केवल कार्यालयीन उपयोग हेतु
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भारत सरकार **GOVERNMENT OF INDIA**
रेल मंत्रालय MINISTRY OF RAILWAYS

Handbook on General Maintenance Schedule for OHE Tower Wagon Mark-III

CAMTECH/2002/E/TW/1.0

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Centre for Advanced Maintenance TECHnology

उच्च अनुरक्षण प्रौद्योगिकी केन्द्र

Execellence in Maintenance

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FOREWORD

Indian Railways uses large number of Tower wagons for maintenance of overhead equipment in electrified section. The proper maintenance of tower wagon is vital to ensure its availability and reliability.

CAMTECH has prepared this hand book to cover all essential aspects of tower wagon maintenance.

This handbook describes various maintenance schedules, trouble shooting instructions and do's and don'ts. It also covers operating and maintenance instructions for OHE car driver.

I am sure the book will prove to be very useful to our field personnel to carry out their work more effectively and efficiently.

CAMTECH, GWALIOR ***M.L.GUPTA***
DATE: 17.01.02 ***EXECUTIVE DIRECTOR***

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PREFACE

Tower Wagon is an important vehicle for regular inspection and attending breakdown of O.H.E. Therefore proper maintenance of tower wagon is necessary to ensure the reliability and availability of tower wagon in emergency and for regular maintenance of OHE. This handbook on "Maintenance of Tower Wagon" has been prepared by CAMTECH with the objective of making our maintenance personnel aware to correct maintenance and maintenance techniques adopted in field

It is clarified that this handbook does not supersede any provisions laid down by RDSO or Railway Board.

I am sincerely thankful to Director(TI)/RDSO/LKO for his valuable suggestions and comments. I am also thankful to all field personnel who helped us in preparing this handbook.

Technological upgradation and learning is a continuous process. Hence feel free to write to us for any addition/ modification in this handbook. We shall highly appreciate your contribution in this direction.

CAMTECH, GWALIOR ***RANDHAWA SUHAG***
DATE: 17.01.02 ***DIRECTOR/ELECT***

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ISSUE OF CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows:

CAMTECH/2001/E/CL/TW # XX date----------

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

Sr. No.	Date of issue	Page no. and Item no. modified	Remarks

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CHAPTER 1

INTRODUCTION

Tower wagon has a key role in the maintenance of OHE and for attending of breakdown, restoration of damaged OHE equipment and erection of small length catenary and contact wires. It is also used for inspection, patrolling and maintenance of overhead equipment. The satisfactory up keep of tower wagon is therefore of utmost importance. It is the direct responsibility of tower wagon incharge to ensure that the tower wagon is maintained satisfactorily and is available always for attending OHE maintenance and for use in the event of OHE breakdown. This handbook deals with details of schedule maintenance to be carried out by OHE depots.

POH facilities are not available in OHE depots and therefore POH of complete tower wagon including engine, running gear arrangement, brake rigging, wheel and axle, roller bearing, pneumatic valves, lifting and swiveling platform, hydraulic transmission, axle drive, bogie, electrical equipment and all under frame equipment shall be carried out at an interval of three years in an EMU shop/ Electric Loco shed/ Electric Loco workshop as decided by CEE. This handbook does not include details of work to be carried during POH of tower wagon in EMU shop/Electric Loco shed/Electric

Loco workshop. Similarly work to be carried out by TXR during monthly examination is not included in this handbook as this handbook is intended for the staff of OHE depots only.

1.1 BODY STRUCTURE

The body of the tower wagon is built up by iron sheets supported on the large frame work erected on the under frame.

Tower wagon's inside is divided into two driving cabs with seating arrangement for driver and supervisor and central portion. The central portion is having various racks and pigeon holes on one side and lattice enclosure on the other side. A space is left at the centre for the staff to work.

All the enclosures are used for preserving the materials and tools for attending OHE maintenance and breakdowns.

The roof of the tower wagon is mounted with iron corrugated sheet and strengthen for staff to work on the top. It is also mounted with lifting and swiveling platform at one end while the other end is having pantograph.

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CHAPTER 2

LIFTING AND SWIVELING PLATFORM AND PANTOGRAPH

Lifting and swiveling platform measuring with in the permissible limits is mounted on the one end of the roof for raising its height and rotating it by 360°. The arrangement is such that when the maintenance staff has to work near the structure , the platform can be rotated so that it reaches the structure and facilitates the working of the staff. Similarly height of the plat- form can be adjusted to suit the working spot on overhead equipment. This has got the chain pulley and gear system and having its operating arrangement on the top by means of a handle.

The platform is surrounded from all the three sides (other than panto side) with collapsible railing of pipe. These railings can be lifted up as and when the staff works on the roof otherwise these are normally kept lowered on the platform and thus the moving dimensions are maintained.

2.1 PANTO GRAPH

Pantograph is similar to that used for AC loco but having spring control only.

The required pressure of panto is adjusted by means of control springs at the bottom. It is mounted on the centre line along the roof of the tower wagon at the other end. The height of the panto is adjusted suitably to meet the requirement of overhead equipment

On panto pan the marking of stagger is done. Similarly the height gauge is also fitted to the pantograph. This facilitates recording of the stagger and height of the contact wire respectively.

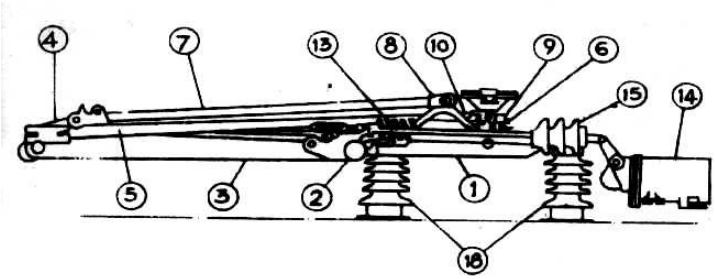

FIGURE 2.1 PANTOGRAPH LOWERED CONDITION

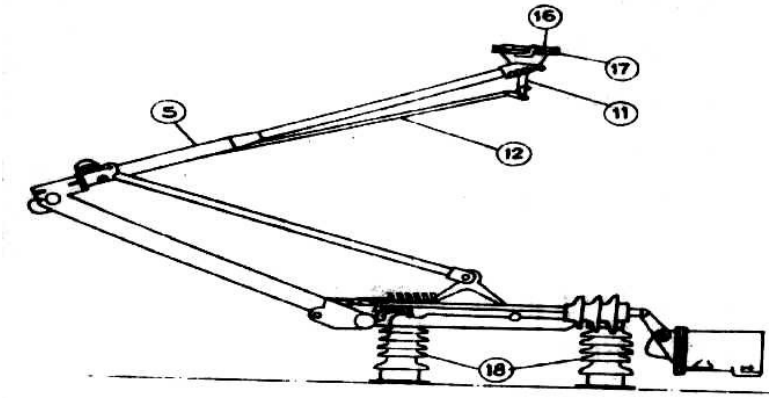

FIGURE 2.2 PANTOGRAPH RAISED CONDITION

Details of figure 2.1 and 2.2

S.	Details	S.	Details
1.	Base	10.	Joint of upper tube
2.	Horizontal Spindle	11.	Spring Box
3.	Lower Arm	12.	Positioning Link
4.	Yoke	13.	Lifting Spring
5.	Tube	14.	Servo Motor
6.	Upper Tube	15.	Tie rod insulator horn
7.	Thrust Rod	16.	Collector
8.	Pivot point	17.	Insulated Horn
9.	Transverse Tube	18.	Support Insulator

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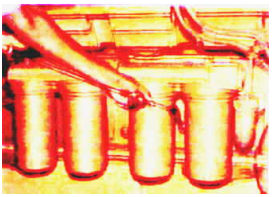
CHAPTER 3

MAINTENANCE OF ENGINE

3.1 'A' CHECK EVERY DAY

S. No	Maintenance Steps	Remarks
1.	Check previous day's engine log book.	Correct as required.
2.	Drain water and sediment from fuel filter through drain cock.	Before starting the engine.
3.	Check engine oil level and top up if necessary.	 dip stick when engine is stopped and has stood for 20 minutes or more (must be measured after all oil is drained back into oil pan).

