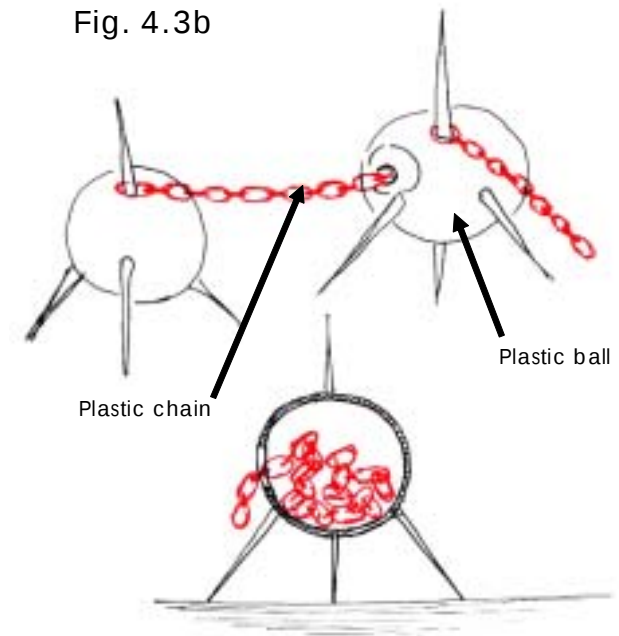
The options for securing the area if dispensing is done from side



Idea 2



Idea 3



4.4 Finalizing the arrangement for Securing the area while dispensing

Alternative solutions were considered for securing the area while dispensing. Few are shown before. All these are some sort of fences and need to set it before the operation of dispensing begins. Again additional space for this has to be arranged in the vehicle. This will again increase the complexity. Few of the solutions needs to be carried over the vehicle or suggested as an attachment to the vehicle. Even after this they may not been able to secure adequate space suggested. Also considering the risk of carrying flammable fuels, there needs a very proof solution. Whereas all the solutions suggested were the some sort of simple fencing.

As this mobile unit is proposed to operate in such way that it is going to a village with certain frequency, another arrangement for securing the area is possible. Barren lands can be rented in a suitable location around the village and a well proof fence can be built. The mobile unit will go to that location and stand for its preplanned duration. So there is no need to carry an excessive fence or fencing arrangement along the vehicle. Another side business can run on the same place such as an automobile spare-part shop. This either can be run by the owner of the land or can be rented to anyone.

The possible layout of this arrangement is explained in the figure shown on next page.

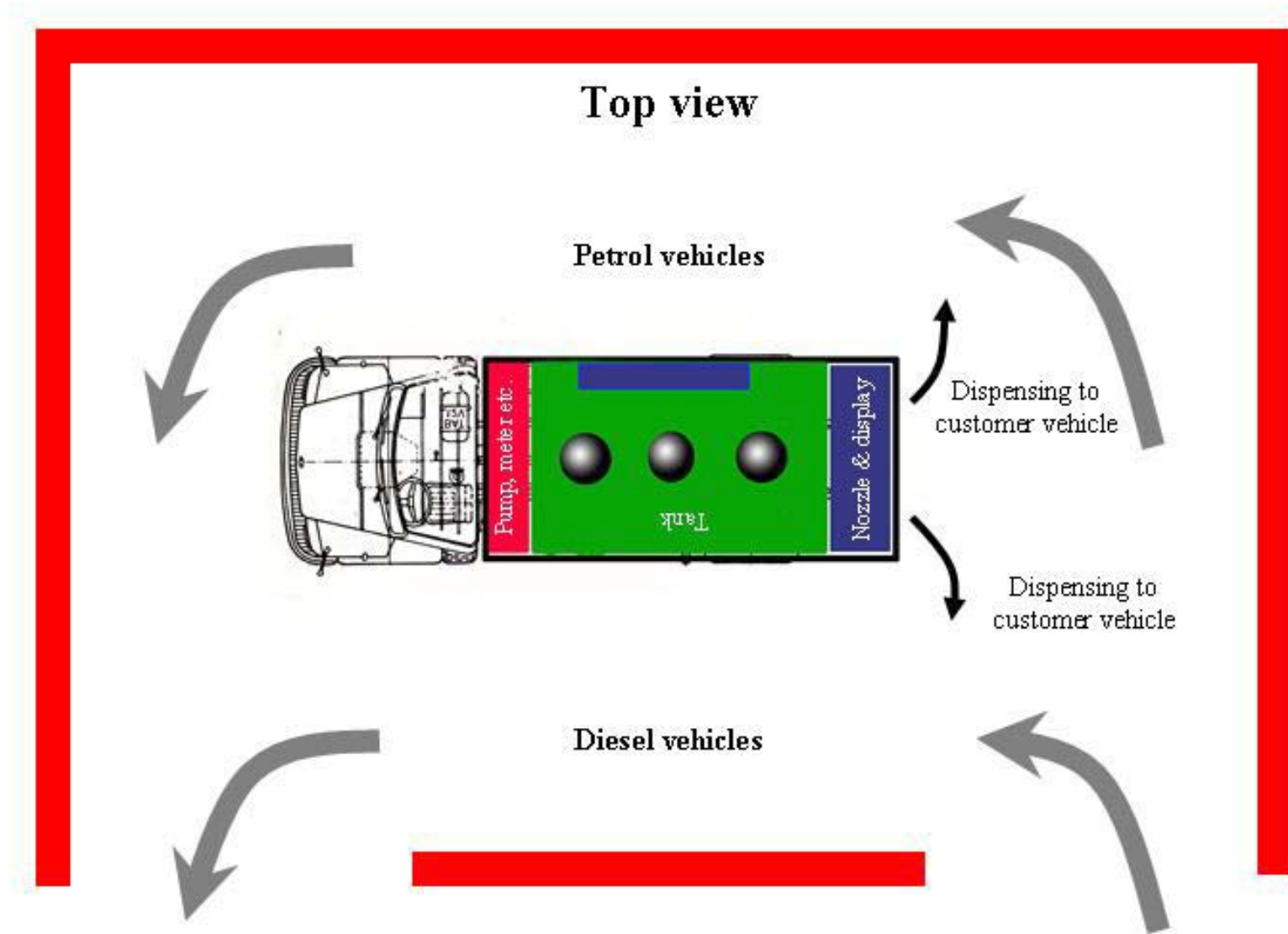


Fig. 4.4a - Securing the dispensing area

4.5 Power arrangement for pump

a) Power from engine of the vehicle

The additional gear box can be provided in between the engine gearbox and differential. Now the power coming from the engine can go to two different possible ways. One way is that it can go to engine differential while driving vehicle. The second way is that it can drive pump when it's standing. This can be controlled by a simple lever provided in driver cabin. This type of arrangement is provided in the fire fighters vehicles.

advantages

It gives better integration of product as well as no separate arrangement is necessary for driving pump.

disadvantages

The problem with this kind of arrangement is that the excessive power input. The power required for driving pump is only $\frac{3}{4}$ HP and can be much less in this case as already there is a gravity head available. Even in idling conditions engine has a much more power than necessary to drive a pump. However unnecessary fuel waste can happen.

The following figure explains the arrangement.

