Instruction Manual for

ON LOAD TAP CHANGER

TELK ANGAMALY

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Contents

INSTRUCTION MANUAL FOR ON LOAD TAP CHANGER B,N & E SERIES

INTRODUCTION :

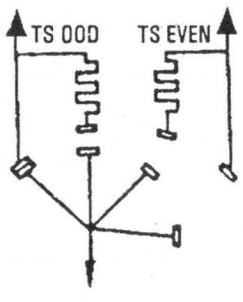
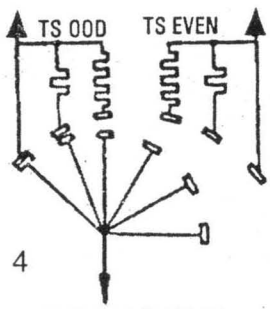
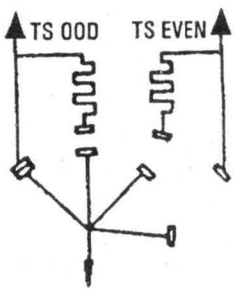
The On-Load Tap Changer consists of a high speed resistor transition diverter switch, tap selector, driving mechanism and external driving shaft.

The operator is required to be completely familiar with the functions and constructions of all parts of the equipment and to handle and maintain the equipment properly. This instruction manual for B, N & E series On-Load Tap Changing equipments is designed to enable the operator to meet the requirements.

CONSTRUCTION :

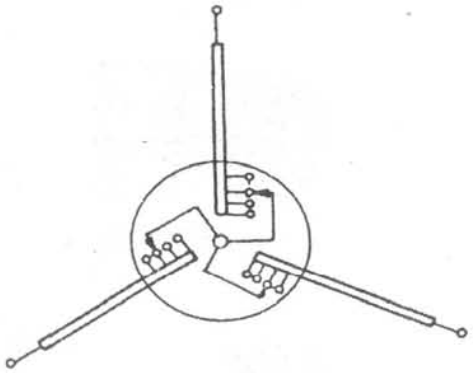
The various tap changers manufactured by us are divided into 14 types. These classifications (Refer table 1) are based on the current ratings and the number of poles in the tap changer.

Table 1

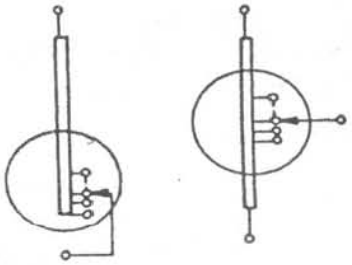
Description	B Series						N Series				E Series			
Type	YB1	YB2	1B2	2B2	3B2	DB2	YN	1N	2N	3N	YE	1E	2E	3E
No. of Poles	1	1	1	2	3	1	1	1	2	3	1	1	2	3
Max. No. of Switching Units per pole	3	3	2	2	2	3	3	2	2	2	3	2	2	2
Max. No. of Resistor Contacts per Switching Unit	2  TO BUSHING						4  TO BUSHING				2  TO BUSHING			
Max. Rated through current of each switching unit - Amps	100	260 / 350					350 / 400				450 / 600			
Step voltage Corresponding to the above-Volts	1000	2000 / 1000					2000 / 1000				2000 / 1160			

Type		B Series		N Series		E Series	
Location of the tap changer on the transformer winding		Neutral end of 3Ø transformer	Line end of 1Ø or 3 Ø transformer	Neutral end of 3Ø transformer	Line end of 1Ø or 3 Ø transformer	Neutral end of 3Ø transformer	Line end of 1Ø or 3 Ø transformer
Rated operating frequency - Hz		50.....60					
Oil displacement per pole in the transformer - Litres		130 - 200		230 - 340		140 - 210	
Quantity of oil per pole in the diverter switch - Litres		120 - 200		300 - 350		130 - 210	
Weight of Tap Selector Diverter Switch Unit per Pole - approx. - Kg		380 - 420		700 - 900		400 - 440	
Weight of the diverter switch contact compartment- approx. - Kg		37		185		45	
Approximate overall size of a pole	Length - mm	900		1050		900	
	Breadth - mm	650		800		650	
	Height above the transformer cover - mm	300		500		300	
	Height inside the transformer cover - mm	1600 - 2200		2100 - 2500		1700 - 2300	