S. No	Maintenance Steps	Remarks
4.	Check for fuel, oil, water and exhaust leaks.	Correct if leaking.
5.	Fill radiator/surge tank with treated water (chromate concentration 3500 PPM)	Radiator cap must be firmly tightened back into the radiator/surge tank neck. Engine must not be operated without the aeration and overheating of the coolant. Check engine radiator water level.
6.	Check air cleaner oil level and change oil, if required (If oil bath type). Clean dustpan and pre- cleaner of dry type air cleaner.	Use clean engine oil.
7.	Check air line connections for leaks.	Correct as required.
8.	Remove and clean air compressor breather, if equipped.	Fill with clean oil upto the mark.
9.	Drain air receiver tank at the beginning of every day and then close the drain cock.	

S. No	Maintenance Steps	Remarks
10.	Clean crankcase breather.	Discard paper type element if clogged.
11.	Check oil level in hydraulic governor, if provided	Check for leaks. Use engine oil for topping up (as shown in fig. 3.1)

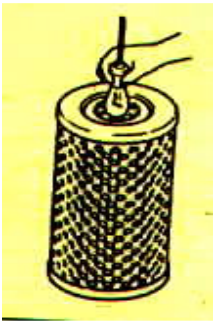
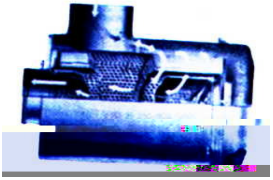
FIGURE 3.1 CHECKING OF OIL LEVEL

S. No	Maintenance Steps	Remarks
12.	Start the engine and note the oil pressure both at idling and maximum speed.	If there is a change in oil pressure from that recorded in the log book on earlier occasion then stop engine and check through trouble shooting technique the cause for oil pressure change and correct if necessary (for assistance in diagnosing the change in oil pressure call your service representative if necessary.

S. No	Maintenance Steps	Remarks
13.	Record oil pressure.	Refer operation and maintenance manual for lub oil pressure limits.
14.	Fill fuel tank at the end of the day.	Use clean fuel and a strainer. Also clean the cap and surrounding area before opening the filler cap. Fill fuel at end of the day allowing diesel to settle. Drain sediment from fuel filter water separator bowl.

3.2 'B' CHECK EVERY 300 HOURS or 6 MONTHS WHICH EVER IS EARLIER

S. No	Maintenance Steps	Remarks
1.	Repeat all maintenance steps of 'A'check	--
2.	Change engine oil.	When lub oil is examined through lub oil analysis in a laboratory, oil change period may be extended. In such cases, refer to your service representative.
3.	Fit new lubricating oil full flow filter element.	Inspect the changed filter element and check for metal particles and oil sludging/oxidation.

S. No	Maintenance Steps	Remarks
4.	Remove, clean and inspect dry type air cleaner element. Remove and clean dustpan. Inspect element for holes and tears. Check gaskets and 'O' rings for damage.  FIG. 3.3 ELEMENT CHECKING WITH ELECTRIC	 FIG. 3.2 AIR CLEANER Blow out dust with compressed air in the opposite direction of the normal air flow. If very dirty , wash in solution of warm water. (48.9°C-60°C) and non sludging detergent. Allow it to dry first then use compressed air. Replace if washed two times. Caution : Excess air pressure will damage paper. Air nozzle must be kept at least 8" from the element. Must not be used if even one pin hole exists. Discard element if punctured and also change gasket along with element.
5.	Clean oil bath air cleaner tray screen.	-----

S. No	Maintenance Steps	Remarks
6.	Change lubricating oil by-pass filter element and gasket if provided.	Record oil pressure
7.	Clean float tank and/or main fuel tank breather.	-----
8.	Check coolant PH value/concentration of DCA/chromate concentration (3500 PPM).	Change corrosion resistor element if PH calue is below normal range 8.5 – 10.5. Check chromate concentration at 3500 PPM.
9.	Check magnesium plate in assembly corrosion resistor. Change water filter element.	Check magnesium plate for pitting or being eaten away. Change if more than 50% of area is lost. Use DCA service element or chromate element bags AR 95679 if concentration is low.
10.	Change fuel filter element washer and 'O' ring on mounting bolt.	Clean shell fuel filter. Change element when restriction exceeds vacuum 20.32cm of mercury.
11.	Check oil in aneroid control, If equipped.	Use same oil as used in oil pan.

S. No	Maintenance Steps	Remarks
12.	Check and adjust belts. New belts will stretch within one hour of use. They must be readjusted.	Tighten belt tension (use ST – 1293)  FIG. 3.4 CHECK BELT TENSION
13.	Tighten foundation bolts and flexible coupling bolts of engine and alternator.	-----
14.	Check all air cleaner connections for cracks-chafing etc. Tighten all air intake connections.	Correct as required.
15.	Check fan hub and drive.	Use special tool no. ST 845 or ST 893 for tightening the fan hub nut.
16.	Clean/change air compressor breather element.	Change element for naturally aspirated engine. Clean screen for turbo engine.
17.	Check throttle linkage.	-----

3.3 'C' CHECK EVERY 1500 HOURS or 1 YEAR WHICH EVER IS EARLIER

S. No	Maintenance Steps	Remarks
1.	Repeat all maintenance steps of checks 'A' & 'B'.	----
2.	Check thermostat operation.	It should start opening and open fully within range 73.9°C and 79.5°C or 76.6°C and 85° C. Discard and fit new thermostat if operation is not satisfactory.
3.	Check fan hub and drive.	Check mounting bolts and bearing end play.
4.	Check impeller water pump for play.	Correct if necessary.
5.	Check for turbocharger oil leaks.	Correct as required.
6.	Tighten turbocharger mounting nuts.	Tighten to the specified torque. Do not tighten when engine is hot.
7.	Check inlet air restriction.	Check after cleaning dry type air cleaner element . If restriction in excess of 63.5cm water, a new element must be fitted.
8.	Clean oil bath air cleaner.	Remove complete assembly and clean inclusive of fixed screens.

S. No	Maintenance Steps	Remarks
9.	Clean and tighten all electrical connections.	-----
10.	Check generator brushes and commutators.	Replace and clean as required.
11.	Clean entire engine.	High pressure and soap water mixture preferred after spraying engine with cleanser taking care of protecting electrical system.
12.	Tighten all mounting bolts and nuts.	Tighten as required. Over tightening may result in distortion or damage.
13.	Clean aneroid air breather.	Replace breather if necessary.
14.	Check engine blowby.	Readings in excess of recommended limits. Corrective action must be taken through analysis with the help of trouble shooting chart.
15.	Clean radiator.	Blow air through the radiator core in opposite direction to the normal flow of air, if working under dusty/dirty condition.(Reverse flushing operation)

S. No	Maintenance Steps	Remarks
16.	Check air compressor	Check shaft and clearance.
17.	Adjust injectors and valves. 	Clean fuel inlet connection screens. Final adjustments must be carried out with engine hot and with correct torque as specified (Refer O & M manual).
18.	Change hydraulic governor oil/aneroid oil.	Use engine lubricating oil.
19.	Check vibration damper.	Check wobble and eccentricity/alignment marks on rubber type. Discard damper if misalignment is more than 0 .16 cm.

3.4 'D' CHECK EVERY 6000 HOURS or 2 YEARS WHICH EVER IS EARLIER

S. No	Maintenance Steps	Remarks
1.	Repeat all maintenance steps of checks 'A', 'B' & 'C'.	--
2.	Check exhaust and inlet manifold nuts and capscrews.	--
3.	Tighten all mounting bolts and nuts.	--
4.	Clean turbocharger diffuser and impeller and check end float.	--
5.	Check turbocharger bearing clearances.	Only end float on semi floating bearing if in excess of limits, replace it.
6.	Check crankshaft end float.	If in excess of recommended limits, corrective action is indicated.
7.	Clean injector inlet screens	Must be done only if a performance deterioration is evident. Some of the indications for performance deterioration are. 1. Black smoke.

S. No	Maintenance Steps	Remarks
		2. Change in fuel manifold pressure. 3. Loss of power. 4. Malfunction of aneroid. 5. Clean and calibrate all injectors. 6. Check fuel pump calibration. 7. Replace aneroid bellows and calibrate
8.	Replace fuel pump filter screen and magnet.	--
9.	Steam clean engine.	If steam is not available, then use clean soap water solution as outlined in 'C' check item – 11.