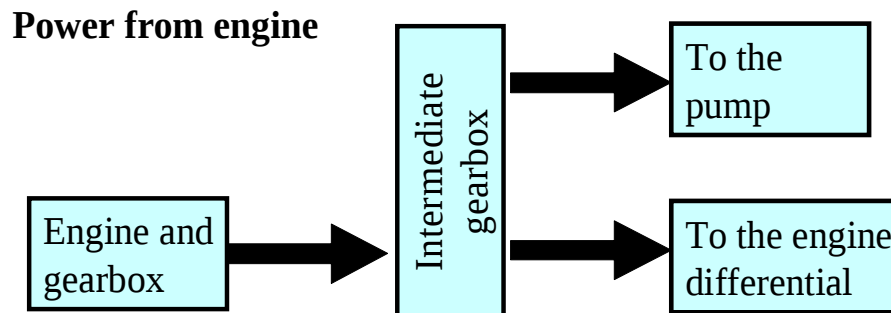


Fig. 4.5a

b) power from external IC engine.

In this arrangement a small capacity engine can be used to drive a pump. So it will just replace the motors with an engine in existing arrangement (Refer chapter 1). This can be a diesel or kerosene engine.

advantages

this is a energy efficient than previous option. Better integration with pump.

disadvantages

The problem with this arrangement is the engine vibration. It is clear that the simple arrangement will be to mount engine with pump but engine vibration can be detrimental to the accuracy of the pump and metering units. So if this arrangement has to accept then there is needed to take care that the engine vibration are isolated from pump and metering unit.

The following figure explains the arrangement.

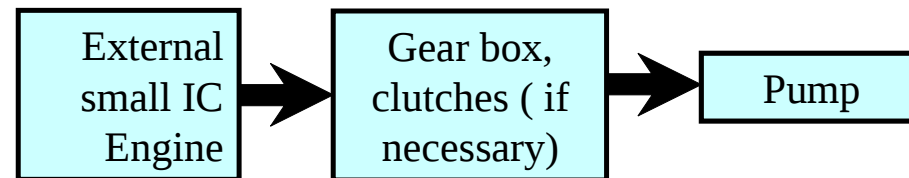
Power from external engine

Fig. 4.5b

c) Power from externally charged batteries or generator

In this arrangement, a power box provides the connectivity both to the batteries and a commercial generator available. Batteries can be externally charged and located in the driver cabin. Same way if batteries are not being arranged then a generator power can be provided externally. Considering all the options, this option is selected for final configuration.

advantages

The greatest advantage of this arrangement is the portability of the units. This will help in locating the pump and meter at any place on vehicle. Besides flexibility in power input can provide flexibility in operations.

disadvantage

Regular maintenance of batteries are necessary. Also everyday batteries needs to be charged.

After comparing all above option, option c is good option for giving power to pump.

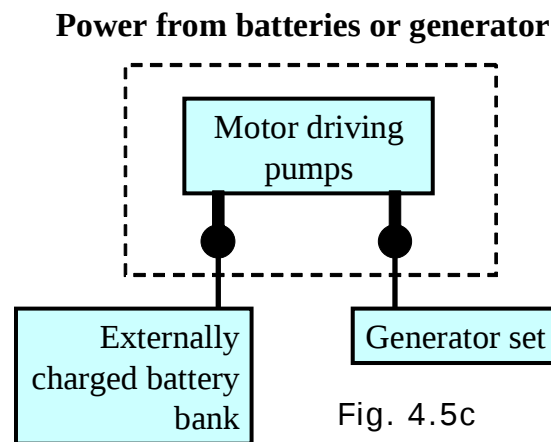


Fig. 4.5c

4.6 manufacturing

The method of manufacturing is to build the completely new body over the ready made chassis. Generally it can be treated as bus body building. But it has lot more differences than bus body building. First difference is that this has both the constructions i.e. tank and body on the same chassis. Secondly careful structural details are needed as other accessories such as hydraulics and interface elements such as display, nozzles will have to be incorporated. Besides all this, the drawings need to be approved by CCOE. So strictly all drawings must be ready before the fabrication starts and minimal changes are expected after the approval of the drawings.

The body is constructed over the I sections laid over the chassis. The square section pipes may be used for the structural members. The drawings with the report show the details of this structure at various sections. The tank is skid mounted. The nuts are welded to bolt so that they should not slip. While removing the tank, these bolts can be cut off but there is very less probability of removing tank from the chassis unless the tank is heavily damaged. The canopy of the dispensing interface at back is hydraulically operated. The hydraulic line of the vehicle can be used for this purpose. Proper graphics must be provided such as the 'no smoking' symbol and note.



Fig. 4.6b



Fig. 4.6a



Fig. 4.6c

4.7 Final product specifications

Chassis:

Model: Tata LPT 1613 (Cowl type)
Max. Permissible RAW = 10200 KG
Overall length = 7380mm
Front track = 1933 mm
Rare track = 1809 mm
Wheel base = 4225 mm
Overall width = 2434 mm.

Tank:

MOC: Mild steel.
overall capacity of the tank = 9000 litres
length of the tank = 3660 mm
height of the tank = 1450 mm
width of the tank = 2135 mm
compartments = 3
Construction details: 3 kl compartments

Pumping unit:

Positive displacement, rotary internal gear pump with CI body and rotor with Sintered bronze bushes. With adjustable bypass valve and union cum check valve
LPM: 35 lpm for standard duty and 70 lpm for heavy duty.
Filters: Suction filter of 150 mesh and discharge filter of 200 mesh.

Motor:

Type: Continuous duty, flame proof, foot mounted, capacitor start induction motor.
Rating: $\frac{3}{4}$ hp. Single phase, 220V AC. 1450 rpm with 5-

8 amps at full load with capacity of 75 start stops per hour and thermal cut-off provision.

Drive mechanism:

The pumping unit will be driven by a motor with power input from generator set of capacity 2 HP and of the desired current and voltage rating.

Metering unit:

Type: positive displacement 120 degrees two piston meter with stainless steel seamless liners and specially selected corrosion proof materials.

Measuring accuracy: +/- 0.20%

Maximum working pressure: 3.5 kg/cm sq,

Pulsar signal: 0.01 Litre (Least count)

Display:

Price, Volume and amount display. With 6 digit , 25 mm for amount, 6 digit 25 mm for Volume and 4 digit, 19 mm for price.

Hose:

Double braid steel wire (hard wall) with breakaway and 360 degree swivel at nozzle end. The hose will be petrol resistant as per IS 2396, suitable for working pressure of 3.5 kg/sq. cm. The hose will be backed by a spring loaded hose retrieval mechanism .

Nozzles:

Auto cut-off nozzle with Aluminium body and spout and size ¾" for standard duty and 1" for heavy duty.

Generator:*Fuel Tank Capacity - Gasoline (lit): 10**Continuous Operating Time (Hours): 6.5**AC Frequency (Hz): 50**AC Voltage (V): 220**Max. AC Output (VA): 1900**Rated AC Output (VA): 1700**DC Output: 12V-8.3A**LxWxH (mm): 545X358X475**Dry Weight (kg): 47*

CHAPTER 5

**FINALIZATION OF
PRODUCT ORGANIZATION**

5.1 Exploring product organization

The minimum required specifications are mentioned below. Based on this various organizations are compared to get the best options.

All the wiring and electrics needs to be flameproof. Especially the motors must be flameproof and of high quality. Normally two persons are sufficient to run the operations. Also the vehicle must return everyday to a fixed place (mother station) after service.