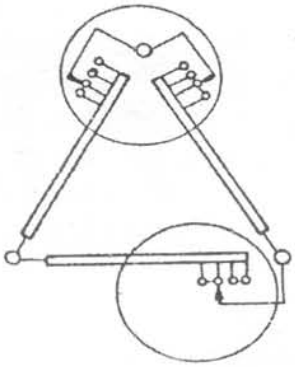
APPLICATION OF VARIOUS TYPES OF TAP CHANGERS



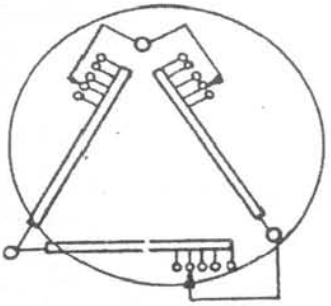
YB1, YB2, YN, YE
FOR NEUTRAL END OF 3Ø STAR
CONNECTED TRANSFORMERS



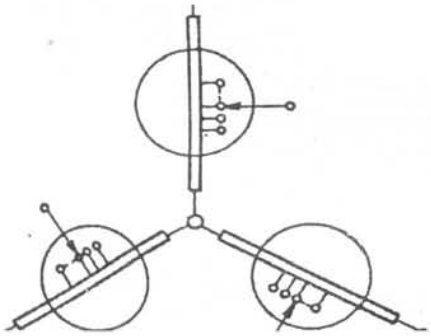
1B2, 1N,1E
FOR NEUTRALOR LINE ENDS OF 1Ø
TRANSFORMERS

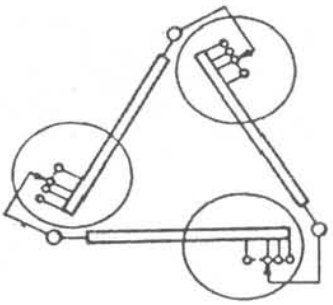


2B2, 2N, 2E
FOR LINE ENDS OF 3Ø DELTA
CONNECTED TRANSFORMERS



DB2
FOR LINE ENDS OF 3Ø DELTA
CONNECTED TRANSFORMERS





3B2, 3N, 3E
FOR LINE ENDS OF 3Ø AUTO OR DELTA
CONNECTED TRANSFORMERS

Fig. 1 Location of the taps on the trnasformer winding

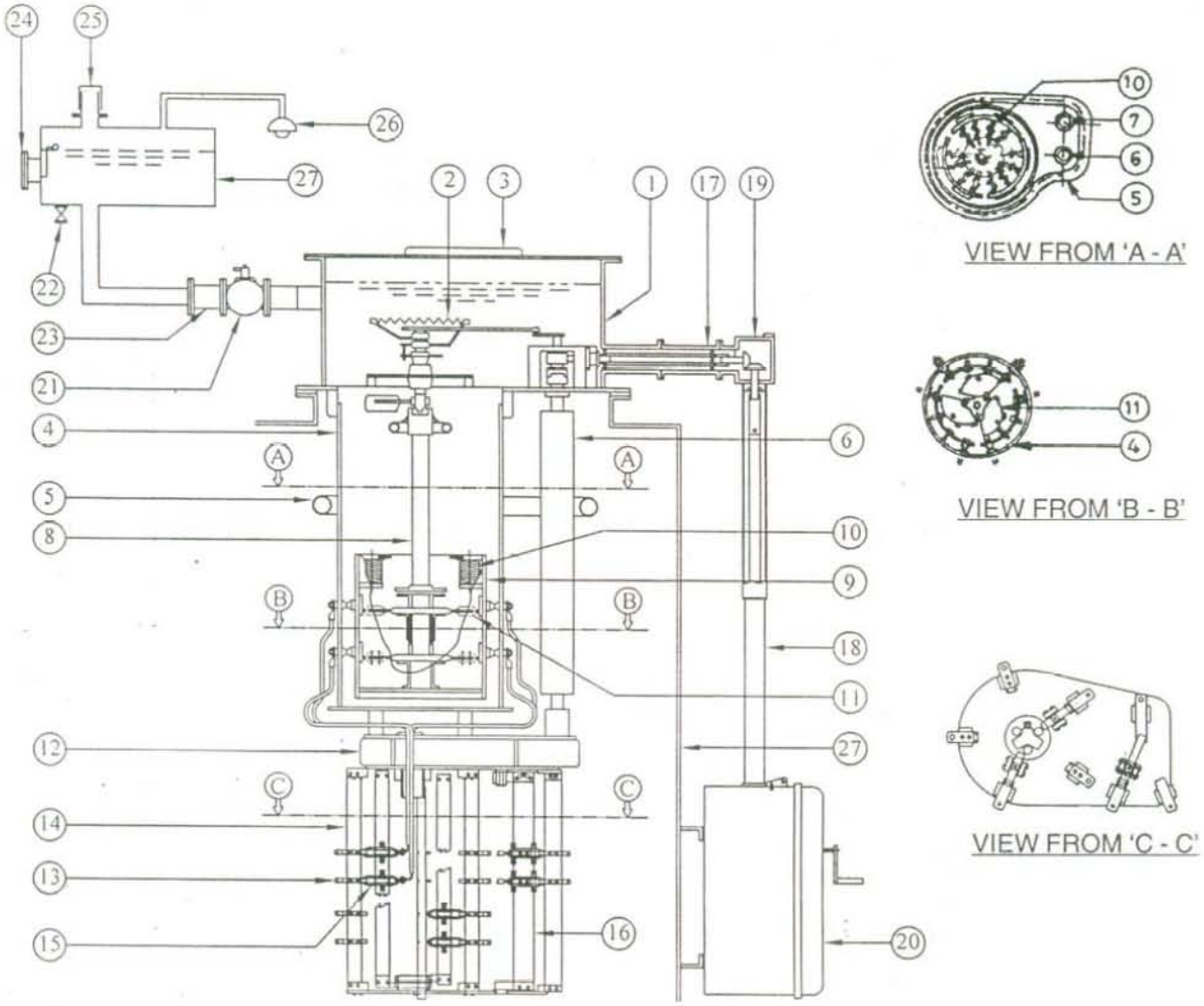


Fig. 2 On Load Tap Changer Type YB1/YB2

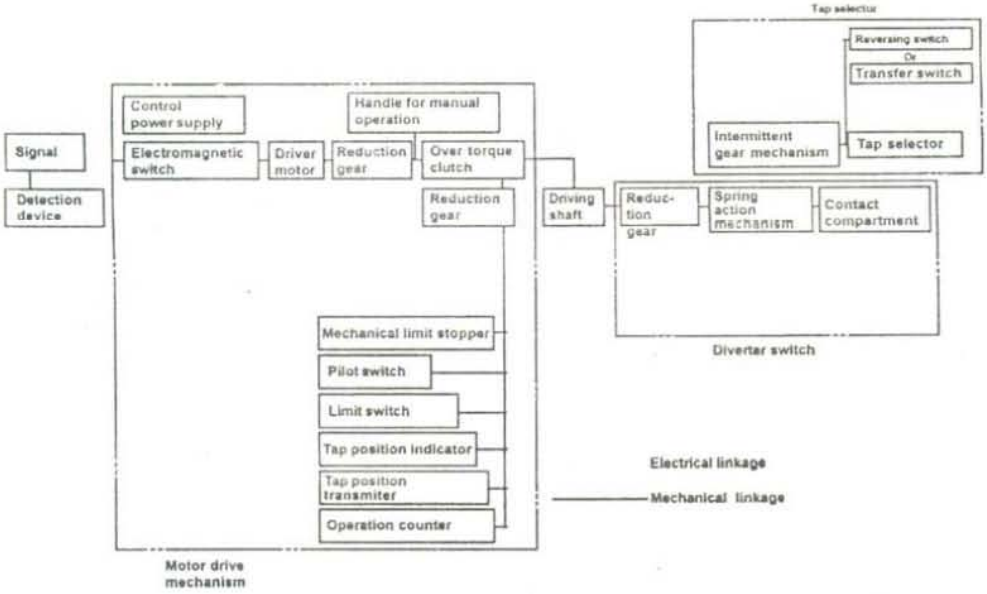


Fig. 3 Block Diagram of power Transmission System

Legend for Fig 2

1. Mechanism Case.
2. Spring Mechanism
3. Explosion Vent.
4. Outer Insulation Cylinder
5. Shield Ring
6. Insulation Shaft for Tap Selector
7. Insulation Drain Pipe.
8. Insulation shaft of Diverter Switch
9. Diverter Switch Contacts Compartment
10. Transition Resistor Assembly
11. Diverter Switch Moving Contacts.
12. Tap Selector Intermittent Gear Box
13. Tap Selector Stationary Contact.
14. Tap Selector Insulation Bars.
15. Tap Selector moving Contacts.
16. Change Over Selector
17. External Driving Shaft
18. External Driving Shaft.
19. Bevel Gear Box.
20. Driving Mechanism.
21. Gas and Oil operated Relay.
22. Stop Valve.
23. Drain Valve.
24. Oil Level Gauge.
25. Silica Gel Breather.
26. Tap Changer Conservator