3.5 'E' CHECK -

Overhauling Of Engine After Two 'D' Check

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CHAPTER 4

TRANSMISSION

The transmission and control equipment were supplied by two firms viz. M/s Kirloskar Pneumatic Co. Ltd., Pune and M/s Venkateswara transmission private Ltd. (VENTRA) Hyderabad. Hydraulic transmission offered by M/S KPC is of their own design and that of M/s Ventra is of Hindustan Motors. However five numbers 4 wheeler tower wagons were provided with Voith transmission system.

A common power pack is used for both the two designs. A Kirloskar Cummins Ltd. model N-743-L naturally aspirated diesel engine developing 210 horsepower at 2100 rpm has been used. The transmission of both powers from diesel engine to wheels is by means of hydrodynamic system incorporating torque converter and gears.

The final power transmission in both designs is through carden shaft and axle drives. In the KPC design the transmission output is directly connected to the axle drive on the rear axle by means of a long cardan shaft using axle drives of two different overall gear ratios. This transmission also incorporates reversing arrangements with the use of plate clutch unit.

In the VENTRA design the transmission output is connected to the axle drive through an intermediate gearbox of a differential gear unit and a hydrodynamic torque converter incorporating speed change provision. The final drive from diesel engine is through a slip- clutch assembly properly aligned with in the engine fly-- wheel housing.

4.1 MAINTENANCE OF VOITH HYDRAULIC TRANSMISSION

4.1.1 Maintenance Schedules

Maintenance interval	Work to be performed
20,000 km	Check oil level
300,000 km	Oil change, inspection of control parts, replacement of filter, replacement of disposable filter.
900,000 km	Major overhaul

4.1.1.1 Maintenance after 20,000 km

Check the oil level.

4.1.1.2 Maintenance after 300,000 km

a) Oil change

Under normal operating conditions, the oil filling lasts for a distance of approx.. 300,000km . This period can be extended if the oil sample is still with in the tolerance of the specification for new oil.

For changing the oil, drain it from valve while it is at operating temperature and drain the oil cooler too. If oil of a different approved brand is to be filled in, flush the transmission and cooling system with half the quantity of the new oil needed for a complete fill.

b) Replace all filters. For this purpose, drain off the oil first, then remove the filters, take off the caps and remove filter elements.

c) Check control parts such as governor, standstill detector valve, operating cylinder, and main control valve for proper operation, leakage and wear.

4.1.1.3 Major Overhaul

A major over haul of the transmission is recommended after approx. 900,000 km of operation, depending on operating conditions and duty. During this over haul, the transmission is stripped as far as necessary. Bearing labyrinth rings, shaft seats etc. are inspected and damaged parts are replaced.

4.2 MAINTENANCE OF HINDUSTAN MOTOR HYDRAULIC TRANSMISSION

4.2.1 Control Linkage

Check the transmission shift control linkage and the directional linkage to ensure that the linkages are free and that the selector levers are properly positioned. The Shift levers should engage in all shift tower positions freely. Inspect the linkages for binding, wear, cracks, breaks or defective cotter pins.

4.2.2 Cold Oil Level Check

The cold check (engine not running) is made to determine if there is sufficient oil to safely start the engine - especially if the vehicle has been idle. The oil level should be at or near the full-level check plug. Some transmissions have one plug, others have two plugs, an ADD and a FULL plug.

4.2.3 Hot Level Check

Oil level must be checked with the engine running at 1000 rpm, transmission in neutral and with the transmission at normal operating temperature (82.3°C - 93.4°C). The upper check plug (if there are two plugs) indicates the full oil level while the lower plug is the add level. The oil must be maintained at the FULL level. If there is only one check plug, the oil level must be maintained at this level. Add oil if necessary to bring the level to the FULL mark.

4.2.4 Oil, Filter Change

The oil should be changed every 1000 hours of operation or sooner, depending upon operating conditions. Also, the oil must be changed whenever there are traces of dirt or evidence of high temperature indicated by discoloration or strong odor. The filter screen in the sump should be removed and cleaned with mineral spirits at each oil change.

The filter elements should be replaced at each oil change and at 200 hour intervals between oil changes.

The filter shells should be cleaned. New gaskets and seal rings must be used when replacing filter elements. After installation, check the filter for oil leakage while the vehicle engine is running.

4.2.5 Keeping oil clean

It is absolutely necessary that the oil put in the transmission be clean. Oil must be handled in clean containers, filler etc., to prevent foreign material from entering the system.

4.2.6 Filling Transmission

At temperature above -23.3°C, pour hydraulic transmission fluid type C-2 into filler opening. At temperature below -23.3°C, an auxiliary preheat is required to raise the temperature in the sump. Use only C-2 fluids from approved manufacturers.

4.2.7 Care of Breather

The breather should be kept clean at all times. It should be checked and cleaned regularly and as frequently as necessary, depending upon the operating conditions. A badly corroded or plugged breather restricts proper breathing, causing oil leaks.

4.2.8 Control Linkage Adjustment

Manual shift linkage must be adjusted so that the operator's control is positioned to exactly match the detent position of the selector valve on the transmission. Adjust the linkage so that it can be freely connected without moving either the valve or the operator's control.

Then operate the range selector lever, the directional selector lever and the output disconnect (if applicable) through each position. Make minor adjustments, if necessary, to insure that each of the selector levers seats in each position of the operator's control. Then inspect the control linkage for binding wear or breaks.

4.3 TROUBLE SHOOTING OF HM HYDRAULIC TRANSMISSION

Causes	Remedy
A. LOW CLUTCH APPLY PRESSURE	
1. Low oil level	Add oil to correct level
2. Clogged oil strainer	Clean strainer
3. Clogged oil filter	Replace filter element
4. Inching control adjustment not fully retracted	Check, adjust linkage
5. Air leak at intake side of oil pump	Check pump mounting bolts.
6. External oil leakage	Tighten bolts or replace gaskets
7. Brake hydraulic (or air) pressure applying clutch cutoff valve	Check brake residual pressure (brakes released); check brakes for full release.
8. Internal failure	Overhaul transmission, or repair subassembly
B. OVERHEATING	
1. High oil	Restore proper oil level
2. Clutch failed	Rebuild transmission

Causes	Remedy
3. Vehicle overloaded	Reduce load
4. Low clutch apply pressure	Refer to A.
5. Engine water overheated	Correct engine overheating
6. Cooler oil water line kinked or clogged	Clean or replace line
C. AERATED (foaming) OIL	
1. Incorrect type oil used	Change oil; use proper type
2. High oil level	Restore proper oil level
3. Low oil level	Restore proper oil level
4. Air entering suction side of oil pump	Check oil pump bolts and gasket
5. Air entering at clutch cutoff valve (air actuated)	Check plug seal and seal ring of valve.
D. VEHICLE WILL NOT TRAVEL	
1. Low clutch apply pressure	Refer at A
2. Selector linkage broken or disconnected	Repair or connect linkage
3. Internal mechanical failure	Overhaul transmission
E. VEHICLE TRAVELS IN NEUTRAL WHEN ENGINE IS ACCELERATED	
1. Selector linkage out of adjustment	Adjust linkage
2. Clutch failed (won't release)	Overhaul transmission

Causes	Remedy
F. VEHICLE LACKS POWER AND ACCELERATION AT LOW SPEED	
1. Low clutch apply pressure	Refer to A
2. Low converter out pressure	Refer to A
3. Engine malfunction	Check engine; refer to engine service manual
4. Aerated oil	Refer to C
G. CLUTCH CUTOFF VALVE INEFFECTIVE	
1. Valve or plug sticking	Rebuild control valve body assembly
2. Brake apply hydraulic pressure incorrect	Check pressure at control valve (min-max limit - 9.15 kg/cm^2 -140.7 kg/cm^2)
3. Brake apply air pressure not reaching air cylinder	Check air cylinder (15.85 kg force required to stroke valve)
4. Plunger sticking in air cylinder	Check operation of air cylinder
5. Air entering at valve (air actuated)	Check operation of air cylinder (seals)

4.4 MAINTENANCE OF VENTRA DROP GEAR BOX

General

Ventra drop gearbox is a single --stage gearbox, all the bearing and gear s are adequately rated to give a longer life. This gearbox transmits the power from converter/ transmission to the rear axle drive gearbox through carden shaft of adequate design.

Description

The input flange is key mounted on the input pinion shaft, which runs on the spherical roller bearings. The input pinion is meshed with out put gear, which is key mounted on the out put shaft. The out put flange is key mounted on out put shaft. The out put shaft runs on spherical roller bearings. The gears and bearing are lubricated through pipe by means of a Hypo pump mounted on the output shaft. Oil seals are provided at input and out put end to prevent the oil oozing through the end covers

Maintenance

1. Daily oil level to be checked through the level plug /indicator, if necessary, top up the oil.

2. Daily check the oil leakage through input, out put oil seals, through the end cover s and through housing joints etc. if so, rectify the oil leakage by changing the new oil seals or by tightening the respective bolts and nuts.