The List of accessories

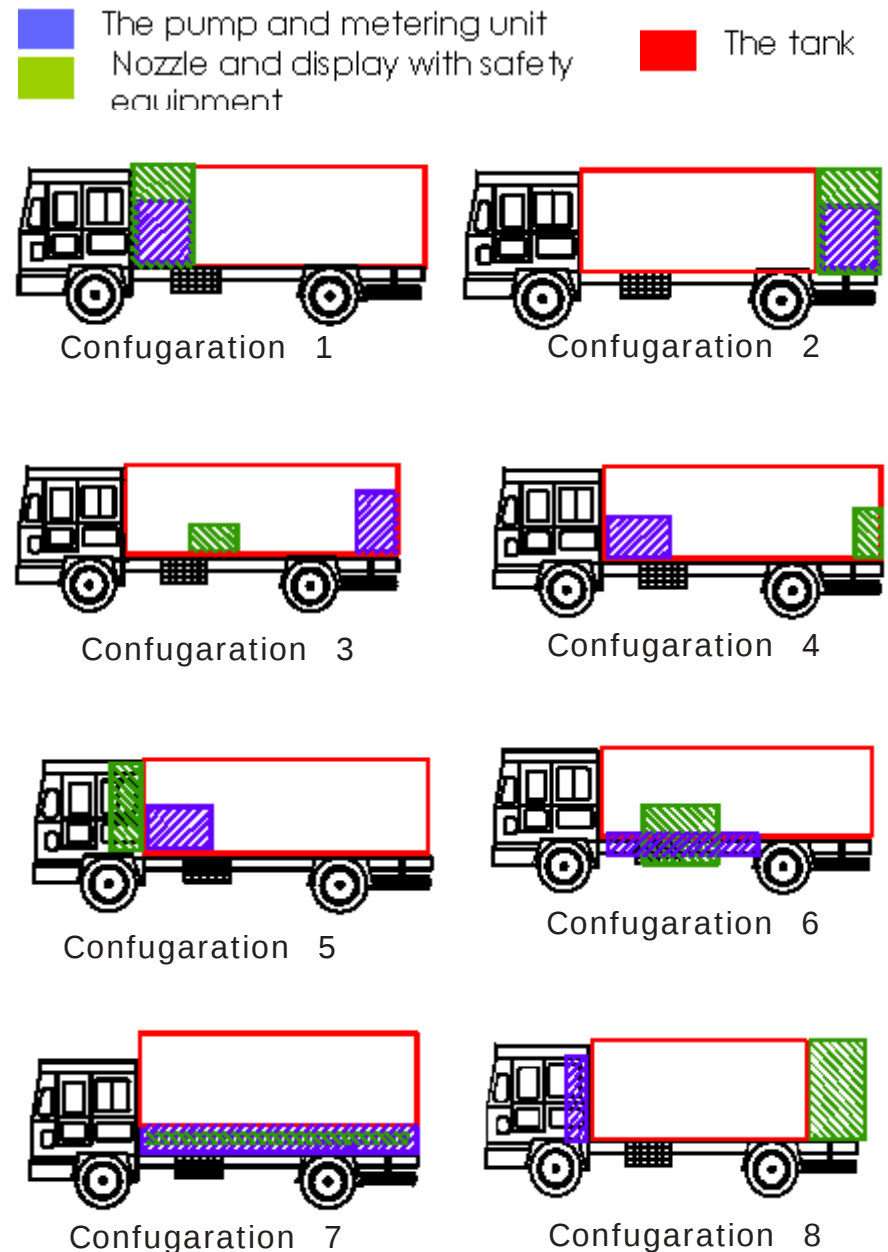
- 1) Pump – 2 nos.
- 2) Meter – 2nos.
- 3) Filter unit – 2 nos.
- 4) Dispensing nozzle – 2 nos.
- 5) Flame proof dc motors - 2 nos.
- 6) extra batteries
- 7) Chassis - 1 nos.
- 8) Display unit – 2 nos.
- 9) Fire extinguisher – 2 nos.
- 10) Tool box – 1 nos.
- 11) Cash box – 1 nos.
- 12) Genset - 1 nos.

5.1.1 selection of product configuration

The configuration has four components as below

- The chassis
- The tank
- The hydraulics
- The dispensing interface

The rearrangement of these components gives different configuration possibilities. The various criteria such as safety, dispensing ease etc. considered for the selection of best possible configuration. The selection chart is shown on next page. The highest ranking configuration is best configuration considering all the criteria mentioned in the table. The various configurations considered are shown in the figures at right.



5.1.2 Evaluation of product configurations.

the criteria	Config. 1	Config. 2	Config. 3	Config. 4	Config. 5	Config. 6	Config. 7	Config. 8
1) ease of dispensing	2	4	-2	2	4	3	2	4
2) maintenance ease	-2	4	-2	-2	2	2	2	2
3) the manufacturing suitability	0	4	0	-2	2	0	0	3
4) Standardization and integration of pump and metering assembly with tank.	4	4	2	0	4	4	0	3
5) Strength and structural considerations	0	4	4	-2	2	0	1	3
6) aesthetics	4	0	2	0	4	2	4	2
7) ease of attaching accessories	2	2	0	-2	2	-1	-1	4
8) ease for securing the area	4	1	2	4	-2	-2	4	4
points given	14	23	6	-2	18	8	12	25

scale of marking is -10 to +10	
0 - neutral/don't matters	
2 - fair	minus 2 - disturbing
4 - good	minus 4 - bad
6 - very good	minus 6 - very bad
8 - excellent	minus 8 - destructive
10 - extraordinary	minus 10 - not acceptable

Few of the configurations were actually modeled to a scale. The Styrofoam model was created to get the feeling of space and configuration. The selected configuration was tried in Styrofoam. The figure shows one of the options. This also helped to understand internal product organization in better manner.