27. Transformer Tank

The type designation is marked on the name plate fitted to the mechanism case of the tap changer. The application of a type of tap changer in a particular transformer can be understood from the rating plate of the transformer.

All the above types of tap changers, will have only one driving mechanism per transformer. In single pole types, the shaft from the driving mechanism is directly connected to the diverter switch while in multipole types, the individual poles are coupled by a common shaft which is connected to the driving mechanism.

The diverter switch and the tap selector assembled to form a single unit, are housed in the transformer tank. This unit is supported by the diverter switch mechanism case, which is mounted on the transformer cover. The driving mechanism is mounted on the side of the transformer in such a way that an operator standing at ground level, will not have any difficulty in operating it.

The diverter switch operates on "Flag Cycle" and therefore it is suitable for bidirectional flow of power. i.e. It can be used in transformers in which there is possibility of flow of currents from tapped winding to untapped winding and vice-versa.

PRINCIPLE OF OPERATION:

The tap lead wires from the winding of the transformer are brought and terminated at the fixed contacts of the tap selector. Tap change operation requires two rotary switches per phase. The odd numbered tappings are connected to one switch and even numbered tappings to other in such a way that the two switches come into use alternately. In fig. 4 connection diagram of 17 Tap Tap changer with change over selector and 9 Tap Tap - changer with linear tappings are shown. (Ref: TFR name plate conn. diagram)

The odd side contact is on tap 7 and even side contact on tap 8 of the tap selector. The odd and even collector contacts are connected to the diverter switch contact O&E respectively. Since the diverter switch is making contacts at 0, flow of current will be through tap 7. When a signal is given to the driving mechanism for changing tap from 7 to 6, it will first operate the even contact of tap selector from tap 8 to 6 without changing the position of the odd contact. For this a roller type intermittent gear mechanism is used in place of the usual geneva gear mechanism, for reducing the friction.

Simultaneous with the operation of the tap selector, the spring mechanism, which is the energy accumulator mounted on the top of the diverter switch will be charged. On the completion of tap selector operation, energy accumulated in the spring will be released for the instantaneous transfer of the diverter switch moving contacts from tap O to E through the resistor contacts O_R and E_R thus changing the flow of current from tap 7 to 6. Energy from the spring action mechanism is transmitted to the moving contacts by means of insulation shaft.

For reverse operation i.e. for changing tap 6 to 7, the tap selector shaft will not operate as its contacts is already on tap 7.