3. Once in a week take out the magnetic drain plug from the gear boxes and check for any wear out particles or debris, if heavier particles found, the gear box has to be opened and checked.

4. For the new gears, first oil changing period is one month Then once in three months, the specified oil to be changed

   Note-- Before changing the equivalent oil, clean the gearbox with kerosene or diesel. Then pour the equivalent oil and drain out 1/2 to 1 litre of the same oil through the drain plug. Then put the oil little above the level plug / indicator

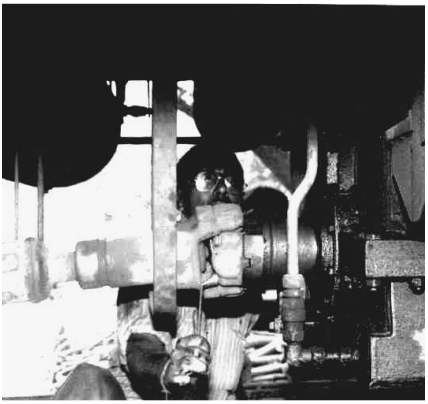
5. Breather must be cleaned thoroughly once in three months.

4.5 VENTRA AXLE DRIVE MAINTENANCE SCHEDULE

The final drive to the tower wagon is affected by the axle mounted right angle drive gear box. The input and intermediate shaft run spherical roller bearing. The axle also run on spherical roller bearing the gear box housings have been provided with oil pockets and gears and bearings get abundant lubrication. The bottom housing serves as the oil sump. Level, drain plug and inspection door have been provided for regular maintenance.

1. Daily oil level to be checked through the level plug and if necessary top up with the same oil (please refer oil chart for quantity/grade).

2. Check for oil leakage through oil seals and housing joints. Seal are to be replaces or housings are to be tightened according to the prescribed tightened torque, if necessary.



3. Once in a fortnightly take out the magnetic drain plug from the gear box and check for any wear particles or debris; if heavier particles are found the gear box has to be inspected by opening the cover at the top.

Note For Changing Oil

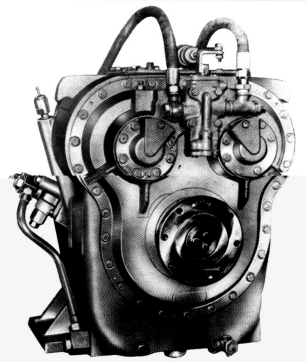
For a new gear box, first oil change shall be done after one month. During changing, clean the gear box with kerosene or diesel after draining out the sump. Pour the recommended/equivalent oil and drain out 1/2 to 1 litre oil again. Close the drain. Fill the sump with specified quality.

Period of changing oil - every three months.

4.6 MAINTENANCE OF KPC HYDRAULIC TRANSMISSION

4.6.1 Maintenance

4.6.1.1 Hydraulic system



a. The oil capacity of transmission is 20 litres.

b. Oil level should be checked daily through the oil level gauge in transmission. Oil level should be checked at idling engine speed, it should be between high & low marks.

c. Oil must be changed after 1000 Hrs. of operation.

d. Drain valve is provided for draining the oil without loss. Connect hose to the drain valve and then open the valve.

e. Fill the oil in transmission through breather cap hole. Run the engine and check the oil level. Replace the breather cap or alternatively, remove plug provided on cover top & fill oil. Refit plug after oil filling.

f. Replace filter element as per recommendations. Remove the filter cover and replace filter element. Use new gasket, if necessary, for the filter cover.

g. Suction strainer: Unscrew plug on top of strainer housing for strainer removal. Clean strainer throughly by flushing in clean diesel oil. All foreign particles must be removed from the strainer before refitting it. Ensure air tightness after replacing plug on housing strainer. Thread sealing compound may be used to avoid leakage of air in to the circuit.

h. Remove the breather assembly every 1000 Hrs. of operation. Flush the oil breather assembly.

4.6.1.2 Inspection - Daily

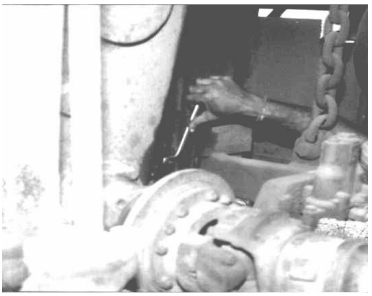
a. Check oil level. Add if necessary.

b. Check all pipelines, end connections for leakages. Replace damaged parts to stop leakages.

c. Check all pressure/ temperature gauges for proper functioning. Replace damaged gauge immediately.

d. Check oil leakage from oil seal bolted joints. Replace damaged oil seals. Tighten loose bolts/ screw to stop leakages from joints.

4.6.1.3. Inspection - Weekly



a Check strainer and clean.

b Check filters element and clean if necessary.

c Check and tighten all bolted joints including mounting bolts.

4.6.1.4 Inspection After Each 1000hrs Of Operation

a Change oil in the sump and fill new recommended oil

b Clean selector valve.

c Check all gauges for their correctness.

4.6.1.5 Periodic Overhaul

A complete over haul of the transmission should be done simultaneously with overhauling of engine . The period is aproximately4000Hrs . of operation or 18 month whichever is earlier.

4.6.2 TROUBLE SHOOTING OF KPC HYDRAULIC TRANSMISSION

Symptom	Cause	Remedy
Overheating	a. Insufficient heat exchanger capacity.	a) Install heat exchanger of sufficient capacity.
	b. Insufficient cooling water flow.	b) Check pipe lines and heat exchanger for clogging. Check correctness of pipe size used.
	c. Clutch slipping.	c) Low clutch oil pressure (see low oil pressure).
	d. Oil level too high.	d) Correct oil level.
	e. Improper oil .	e) Use only recommended oils.
	f. Clutch plates warped	f) Replace clutch plates.
Low oil pressure	a) Clogged strainer.	a) Remove & clean strainer .
	b) Stuck pressure regulation piston in selector valve assembly.	b) Remove selector valve assembly and clean piston.
	c) Broken piston rings in clutches.	c) Disassemble clutches and replace piston rings.

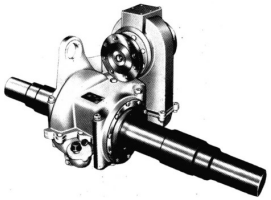
Symptom	Cause	Remedy
	d) Damaged or worn oil pump assly. e) Clogged or plugged orifice plate in selector valve assembly. f) Low oil level. g) Foamed oil.	d) Remove oil pump. Replace damaged /worn assly. e) Remove orifice plate and clean . f) Add. oil to maintain proper oil level. g) Check for air leak in suction line.
No oil pressure	a) Faulty pressure gauge . b) Low oil level or emply sump . c) Fully clogged oil strainer. d) Damaged oil pump.	a) Replace pressure gauge . b) Check gasekets,seals for leakage. Replace parts causing leakage. Maintain correct oil level. c) Remove &clean it. d) Replace oil pump.
Poor performance	a) Low oil pressure. b) Improper oil.	a) Add oil to maintain oil level. b) Use recommended oil .

Symptom	Cause	Remedy
	c) Clutch slipping	c) Disassemble clutch assemblies. check clutch plates and replace worn-out or damaged plates.
Excessive Noise	a) Air leak in suction line of the sump. b) Bearing failure	a) Check and tighten all joints. Replace damaged end fittings/hoses /pipes. b) Disassemble transmission. Replace damaged bearings.
Neutral	a) clutch plates warped.	a) Replace clutch plates.

4.7 KPC AXLE DRIVE MAINTENANCE SCHEDULE

1. Periodic maintenance

Daily - Check oil level daily. It should be at the upper mark. Refill the oil, if the level has dropped below the minimum mark. Be sure to use the same oil brand.



Check the bolts and screws and re-tighten if necessary. Inspect the torque reaction rod assembly and its mounting to base frame.

2. Every 375,000 Kms

Subject all parts to an intermediate inspection. Check the bearing pattern on the bevel gear drive. Check the taper roller bearings for proper axial clearances.

3. Every 750,000 Kms.

Subject all components to a major inspection and replace if necessary.