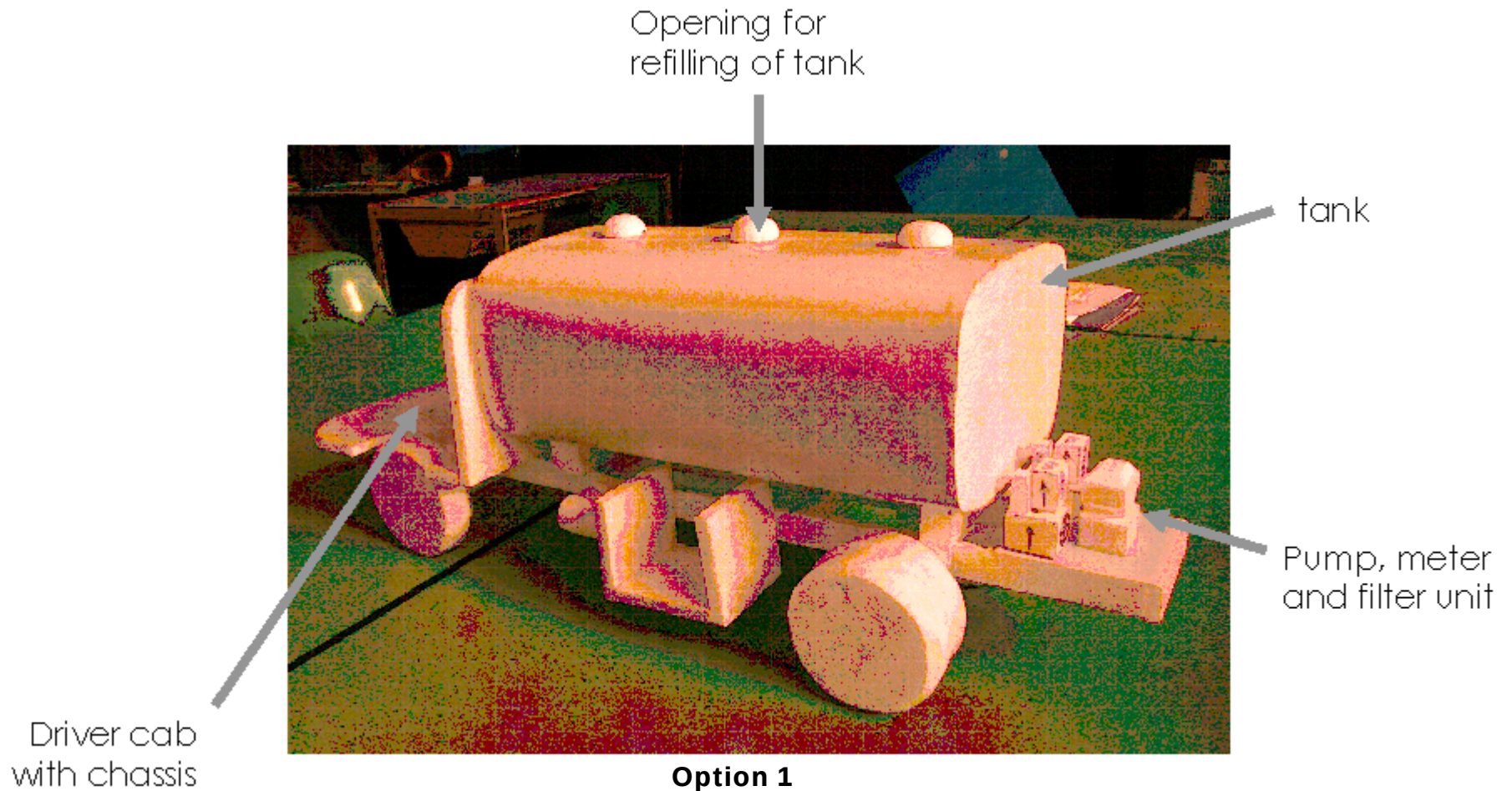


Fig. 5.1a - Styrofoam study model

5.2 Position of Hydraulics (pump, meter)

As mentioned before, there are many possibilities to locate the pump, motor and meter. However two are considered in more detail. These two locations offer a most suitable position in overall configuration.

Option 1

As shown in first figure on next page, the pump and accessories are located in-between driver cabin and tank. But the tank is half a meter away from the cabin just enough to fit the pump and accessories. The tank should be placed at the middle of the chassis so that the load is equally distributed to all wheels. In this case, it is moved by almost 30 cm. This doesn't make any significant difference.(Fig. 5.2a)

advantages

This allows the space at back. This again can be used for lot of other purposes. Also the access to the pump can be provided from the driver cabin.

disadvantages

The difficulty may come in the constructional details and fixing of these pumps, as space has to keep limited. But the access will be easy compared to other option.

Option 2

Second option is to locate the pump at the rear end just after the tank. Over which again a dispensing nozzle, hose and display will come.

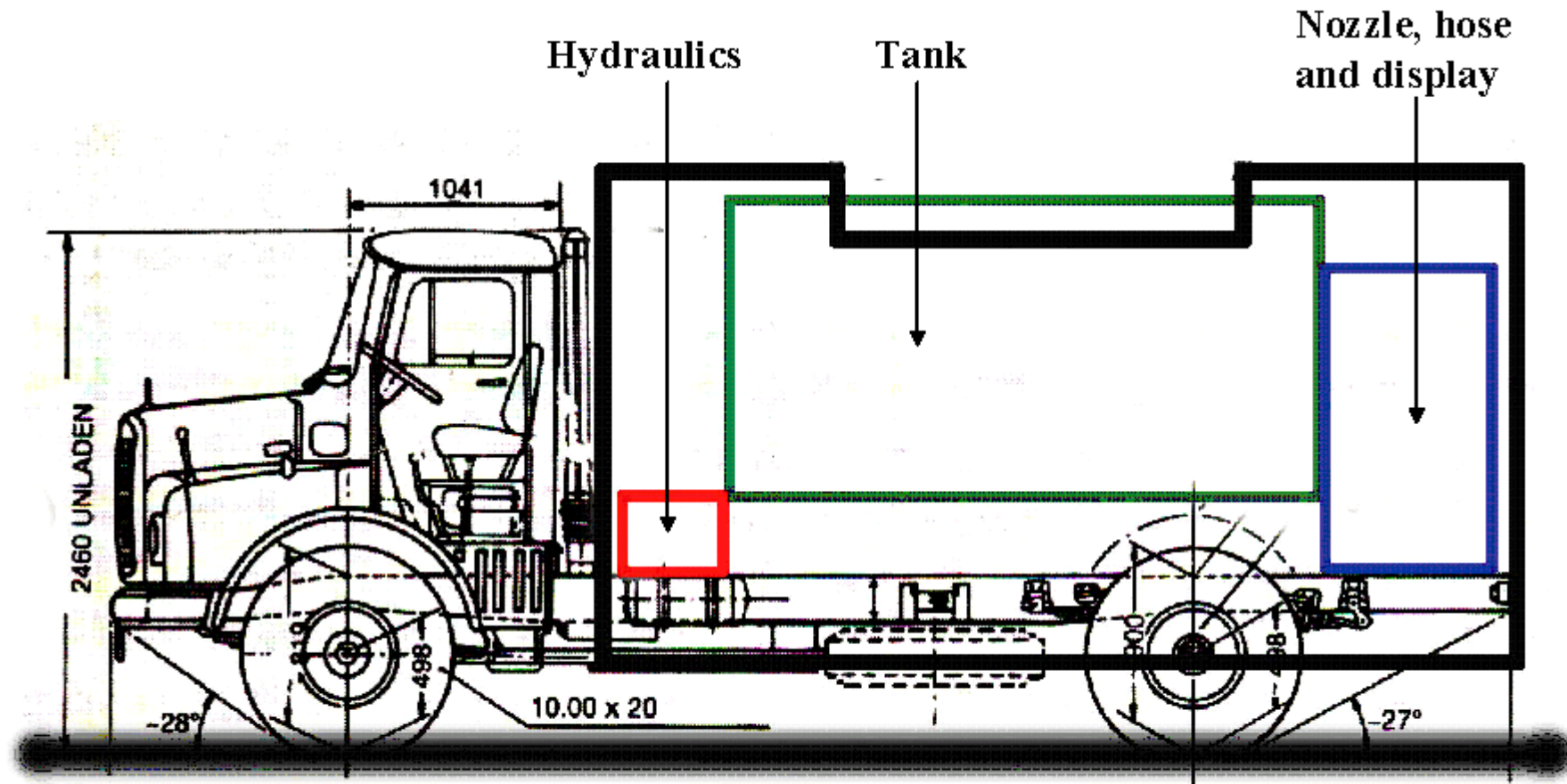
advantages

Ease in the fabrication. The tank is placed near to the centre of chassis which distribute loads equally on the wheels.

disadvantages

The main difficulties are as the all components such as meter, pump, motor, display, nozzle etc-etc; it again will be a difficult task for maintenance. Furthermore compromises may have to do for display height, the space for hose and nozzle as the pump and accessories will share the space at back. This may not be a good idea for deciding the interface for operator, as already vehicle has heightened the whole interface compared to its height of the pumps on ground. Also there is a rule that no display is to be provided below the height of 1.2 meters from the base of the pump.