(1)

17 TAPS WITH TRANSFER SWITCH

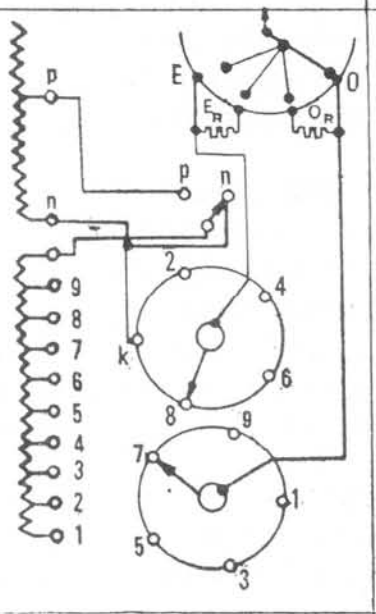


FIG.SHOWS OPERATION AT TAP POSITION 6.

TAP POSITION	TAP POS.1-17			TAP POS.17-1		
	TAP SELECTOR		TRANS SWITCH	TAP SELECTOR		TRANS SWITCH
	ODD	EVEN		ODD	EVEN	
1	3	(2)		3	(2)	
2	(3)	2		(3)	4	
3	3	(4)		5	(4)	
4	(5)	4	n	(5)	6	n
5	5	(6)		7	(6)	
6	(7)	6		(7)	8	
7	7	(8)		9	(8)	
8	(9)	8		(9)	K	
9	9	(K)		1	(K)	
10	(1)	K		(1)	2	
11	1	(2)		3	(2)	
12	(3)	2		(3)	4	
13	3	(4)		5	(4)	
14	(5)	4	p	(5)	6	p
15	5	(6)		7	(6)	
16	(7)	6		(7)	8	
17	7	(8)		7	(8)	

(2)

17 TAPS WITH REVERSING SWITCH

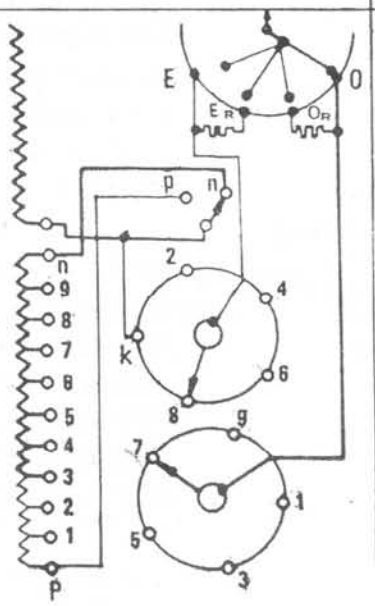


FIG.SHOWS OPERATION AT TAP POSITION 6.

TAP POSITION	TAP POS.1-17			TAP POS.17-1		
	TAP SELECTOR		REV SWITCH	TAP SELECTOR		REV SWITCH
	ODD	EVEN		ODD	EVEN	
1	3	(2)		3	(2)	
2	(3)	2		(3)	4	
3	3	(4)		5	(4)	
4	(5)	4	n	(5)	6	n
5	5	(6)		7	(6)	
6	(7)	6		(7)	8	
7	7	(8)		9	(8)	
8	(9)	8		(9)	K	
9	9	(K)		1	(K)	
10	(1)	K		(1)	2	
11	1	(2)		3	(2)	
12	(3)	2		(3)	4	
13	3	(4)		5	(4)	
14	(5)	4	p	(5)	6	p
15	5	(6)		7	(6)	
16	(7)	6		(7)	8	
17	7	(8)		7	(8)	

(3)

9 TAPS

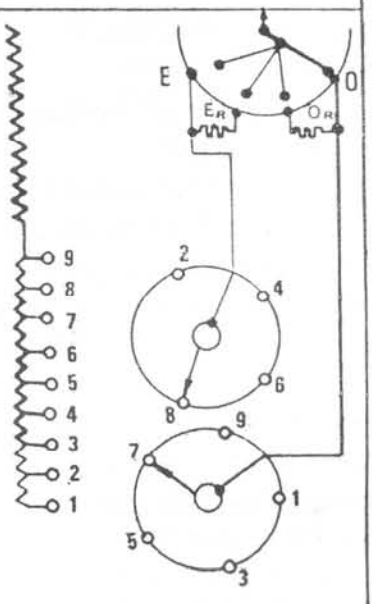


FIG.SHOWS OPERATION AT TAP POSITION 7.