4. Oil Change

After a new axle drive has been in use for 50 Hrs., the oil must be changed. Further oil change must be made after every 6000 Hours of operation.

Remove the oil drain plug to drain the oil from the drive. If excessive metal particle are detected on the magnetic plug or in the oil, it shows that some components have rubbed each other. Open the axle drive and inspect, Remove the plunger type pump and clean pump strainer.

Clean the housing from oil sludge. Replace the drain plug. Fill with new filtered oil through the filler neck.

5. Axial clearance check, Tapered Roller Bearings:

Proceed in accordance with the guidelines and instructions. The bearing clearance must be maintained.

6. Check of Bearing Pattern, Bevel Gear Drive:

To enable this inspection the axle drive must be opened. Lightly coat three or four teeth on bevel pinion with blue colouring. Rotate the driven gear by hand. Check the bearing pattern on the contact surfaces. The bearing pattern should be centered on the working surface or pointing a little toward the minor diameter. If the bearing pattern falls short of this requirement, readjust.

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CHAPTER 5

BRAKE SYSTEM

5.1 AIR PRESSURE SYSTEM

5.1.1 Introduction

Air pressure system in the Tower car mark III carried out the following operations -

i) Operation of the brake cylinders

ii) Control system

iii) Signal Horns

iv) Parking brake

When the power pack of tower car works, the entire air pressure system is charged by the integrated diesel engine air compressor. The main reservoir pressure is kept between 7 to 8 kg/cm2 with the help of governor, time relay auto drain valve (fitted with main reservoir) and unloader. There is one another Safety valve set at 9.5 kg/cm2 which can save the air pressure system in the worst case, when the usual safety valve (unloader and auto drain valve with time relay) fails.

Duplex pressure gauges have been provided in both the Dr cabins which will show the M.R. and B.P. of the air pressure system. Two nos. gauges have been also provided in the Driver's cabin to show the Brake cylinder pressure when brake is applied. Another two nos. gauge have been provided for control system (one in each Dr.'s cabin) One no. of pressure gauge has been provided on control box. Which will show the actual pressure receiving by the control system. There is one air pressure oiler fitted with service pipe line to control box to facilitate the lubrication of pneumatic valves and equipment fitted in control board.

Condemned water from the system can be removed by means of drainage valve provided in air supply tanks. There are 4 nos. of brake cylinders (one for each wheel) to facilitate perfect brake on the tread of wheels from both sides.

There are two spring brake actuators provided specially for parking brake. It can park the Tower car where there is no air in the system. In the normal running condition due to air pressure brake are in the released condition.

It will function as emergency brakes when the air pressure drops below the spring brake hold off pressure, the spring pushes the piston and the push rod out to apply the brakes.

5.1.2 Important valves and their functions.

5.1.2.1. C3W distributor valve

The C3W distributor valve consists of the following major parts.

i) Main valve
ii) Quiere service valve
iii) Inshot valve
iv) Cut off valve
v) Double release valve
vi) Auxiliary reservoir check valve
vii) Freight to passenger change over device or lock.
viii) Application and release chokes.

5.1.2.2 Operation

The compressed air from brake pipe charges into (CR) control reservoir of the C3W valve and auxiliary reservoir (AR) through cut off valves. when the BP pressure is reduced by the Driver's brake valve due to differential pressure across the main valve diaphragm, the hollow stem lefts and allow AR pressure into B.C (brake cylinder) through inshot valve. The B.C pressure also acts.on top of the upper diaphragm bringing the main diaphragm assembly down wards and finally to cap position. In this position B.C pressure is held against permissible leaks. Every time B.P. pressure is reduced in steps this phenomenon repeats.

The quick service valve helps in quick propagation of B.P (Brake pressure) reduction through the length of the train also. When the B.P. (Brake pipe pressure) is increased by Driver's brake valve, the hollow stem of main valve is brought to normal position by neutralizing the pressure differential across the main valve diaphragm and the B.C. pressure is released through the hollow stem to the atmosphere. As in the application, the upper diaphragm balance against upward force and comes to the lap position. Everytime B.P. pressure is increased in steps, this phenomenon repeats.

There is on lever provided in C3W valve, by pulling it, the brakes can be released manually. The passenger freight change over device helps to achieve required brake application and release timings depending on the type of service either frieght on passenger.

5.1.2.3. Spring brake actuator

Function

To produce braking forces at the wheel for parking brake.

Operation

In the normal running condition the chamber air is pressurized and the piston compresses the spring and the brakes are in released condition.

5.1.2.4 Spring brake application (Parking brake)

When the air pressure in the Chamber is depleted, the spring pushes the piston and thereby the push rod out and applies the brakes through the slack adjuster.

5.1.2.5 Emergency brake

When the system air pressure drops below the spring brake hold off pressure, the spring pushes the piston and the push rod out to apply the brakes through the slack adjuster.

Mechanical Release

To release the brake temporarily for towing the vehicle, the wind off nut is unscrewed after loosening the lock nut, thus retracting the push rod.

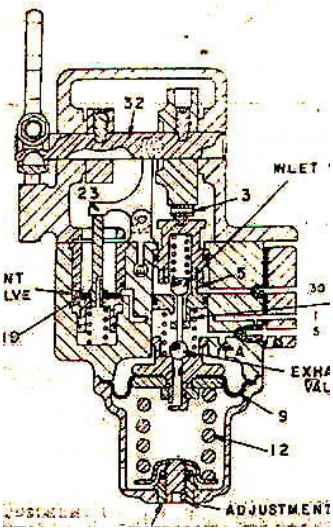
Brake Cylinder

In tower car 4 nos. of brake cylinders have been used which have been fitted at rear end and front end. One brake cylinder works on each wheel.

When C3W valve BC lines operates, the air pressure rush into the cylinder and compress the spring and ultimately push out the piston and apply the brake on wheels treads from both sides with the help of mechanical levers and brakes shoes. If the driver release the brake with the help of auto brake valve A9,the pressure is released by C3W valve as well as through shut off vent type.

5.1.2.6 Auto Brake Valve (A-9 Automatic Valve)

It is valve by which drivers can apply the brake to the tower car as well as release the brake to run the vehicle (Tower car)



Description

The A-9 Automatic Brake Valve is a compact self-lapping, pressure maintaining brake valve which is capable of graduating in application or release of tower wagon brakes. The A-9 Automatic Brake valve has five positions: Release, minimum Reduction, Full service, Over - reduction and emergency. The full service application position is preceded by a zone in which brake pipe air is supplied or exhausted in proportion to brake valve handle movement through this zone, thus providing the graduation of an automatic application or release of the tower wagon brakes.

The A-9 Automatic Brake Valve consists of a self-lapping regulating portion, which supplies or exhausts the brake pipe pressure and a vent valve which is actuated only when the brake valve handle is placed in Emergency position for the purpose of venting brake pipe pressure at an emergency rate.

5.1.2.7 Double check valve

Function

To charge a central line in a selected manner from two independent sources.

Operation

When a pressure differential exists between the two end ports, the higher air pressure forces the check valve over to seal against its seat on the low-pressure side. This closes the passage between the low pressure port and the common port in the body. Air then flows from the high-pressure port through the common port to the device under control.

5.1.2.8 A1 Check valve

Check valves are used in pneumatic brake system to allow -compressed air to flow in one direction only. The A1 check valve is metal seated check valve and is used in compressor delivery line. When compressed air flows in the right direction, the valve of the check valve lifts by the upward air force acting underneath the valve and allows air to pass through the outlet connection. In case of reverse flow, the valve is pressed on its seat tightly due to air pressure acting on top face of the valve.

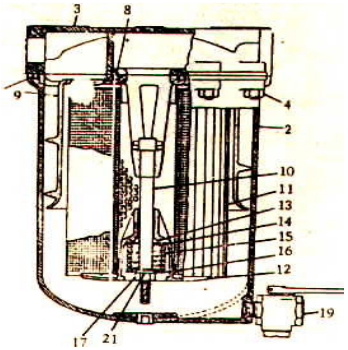
5.1.2.9 J1 Safety Valve

The J1 safety valve is installed vertically in the main reservoir system, vents pressure at a pre determine setting to atmosphere in order to prevent excessive main reservoir pressure build up.

5.1.2.10 Automatic Drain Valve

The automatic drain valve automatically discharges precipitated moisture from a reservoir with each operating cycle of the control device.