Considering all the factors the first option is a good choice.



Option 1

Fig. 5.2a - product configuration

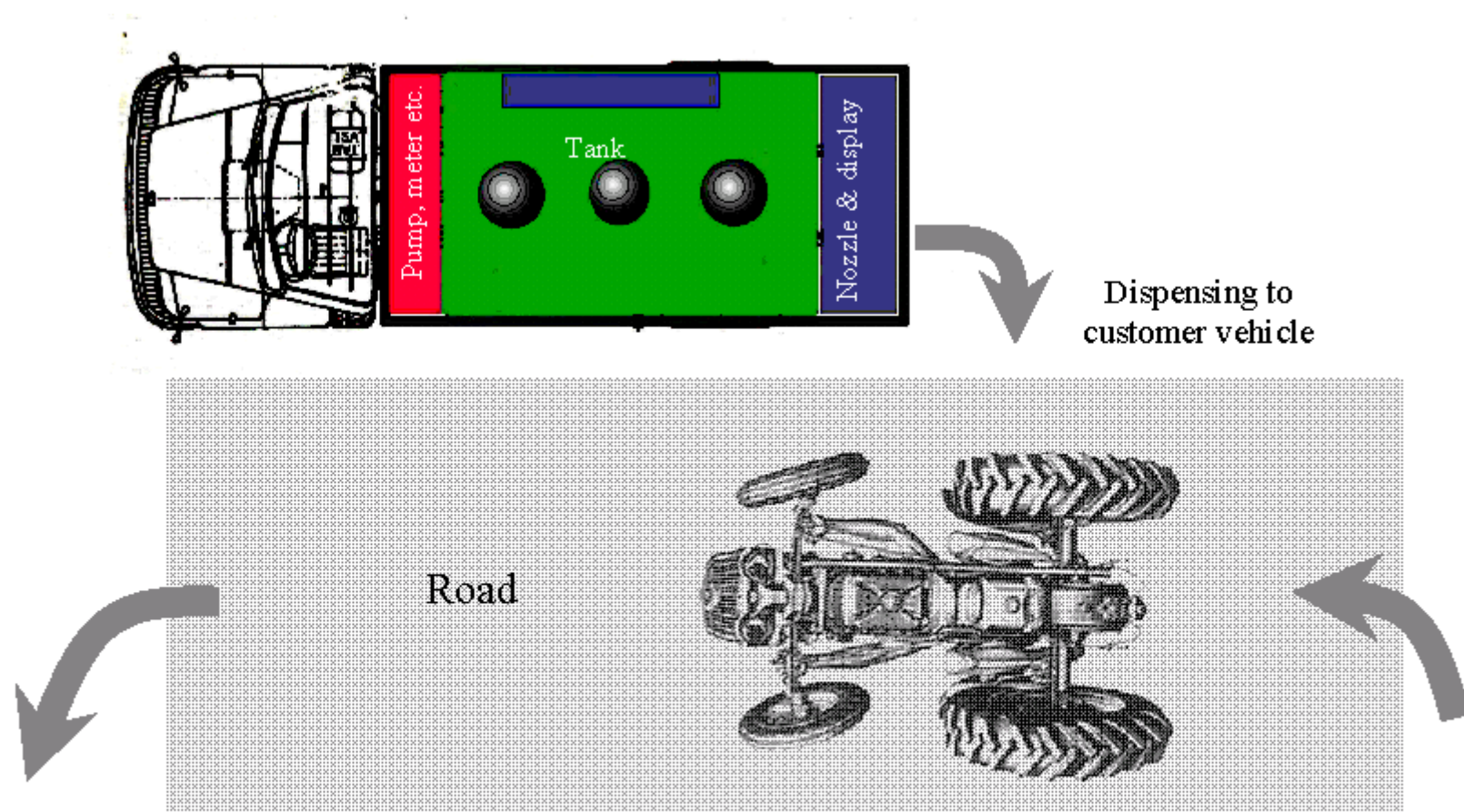
5.3 Position of the display nozzle and hose

After considering the possibilities for position of display and nozzle, the two main locations were considered in detail for final configuration.

First option is to provide display at the middle of the length of vehicle where there is good gap between the tanks side face and the minimum ground clearance necessary. The advantage is that when area has to be secured while dispensing, the half of the area at the back gets secured automatically due to the vehicle itself. Also a little distance more along the length is sufficient to secure it in that side. So overall half of the area of radius of 6 meters is only needs to be secured. The disadvantages are that it may be difficult to store a long hose and there is less flexibility when we consider the overall layout while the dispensing is happening.

The second option is to provide this arrangement at the back. Advantage is that there is a good possibility for different layout while dispensing the fuel. This is explained in the figures on next page (Fig. 5.4b and c). Also if the vehicle goes in to the remote place then there is good possibility going close to the vehicle even in narrow regions with reversing of vehicle.

Considering the all possible situations of operations of this vehicle, the second option of arranging nozzle and display at the back is good idea. Also an extension of hose with nozzle can be provided at the middle of the vehicle as an extra outlet.