TAP POSITION	TAP POS.1-9.			TAP POS.9-1.		
	TAP SELECTOR			TAP SELECTOR		
	ODD	EVEN		ODD	EVEN	
1	(1)	2		(1)	2	
2	1	(2)		3	(2)	
3	(3)	2		(3)	4	
4	3	(4)		5	(4)	
5	(5)	4		(5)	6	
6	5	(6)		7	(6)	
7	(7)	6		(7)	8	
8	7	(8)		9	(8)	
9	(9)	8		(9)	8	

(○) .....OPERATING TAP

Fig. 4 Connection Diagram

But the transfer of the diverter switch moving contacts from E to O will take place completing the tap changing operation. During reverse operations, the tap selector shaft is kept idle by means of a lost motion device in the intermittent gear mechanism.

DIVERTER SWITCH

The diverter switch consists of contact compartment, transition resistors, spring action mechanism and worm gear assembly. These parts are built light and compact and can be hoisted out easily for routine inspection without lowering the oil level in the main transformer tank. A perfect oil tight structure is employed between the diverter switch and the transformer tank, to prevent mixing of oil outside the Switch chamber with the oil inside, which will be contaminated due to the switching operations. Lower fitting frame of the diverter switch is connected to the neutral or line terminal of the transformer depending on the location of the tap changer.

In the YB1, YB2 and YN type diverter switches, there are 3 sets of fixed and moving contacts for 3 phases while in the other there will be the maximum of 2 sets of contacts per pole. The stationary contacts are arranged on the inner surface of the insulation cylinder and the segments of moving contacts, mounted eccentrically to the operating shaft, rotate on the stationary contacts as the operating shaft turns. Each set of stationary contact is mounted on separate segments can be removed for inspection without disturbing the contacts on the other segments. The tips of arcing contacts are made of copper-tungsten alloy which has got excellent arc resisting characteristics. Current limiting resistors consist of nickel chormium wire wound on heat resisting bobbins held at both ends by insulation plates. These are mounted above the stationary contacts.