5.1.2.11 J air filter



The J-air filter function to assist in preventing the passage of dirt and moisture which may be mixed with the air flowing from the main reservoir into the air brake equipment.

5.2 MAINTENANACE OF THE VALVES

5.2.1 Cleaning, Inspecting andRepairing

- With the brake valve completely disassembled, all parts must be cleaned and inspected.
- All the parts (excepting rubber parts) must be washed in a suitable solvent that will dissolve oil or grease and permit all the parts to be thoroughly cleaned without abrasion. The exterior of the body must be thoroughly cleaned by means of a cloth or rag saturated with a suitable solvent.
- All Gasket, Diaphragms, and "O" rings must be replaced.
- All Packing rings should be replaced.

- Clean all springs using a wire brush and suitable solvent and inspect for pitted marks distortion, or permanent set. Replace where necessary.

- Replace all parts that are cracked, broken, worn excessively, damaged or in such a condition as would result in unsatisfactory operation.

- The spring may be wire brushed to assist in the removal of rust and scale. After cleaning, blow all metal parts with a low pressure jet of clean and dry air.

- Promptly blow the parts dry with low pressure jet of clean and dry air.

- Discard the filter unit and replace with a new one.

- Inspect all other parts. Reject and replace any part that is cracked, cut damaged, worn excessively or is in such a condition that would result in unsatisfactorily operation.

- The spring must be replaced if it is rusted, distorted or has taken a permanent set.

- Frequency of overhauling of valves is to be decided by depots depending upon the utilization of tower wagon. However overhauling is to be carried out at least once in year.

NOTE : All the gauges and meters are to be caliberated once a year.

CHAPTER 6

TXR CHECKING

A general inspection of brake, control, wheel and axle and suspension should be done by depot's staff before going on trip. A monthly inspection of running gear, soundness and conditions of wheels and axle, underframe, undergear fittings, buffer height, brake rigging, roller bearing, axle box, laminated springs, horn check gap and wheel line gauge should be done by the TXR as per the relevant drawings issued by Jamalpur workshop of Eastern Railway.

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CHAPTER 7

ELECTRICAL MAINTENANCE

ELECTRICAL ITEMS (OTHER THAN BATTERIES)

7.1 TRIP SCHEDULE

7.1.1 Condition - Diesel engine running
General examination

a. Check for high temperature, unusual sound and odour of the following:

- Alternator
- Lube oil pump
- Engine tachometer
- Starting equipment

b. Ensure the working of hour meter and battery charging:

7.1.2 Condition - Diesel engine stopped
General examination

Make visual examination of junction boxes, distributors, electrical control equipment and instruction for dirt, flashover, overheating, loose covers and screws, leads and wiring connections for tightness, presence of moisture and incipient damage due to rubbing and other defects.

Lights

Check operation of:

a. Head and buffer lights
b. Cab lights
c. Gauge lights
d. Warning and indicating lights
e. Inspection lights
f. Dimmer lights
g. Flasher lights

7.2 FORTNIGHTLY SCHEDULE

7.2.1 Condition - Diesel engine stopped

- Check insulation resistance of reversible protected type plugs and ensure for earthing.

- Check the condition and ensure proper working of all relays, pressure and tumbler switches, rectifiers and contactors etc. Adjust if required.

- Clean and inspect contacts of engine starting press keys.

7.3 MONTHLY SCHEDULE

7.3.1. Condition - Diesel engine stopped

- Open cabinet doors of pneumatic and electrical control and blow out with clean and dry compressed air. Ensure that the equipment is dry sand clean.

- Check starter motor, alternator and engine tachometer. Blow off dirt with compressed air. Inspect carbon brushes, holders and commutators. Check brush pigtail.

7.4 QUARTERLY SCHEDULE

7.4.1 Condition - Diesel engine running

- Check and adjust alternator
- Check engine tachometer with a master tachometer for correct and accurate operation.

7.4.2 Condition Diesel Stopped

- Check the complete circuit and wiring and rectify as required.
- The alternator and self starter may be removed and inspected, connections checked and their working may also be checked.

7.5 HALF YEARLY SCHEDULE

7.5.1 Condition - Diesel engine stopped

Remove and repair alternator if condition warrants.

7.6 YEARLY SCHEDULE

7.6.1 Condition - Diesel engine stopped

7.6.1.1 Remove and overhaul the following electrical machines

- Self starter
- Alternator
- Engine tachometer generator

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CHAPTER 8

MAINTENANCE OF BATTERY

The following simple instructions will, if observed have to obtain long life built into battery.

- Keep Clamps and terminals clean

  Corrosion product has high resistance, cause power loss, and prevent full charging back.

- Smear Terminals with Vaseline

  Vaseline film prevents corrosion (grease may contain metal soaps which attack lead and should not be used).

- Top Up Regularly

  Water is lost during charging as gas or by evaporation. Low level of electrolyte will damage, 'dry', top of plates, make acid stronger and more destructive to plates.

- Keep Vent plug tight

  To prevent electrolyte evaporation or splash.

- Keep battery top clean and dry

  Dirt and moisture cause surface current leaks between top metal resulting in battery running down.

- Use distilled or deionised water only.

  Ensure water will cause self-discharge or attack plates due to the impurities present in it.

- Keep cable connection tight.

  Because loose connections cause power loss.

- Keep hold downs firmly secured

  To prevent bouncing, container abrasion and damage.

8.1 HYDROMETER READING AND BATTERY CONDITION

Hydrometer reading Correct at 27° C	Battery Condition
1.250 ± 0.005	Fully Charged
1.170 ± 0.005	75 % Charged
1.120 ± 0.005	50 % charged
1.100 or below	must be recharged

Keep return record of daily and monthly inspection. The monthly inspection included gravity and voltage readings of all shells, flushing down the battery, checking connectors and compartment vents.

CHAPTER 9

IMPORTANT OPERATING AND MAINTENANCE INSTRUCTIONS FOR DRIVERS OF O.H.E. CAR.

9.1 DESCRIPTION AND OPERATING PRINCIPLE

The following components are used in electro pneumatic system -

9.1.1 Station Selection Key Switch (CSI)

A station selection switch is provided in both the drivers' cabin, which is key operated. Only one key is to be used for both the cabins so that the control system can be operated from only one cabin at a time.

9.1.2 MCB (CSO)

A 15 ampere capacity Miniature Circuit Breaker (MCB) is provided in control system as a MAINS if due to any fault, current in the control system exceeds than 15 ampere, it will trip the control circuit automatically.

9.1.3 Engine Operation Mode Selection Switch (Cs2)

The engine mode selection switch is provided to select the engine mode of operation i.e. 1) Test 2) off 3) run. The engine can be started only in test mode and clutch selection is possible only in run mode.

9.1.4 Direction selection switch (CS4)

The direction switch is provided to select the desired direction by engaging correspondence clutch. The switch has three positions i.e. Forward-Neutral-Reverse. The direction selection from neutral is possible only when the engine is operating in run mode.

9.1.5 Speed selector switch (CS5)

Engine speed selector switch with 8 positions is provided to select the speed of engine. This can be rotated through 320 from position 0 to 7 in clockwise direction. To decrease the speed rotate it anticlock wise. No attempt should be made to rotate the switch from position 7 to 0 in clockwise direction.

9.1.6 Stand still detector (SSD)

The stand still detector mounted on axle drive is provided to detect the stand still condition of OHE CAR. The clutch cannot be engaged in either direction unless OHE CAR is stationary.

9.1.7 Clutch actuating cylinder (CAC)

The clutch actuating cylinder mounted on transmission is provided for shifting the lever of selector valve to forward, neutral and reverse position. This is a pivot mounted double acting and spring centered air actuator. The rod of the cylinder is connected to the lever of selector valve of transmission. When operated the rod shifts the lever as per direction selection and hence the respective clutch is engaged.

9.1.8 Solenoid valve (SOV. 5)

Its function is to start and run the engine. The coil of valve is energized by 24 volt DC supply. It can also be operated manually by tightening the screw provided on it.

9.1.9 Solenoid Valves (Sov. 1 to 4)

These are also operated by 24 volts DC supply and used for speed control of engine with the help of CS3.

9.1.10 Solenoid Valve (SOV. 6)

3/2 way solenoid operated valve is used for supplying air to stand still detector when energised by 24 volt DC supply.

9.1.11 Solenoid valve (SOV. 7 & 8)

A 5/3 way solenoid operated valve is used for supplying air to the desired port of clutch actuating cylinder by energizing the corresponding solenoid. This in turn controls the movement of selector valve lever.