Top view

Fig. 5.3a - Layout possibility 1

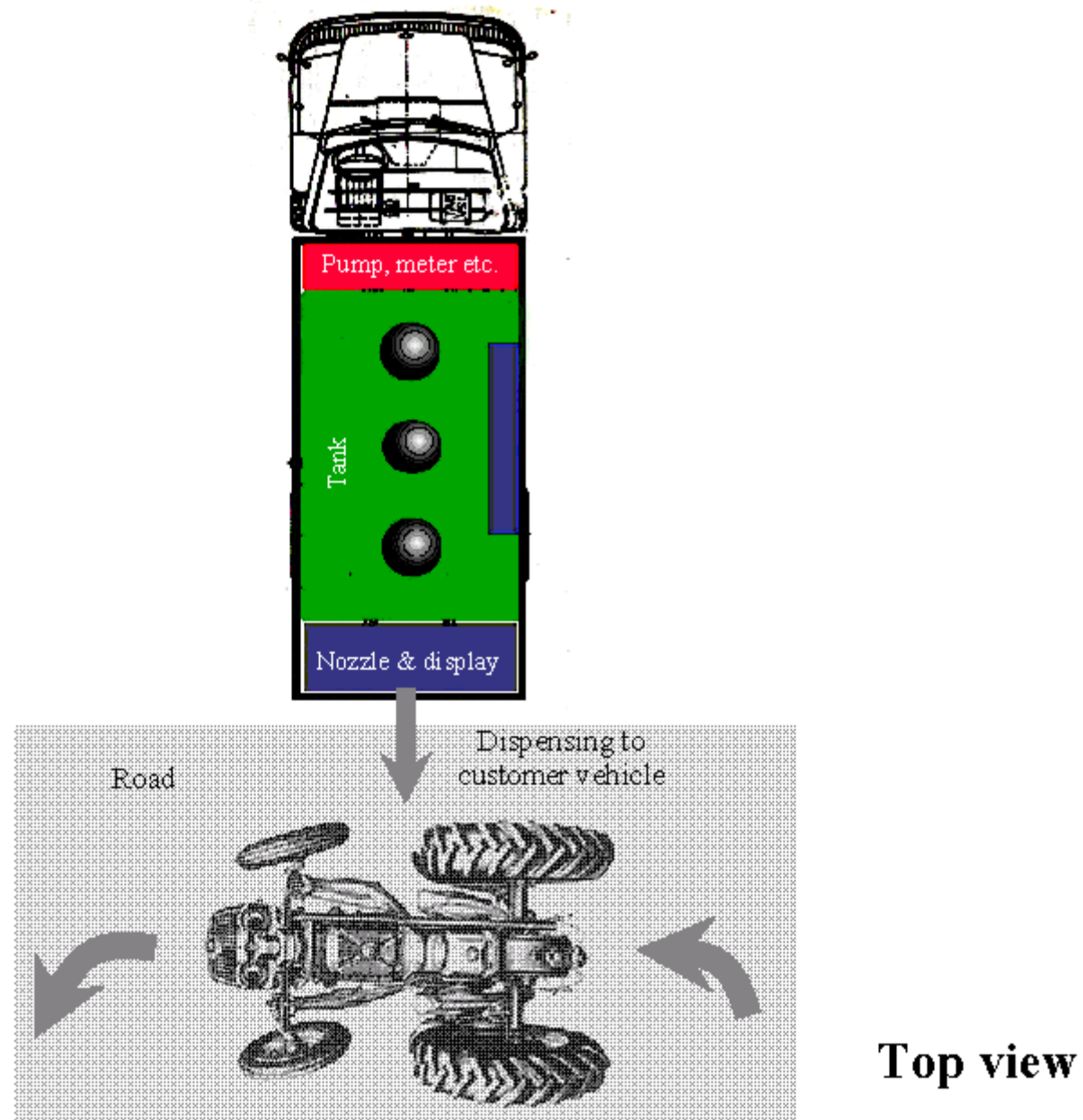


Fig. 5.3b - Layout possibility 2

CHAPTER 6

CONCEPT GENERATION



Fig. 6.1a



Fig. 6.2b



Fig. 6.3c



Fig. 6.4d



Fig. 6.5e



Fig. 6.6f

6.1 Product form

The form for this type of product is very important as it is first of its kind. As this will be new product in the market, it has semantic issues. Just any form may not suffice the actual requirement. In addition there is issue that whether to change the vehicle carrying tank needs to be changed or not. There is also a possibility that entirely new body along with tank can be designed on the same chassis. Few of the concepts in last chapter introduces to such possibilities. Semantically the classification can be as follows –

6.1.1 main identity of the product as service vehicle

As this product is designed primarily with focus to service rural areas, this has to be fit in that class of products. The different service vehicles such as ambulances, mobile banking vans, mobile restaurants etc. comes into this category. For the acceptance of product in the market mobile petrol dispenser have to project a new identity through form. some efforts are made in this direction as shown in fig.4.3a to 4.3c

Again the petrol tankers, oil tankers say loudly what they are. This product also belongs to this category. Somehow this product also has to say this through form.(Fig. 4.3d to 4.3f)

6.1.2 Identity as a petrol pump

Another important consideration is that mobile gasoline dispenser should create ambience of a petrol station. While giving its services, this product has to say that 'I am a petrol pump'. The biggest challenge probably is to integrate all these in same product.

6.2 Final Product form options

The brief gave the frame work for thinking. This defined the direction for ideation process. There are broadly two different categories made for generation of the ideas. These are explained as follows along with the various ideas.

Category one – open tank vehicles.

In this category the assumption was made that the chassis and cab of the vehicle and tank, its accessories are treated differently. That is for example, TATA SE 1613 C chassis come with inbuilt cabin. In this case, on same chassis the tank at the back is open and all accessories around it. The cabin form can be treated separately and modified if necessary. The very strong visual statement is there due to the open tank. This visually identifies the product in the category of petroleum carrying products. But there is less identity of gasoline pump, which is necessary. This can be improved by the new forms having the visual clues from the gasoline pump. Here also the visual identity of the vehicle is important. The vehicle should look strong and secured, as it is carrying a flammable fluid with it. The various ideas and explorations are shown in the figures. There are also concepts where the tanks are enclosed but the cab is separate from the tank body.(Fig. 4.4a)

Category two – enclosed tank vehicles.

The ideas in this category are integrated construction. The all vehicle has one unique form. These vehicles have the forms like the service vehicles like ambulances and mobile atms.

There is very good possibilities for form explorations in this category. Here the tank and accessories are totally enclosed by an outer form. (Fig.4.4b) There are only doors and opening at service points such as the dispensing outlet. Before generating ideas, a discussion was made with fabricator to understand his limitations. However the form may likely to change or may have a visual noise on later stage of development. These are the ideas only and needs to be developed properly considering all other factors involved.

Category three – hybrid vehicles

This type of vehicles is the combination of above two types. In this type of vehicles the part of the tank is disclosed. This can have a flat front like bus (Fig.4.4c and 4.4d) or it can be built like the figure 2 shown below.

The renderings on next pages show the various form options considered.

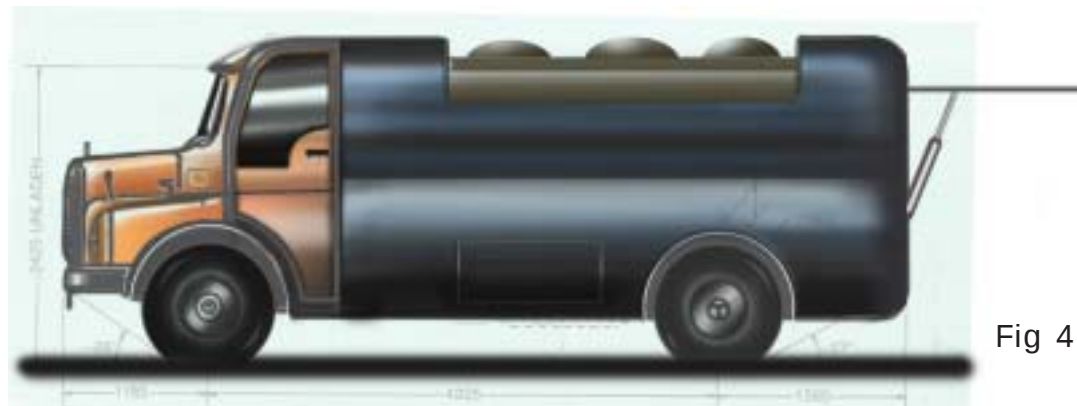
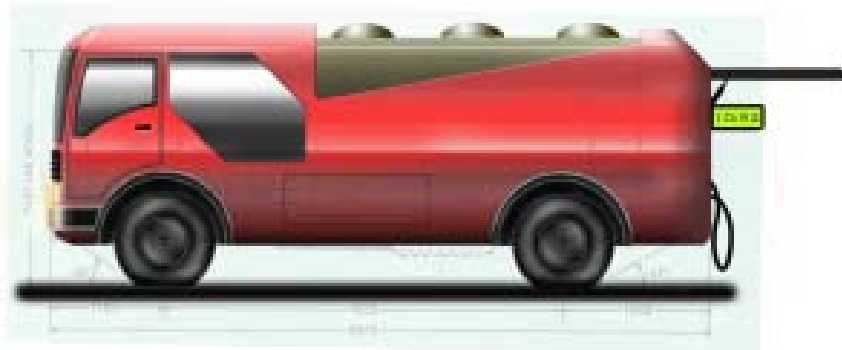


Fig 4.4d

Type 1 – subtle forms

The form options shown on these pages are originated from the bus type form. The main benefit of such form is the space available inside i.e. maximum volume. Besides the availability of vendors for body building of such forms is also abundant. The major play in terms of form is at the front portion of the structure. It can have different shapes with subtle and tight curves but not much strong. Also the color can play important role in this type of products. The cutout for the tank also can be experimented as shown in the following concept. The way tank is exposed has also makes a significant impact on product aesthetics. Also there can be enormous possibilities for creating interest in the form at the front portion of vehicle. The grill, mirrors, doors are few elements that can be treated for aesthetic treatment.