9.1.12 Flow control valves

Flow control valve FC1, FC2, & FC3 are used as time delay valves in pneumatic circuit.

9.1.13 Pressure switches

Pressure switches PS2 & PS3 are for forward/reverse clutch pressure for the safety of transmission .If the clutch pressure is below the set value 10Kg/cm2 on a pressure switch, it will not allow the operation of engine speed control switch even if speed is selected after clutch engagement. Pressure switch PS1 is pneumatically operated by 3/2 way solenoid valve through SSD. It is used for avoiding the clutch engagement without achieving the stand still condition of OHE car.

9.1.14 Lubricating oil pressure switch

It is mounted on engine. It will stop the engine if the engine lubricating oil pressure is below 0.842 kg/cm^2.

9.1.15 Water temperature switch

It is also mounted on engine and will bring down the engine RPM to idle from high if the engine cooling water temperature reaches above set value 204° F on it.

9.2 STATIONARY CONDITION

On entering the Driver's Cab, the Driver should check and observe the following:

- Check visually all equipment for any visible defects as leakage in water, fuel, luboil, TC oil line or pneumatic pipe lines, loose joints, etc. and rectify. Clean. Driver's cave inside and wind shields.

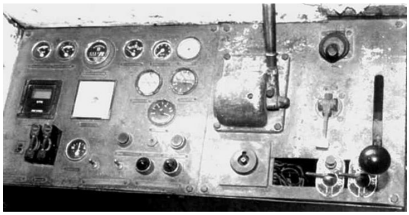

FIGURE 9.1 CONTROL PANEL

- Ensure that the handle of the Driver's brake Valve of the rear cabin is in "ISOLATING POSITION".
- Handle of the Driver's Brake valve of the Driving Cabin should be in release and running position.
- Start the engine as follows:
- Switch on the ignition key.

- Press the button (pink) for oil indication and simultaneously press the starter (green) push button, release the button once the engine starts.
- Ensure F/R (forward/ Reverse) switch is in Neutral position.
- Move the engine throttle to higher notch for fast charging of the MR/BP.
- Pressure build up time : Check that MR pressure is build up from 0 to 7.5 kg/cm^2 in 10 minutes.
- Ensure MR pressure between 7 to 8kg/cm^2.
- Check brake pipe pressure to 5 kg/cm^2.
- Observe the brake cylinder pressure to be 'zero'. If not, pull the manual release valve of the distributor valve for a short while.
- Apply leak hole test : In this test mild steel plate of 8mm dia hole is to be provided at the end of BP pipe and ensure that pressure drop of BP is not more than 0.5 ±0.1 kg/cm^2 in 5 minutes and pressure drop in MR is not more than 0.7kg/cm^2 in 5 minutes.

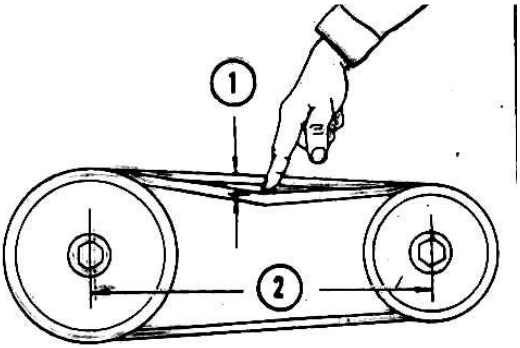

FIGURE 9.1 CHECKING BELT TENSION

- Check proper belt tension manually.
- Check the working of horn, wipers before moving the car.
- Once the system is charged then apply emergency brake application and observe BC pressure to be 3.8 kg, ± 0.1 kg/cm2 and BP 0 kg/ cm2.
- Release the brake and recharge the system.
- Ensure that brake application time is 6 to 9 sec. and brake releasing time is 10 to 15 sec.
- Check graduated application and release of brakes for proper lapping and number of steps (Minimum 6 Nos.)
- All the BC Isolating cock should be open and outer most angle cock of wagons & OHE car should be kept closed.
- Every time driver should ensure charging of BP by seeing the pressure gauge readings as well handle position. After BP is charged, he should wait for 5 minutes for complete charging of brake system including CR pressure and AR pressure etc.
- Driver must confirm availability of service brakes before moving the car.
- Isolating valve handle of R-Charger must be in down ward position; otherwise charging of distributor valve will not take place.
- Whenever quick release valve is operated for manual release of brake, driver should wait for recharging of brake system and confirm the availability of brakes again by bringing the handle to application position.

9.3 RUNNING CONDITION

- During the run, if brake application is required to reduce the speed, the handle of the Driver's brake valve should be brought to Ist notch in the application range. Driver should reduce the BP to minimum value, as reduction of BP by 1.4 kg/cm2 will give full brake cylinder pressure of 3.8 kg/cm2.
- To operate the car on down gradient, short application and release of air brakes is recommended to maintain the specified speed and brake power.
- Spare sub assemblies. Should be made available in the OHE car for unit exchange basis in case of an emergency. This include BP hose, angle cock, Distributor Valve, relay valve etc.
- Independent emergency brake valve is provided in the cab (both ends facilitate the guard to initiate an emergency brake in case of emergency.

9.4 CHANGE OF CABIN

Apply emergency application and then remove the driver's brake valve handle by bringing it quickly to isolating position. Switch off the ignition key. Change the cabin and repeat all the checks given under heading 9.2

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CHAPTER 10

DO'S AND DON'TS

10.1 DO's

1. Do keep the engine clean.
2. Do pay particular attention to lubrication.
3. Do use only approved grades of lubricating oil.
4. Do keep all bolts and nuts tight.
5. Do eliminate all air from the fuel system and keep all fuel oil unions air tight
6. Do examine engine oil level in sump daily and replace if necessary.
7. Do completely change engine oil in accordance with periodical attentions.
8. Do renew element in lubricating oil filter in accordance with periodical attention.
9. Do keep a check on the temperature of the cooling water
10. Do attend immediately to fuel and lubricating oil leaks.
11. Do keep essential spare in store.
12. Do drain radiator if engine is being left idle in frosty weather.
13. Do remove pressurized radiator filter cap (where fitted) before draining the coolant system.

10.2 DON'Ts

1. Do not neglect the routine maintenance.
2. Do not race the engine in neutral.
3. Do not run the engine unless the gauge shows oil pressure.
4. Do not unnecessarily interfere with any adjustments.
5. Do not continue to run the engine if the cooling water boils.
6. Do not forget to keep the fan belt adjusted.
7. Do not continue to run the engine if black smoke is coming from the exhaust.
8. Do not omit to wipe the engine occasionally with a clean rag.
9. Do not use cotton waste or any fluffy cloth when cleaning.
10. Do not use unapproved brands of lubricating oil.
11. Do not store fuel oil in a galvanised container.
12. Do not subject the engine or vehicle to continuous overloading.
13. Do not load the vehicle beyond the stipulated payload.
14. Do not coast when travelling down hill.

10.3 SUGGESTION FOR ACHIEVING ZERO FAILURES

- Engine should run idle for 3 to 5 minutes before shutting it off after a full load operation.This allows adequate cool down of pistons, cylinder liners, bearing & turbocharger components.
- Do not idle the engine for excessively long periods.
- If the engine coolant temperature becomes too low, 60° C, raw fuel will wash the lubricating oil off the cylinder walls and dilute the crankcase oil. All the moving parts of the engine will not receive correct amount of lubrication.
- Operate engine only on electrical mode & ensure all safety controls are functioning.
- Do not over load the engine.
- Do not remove radiator cap when engine is in operation or immediately after stopping the engine.
- Perform periodic maintenance as per recommendations.
- Ensure trained person carries out the schedule maintenance.
- Ensure periodic health checks by experts.
- Ensure quality of lubricants and fuel as per standards.
- Correct problems when they are minor.
- Use proper tools.

- Use only CF4 grade lube oil for engine lubrication.
- Do not operate the engine without thermostat
- Do not crank the engine for more than 5-7 seconds .
- Use only genuine parts while repairs/maintenance.

10.4 MAINTENANCE STEPS FOR ENGINE

- keep dirt out of engine.
- Maintain a lubricating film on all bearing surfaces.
- Regulate the engine fuel.
- Control operating temperatures.
- Guard against corrosion.
- Let the engine breath.
- Prevent over speeding
- Know your engines condition
- Correct troubles while they are simple.
- Schedule and control your maintenance.