Type 2 – strong forms

These forms have a play over the whole body. There is change at every possible place. The surfaces have curves. The tank cutout for tank exposure also has different way of treatment. Every attempt is made to escape from the boxy look of the vehicle. The front is also treated with more dynamic curves. There also good flow of the curves over the body itself going along with the form of front portion. There graphics also provided to enhance the formal look of vehicle. Few of the concepts might look bulky at the back due to large surface covering the tank. This is taken care by providing a cutout on this surface or providing a graphics. This also creates interest and can be a aesthetic element. The doors are also treated differently.



CHAPTER 7

FINAL CONCEPT

7.1 The product description

The final product is designed with best possible safety features. The dispensing arrangement is provided at the back. As mentioned before, the hydraulics is located between the tank and the driver cabin. A separate compartment is provided for hydraulics. The frame containing all the hydraulics and motor is provided with high quality anti-vibration pads. Because of anti-vibration pads the accuracy of the meter is preserved. Fire extinguishers are provided at the left side of hydraulics' compartment. The rack for maintenance tools is provided at the right side of the hydraulics compartment. At the top of hydraulics compartment, racks for lubricant oils and other consumables are provided. Access to all this is provided from the driver cabin. A fire extinguisher is also provided at the back near nozzle. The two nozzles are provided for dispensing. The nozzle is provided with hose retrieval mechanism. The lighting is provided inside the canopy. All the lighting is flameproof. The hoses are also connected by break-away coupling. The canopy over the interface is hydraulically operated. The displays are EMD type. The display box can turn 90 degrees so that any convenient display positions can be adopted. The display height as well as the nozzle height is according to standard ergonomic norms. The operations will be carried by two persons. The motors and electronics are powered by genset.