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ANNEXURE - 'A'

TECHNICAL SPECIFICATION OF TOWER WAGON

Model	:	OHE Tower Car Mark - III
Type	:	Diesel Hydraulic
Track Gauge	:	1676 mm
Axle classification	:	O - B' - O
No. of axles	:	Driven/carrying
	:	Two/One/One
Nominal axle load	:	16t max.
Tractive Effort vs Speed Curve No.	:	VT/G-490
Adhesion factor	:	0.3
Maximum speed	:	70 kmph
Wheel dia	:	904.5 (Half worn)
Fuel tank capacity	:	300 litres

1. POWER PACK

1.1 *Diesel Engine*

Make	:	Kirloskar Cummins Limited
Model	:	N - 743
Installed Power	:	212 HP @ 2100 rpm
Governed speed	:	2100 rpm
Operating cycles	:	four
No. of cylinders	:	Six
Bore & Stroke	:	130 x 152
Formation	:	In line
Engine breathing	:	Naturally aspirated

2. TRANSMISSION

2.1 TECHNICAL DATA OF VENTRA TOWER WAGON

2.1.1 HYDRAULIC TRANSMISSION

Make : Hindustan Motors Limited
Model : Allison CRT - 5633
Type : Torque converter, three speed forward & reverse power shift transmission with drop gear box.
Ratio : Forward I speed 3.95 : 1
II speed 1.96 :1
III speed 0.99 : 1
Reverse I speed 4.11 : 1
II speed 2.04 : 1
III speed 1.04 : 1

2.1.1.1 Drop gear Box

Make : VENTRA
Model : GBM 0081
Ratio : 2.41 : 1

2.1.1.2. Axle drive gear box

Make : VENTRA
Model : GBM 0063
Ratio : 1.71 : 1

2.1.1.3 Carden shafts

a. Make : Twindisc, USA
Model : J - 230 - TS
Between transmission & drop gear box output and axle drive gear box input

2.1.1.4 Compressor

Make	:	Kirloskar Cummins
Model	:	Single cylinder
Engine	:	Engine mounted (13.2 cfm 100 PSI)

2.2 TECHNICAL DATA OF KPC HYDRAULIC TRANSMISSION

Model	:	KTC 100.20
Specifications		
Spec. Number	:	780.430
Converter	:	8-1600
M.S.Value	:	330
RatioF/R	:	1.333 : 1
Housing	:	Suitable for SAE - 1 Flyweel housing
Dry weight	:	500 Kg Approximately
Sump capacity	:	20 Litres (excluding pipe lines, heat exchanger)
Pump capacity	:	52 Litres/min. at engine speed of 1400 rpm

2.2.1 Operating pressure at 2100 rpm engine speed

a.	Converter base pressure	:	2.0 to 4.5 kg/cm2
b.	Clutch engagement pr.	:	13.0 to 16.0 Kg/cm2
		:	12.0Kg/cm2 minimum
c.	Clutch neutral pressure	:	4.5 Kg/cm2
		:	3.0 Kg/cm2 minimum

2.2.2 Operating temperature : 80°C to 110°C

2.2.3 Oil change interval : Replace every 1000 hours of operation or 3 months whichever is earlier.

2.2.4. Main filter element change interval : First change after 60 Hrs. of operation
: Thereafter every 1000 Hrs. of operation.

2.2.5 Suction strainer cleaning : Every 10 -15 Hrs operation initially and once a week thereafter.

2.2.6 Recommended oils & Grease,

Oils

a.	Hindustan petroleum	: ENKLO NX 32
b.	Indian Oil Corp.	: Servo Torque 10

Grease

a.	Hindustan petroleum	:	Multipurpose Grease H
b.	Bharat	:	Bharat MP Grease2
c.	Veedol	:	Veedol AP Grease

Recommended torque tightening values for bolts/screws.

Thread	Torque in M-Kg (Lubricated threads)
M10	4.2
M12	7.0
M14	10.8
M16	16.2

All bolts must be tightened to its specified torque value. Use appropriate torque wrench for it.

2.3 TECHNICAL DATA OF KPC AXLE DRIVE

Dry weight of axle drive exclusive of axle shaft	670 kg
Oil capacity	12 Lit.
Max. oil level below axle centre line	145 mm.
Min. oil level below axle centre line	155 mm.
Normal - axle load capacity	18 T. Max.

2.3.1 Gear ratio

Total reduction Ratio	4.289 : 1

2.3.2 Torque Value

Torque values for fastener tightening when threads are not lubricated while fitting (if lubricated use values lower by 20%)

S. N	Description		Approx. Torque M-Kg.
1	M 12 X 1.75 x 35	Screw Socket Head	12
2	M 14 x 2	Bolt Hex. hd	14
3	M 16 x 2 x 50	Screw Hex. hd	21
4	M 20 x 2	Bolt Hex. Fitted	41
5	M20 x 1.5 x 140	Bolt Hex. hd.	46
6	M24 x 1.5 x 170	-- " --	46
7	M24 x 3 x 330	-- " --	71
8	M24 x 3 x 270	-- " --	71
9	M10 x 2 x 60	-- " --	21
10	M14 x 2 x 35	-- " --	14

2.3.3 Recommended Oils for the Axle Drive

S.N	Name of Petroleum Co.	Grade of Oil
1	Hindustan Petroleum	HP Gear Oil EP 90
2	Bharat Petroleum	Bharat Spirol 90 EP
3	Indrol	Hypod C 80 W/90
4	Indial Oil	Servo gear HP 90

3. CONTROL EQUIPMENT & INSTRUMENTS

In the Tower Car there are two cabins and two control desks. The operator can drive the car from any one cabin in whichever direction he desires to travel.

Adequate controls including gauges, instruments and safety devices are provided for safe and satisfactory operation of the car. The equipment is so arranged on the driver's desk and it is within easy reach.

3.1 Controls

a. Engine start & stop
b. Engine throtle control
c. Forward/reverse
d. Speed changer
e. Horn
f. Provision for air brake and parking brake.

3.2 Instruments & Gauges

a. Engine RPM meter
b. Engine Hour meter
c. Engine oil pressure gauge
d. Engine oil temp. gauge
e. Engine cooling water temp. gauge
f. Ammeter
g. Transmission temperature gauge
h. Transmission pressure gauge
i. Air pressure gauges
j. Speedometer

3.3 Indication & warning lights

a. Engine on indication
b. Battery charge indication
c. Air on indication
d. Forward/reverse/neutral-cum-speed indication

3.4 Safety devices

a. Water temperature too high.
b. Transmission oil temperature too high.
c. Low lubricating oil pressure
d. Engine speed too high.
e. Low radiator water level.

3.5 Electrical Equipment

a. 24VElectrical system complete with batteries, alternator/rectifier and starter motor provided.
b. Switch for light provided.

3.6 Storage Batteries

24V Lead acid batteries - one set is provided.

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ANNEXURE 'B'

OIL CHART

Description	Capacity	Hindustan Petroleum Corpn.	Indian Oil	Caster Oil	Bharat Petroleum Corpn. Ltd.
Diesel Engine Fuel/ Lube Oil	300 Ltrs. 32 Ltrs.	High Speed Diesel Hy-Lube - Extra 20W - 40	High Speed diesel servo super 20W - 40	High Speed Diesel Deus OL 20 W - 40	High Speed Diesel Bharat Actuma 20 W - 40
CRT - 5633 Transmission	42 Ltrs	Power Glide C - 3 C - 310 or C - 330	Servo Transmission C4 SAE 30	--	--
DROP GEAR BOX	10 Ltrs.	EP - 140 GR.OIL	SERVO GEAR HP - 140	--	Bharat Spiral 140 EP
Axle drive gear box	40 Ltrs. for each gear box	EP - 140 GR oil	Servo Gear HP - 140	--	Bharat spiral 140 EP

REFERENCE

1. Operating and maintenance manual bulletin 3243773 - 02 Cummmins India Ltd.
2. Instruction and Maintenance Manual
   By Kirloskar Pneumatic Co. Ltd.
   i. Electro Pneumatic control of 4 wheeler OHE Car
   ii. Hydraulic Transmission KTC 100 - 20
   iii. Axle Drive V - 1719.

3. Operating and Maintenance Manual of VENTRA Locomotive Ltd.
4. Allison Transmission CRT 5633
   By Hindustan Motors
5. Papers presented during the seminar at CAMTECH on maintenance of Tower Wagon.

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