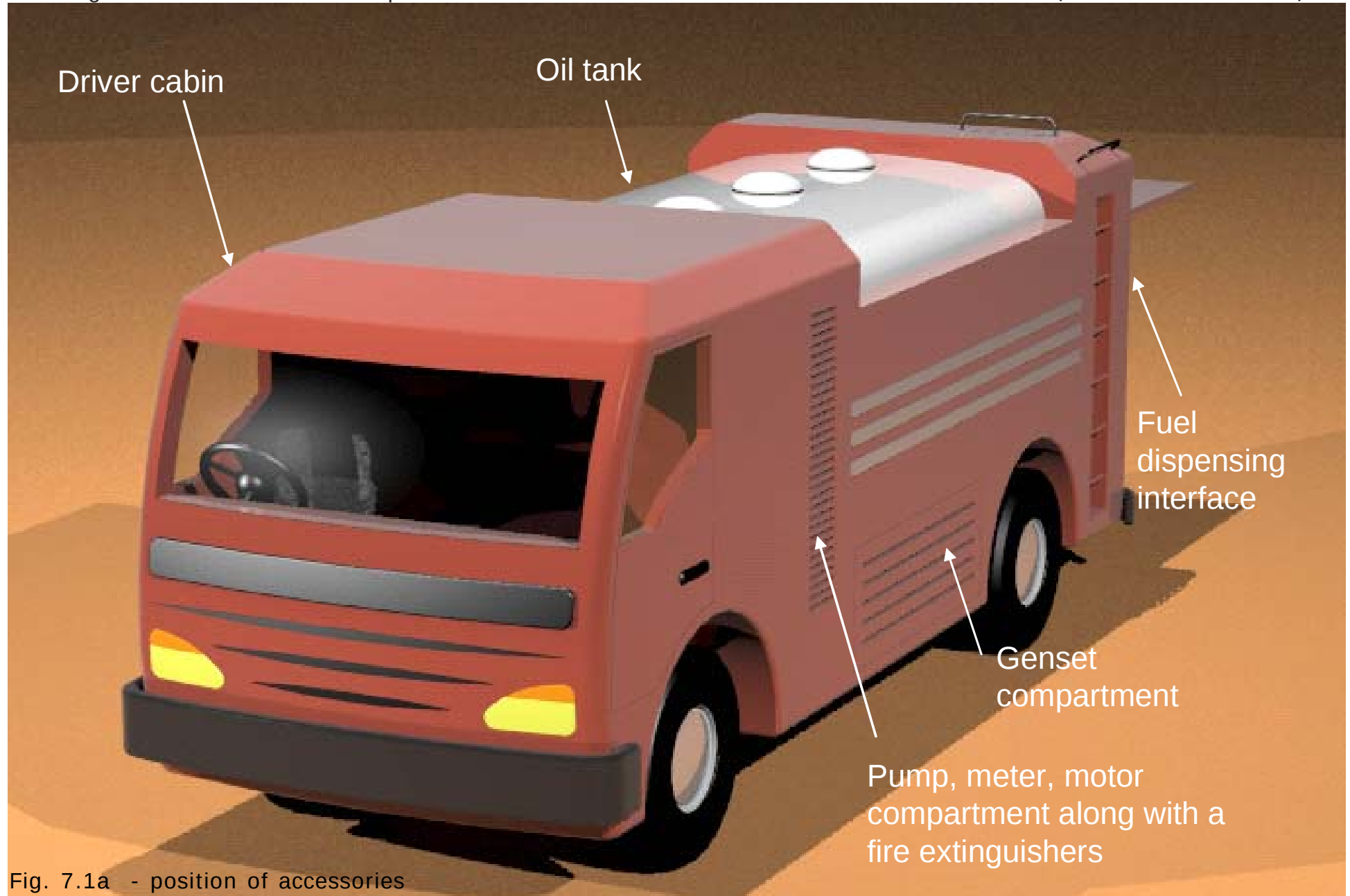


Fig. 7.1a - position of accessories

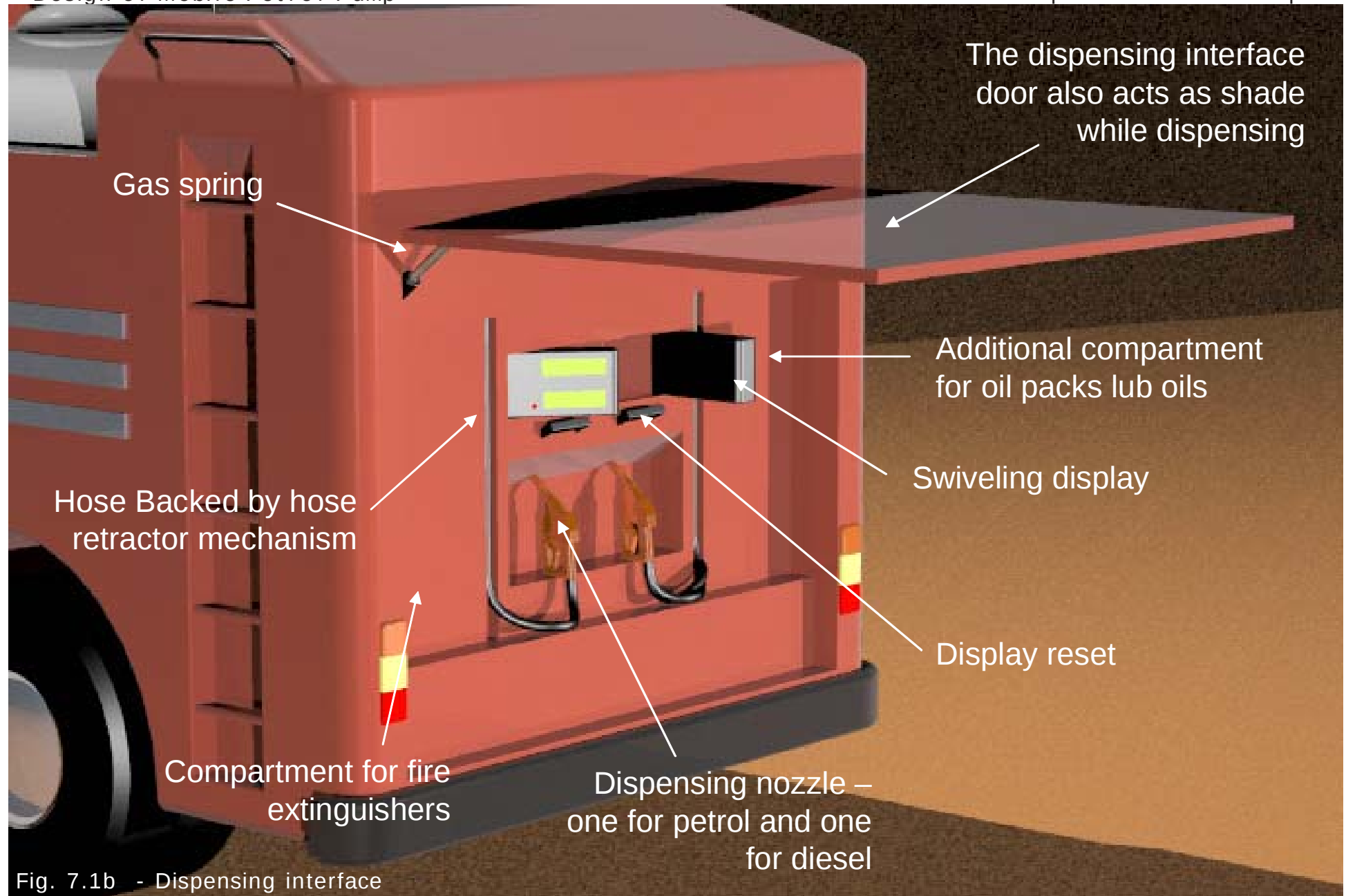


Fig. 7.1b - Dispensing interface

7.2 product features

Following are the product features.

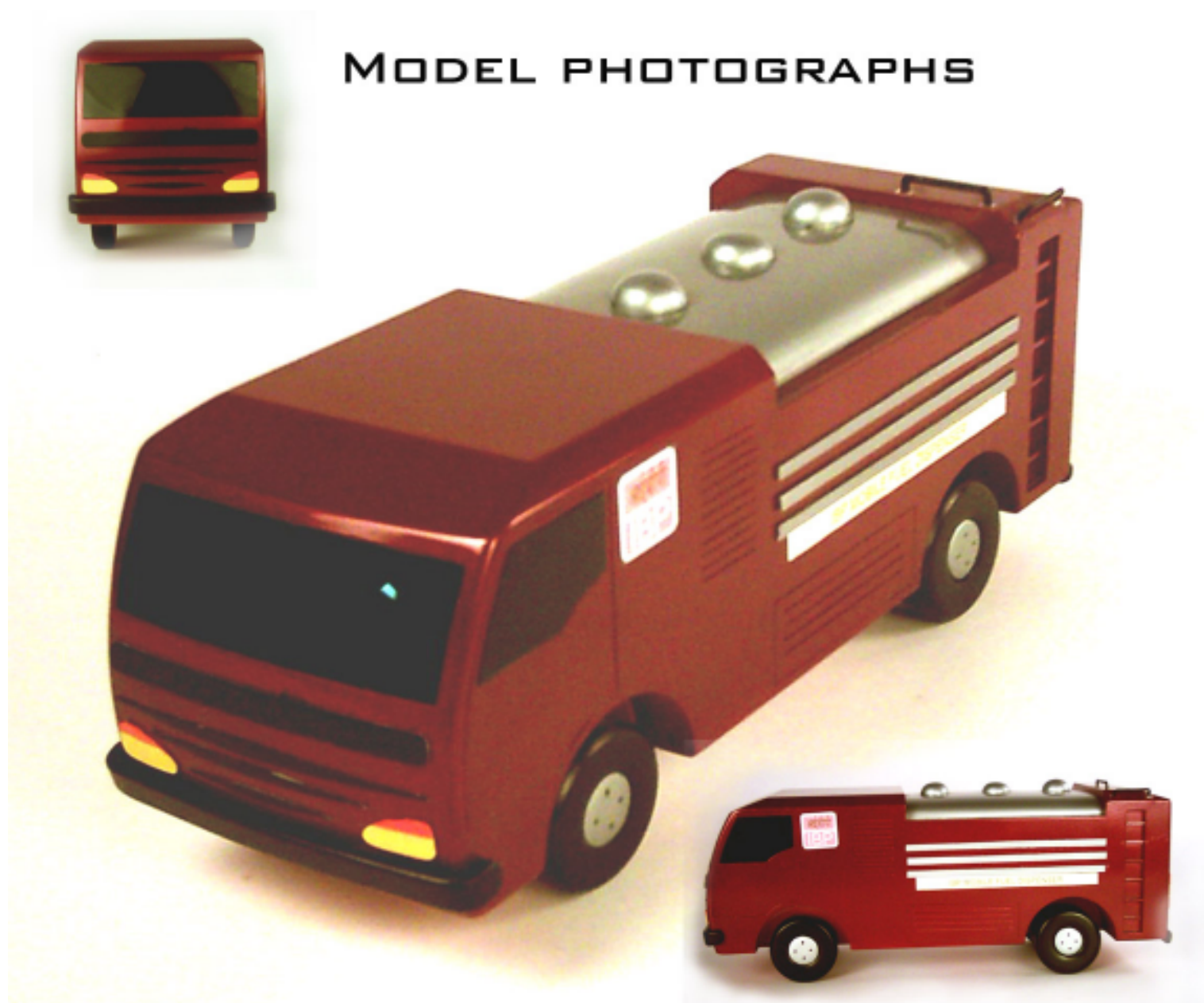
- Duel dispensing, gasoline as well as diesel.
- Easy of maintenance. Access is provided through driver cabin to hydraulics.
- Carefully designed user interface with ergonomic standards.
- Dispensing interface at the back facilitates flexibility in dispensing operation and layout.
- Rugged chassis suitable for village roads.
- Independent identity of the vehicle as a service vehicle, through new form.
- Arrangement is also provided for selling of consumables such as lubricant oils.

7.3 The final form

The main advantage of this type of form is the cost of the product. Each vehicle is separately built over the chassis, so complicated forms normally become expensive due to the workmanship involved. However attempt is made to create a new identity through partial exposure of the oil tank. Also graphics also can enhance the form. This option also has other aesthetic elements such as the aluminum buffers running over the vehicle sides. The form is such that it is neither like a box nor like a complicated organic form. This form of the mobile dispenser predominantly uses curves to create a new identity for this type of vehicle. A large bumper is used to use to give the strong look to the vehicle. The canopy also has a large width to maintain the identity of the gasoline station. This width can be used for the graphics of Oil Company.



Fig. 7.3a - Final product form



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ANNEXURE