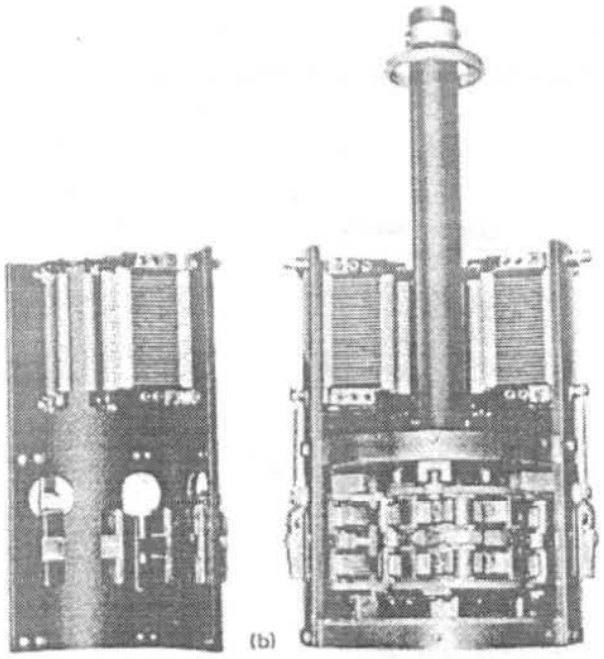
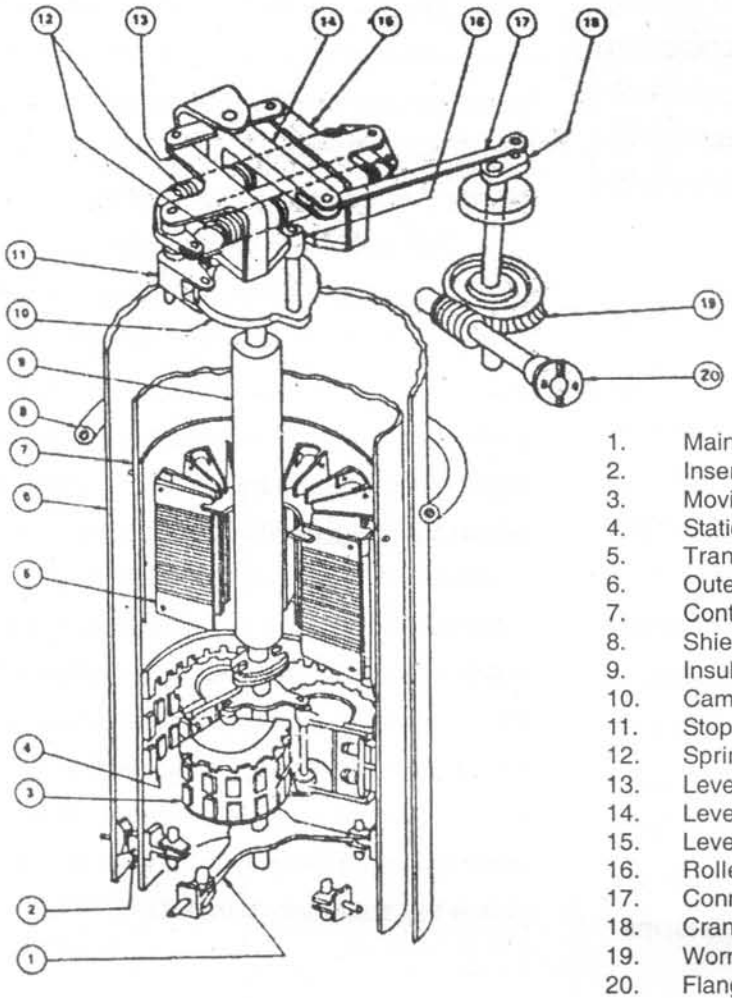


Fig. 5 YB2 Contact compartment with transition resistors (One Segment of cylinder is open)



1. Main Contact
2. Insert Contact
3. Moving Contact
4. Stationary Contact
5. Transition Resistor
6. Outer Insulation Cylinder
7. Contact Compartment Insulation Cylinder
8. Shield Ring
9. Insulation Shaft
10. Cam Shaft
11. Stopper
12. Springs
13. Lever
14. Lever
15. Lever
16. Roller
17. Connecting Road
18. Crank Shaft
19. Worm Gear Assembly
20. Flange Coupling for external Shaft.

Fig. 6 Construction of YN Diverter switch

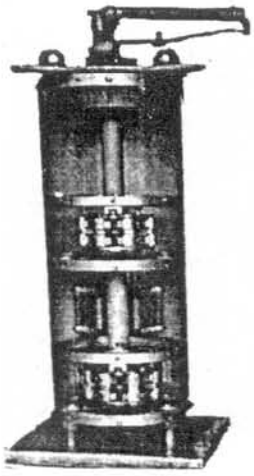


Fig. 7 Diverter switch Type DB_2

The spring action mechanism matches with the interruption characteristics of the diverter switch. When the tap changer is operated, energy is accumulated in the spring. This energy is released by the tripping of a latch. As the mechanism trips, the diverter switch shaft turns at a very high speed performing the tap changing operation. Suitable dampers are provided on the shaft to reduce speed at the end of the operation there by minimising the shock. Since stored energy of the spring is employed for the instant switching operation, it is not affected by control source trouble.

The driving power from the driving mechanism is transmitted to the spring mechanism and the tap selector through a reduction gear assembly consisting of a worm and worm wheel. The gear assembly and the spring mechanism are mounted inside the mechanism case which forms the top most part of the diverter switch chamber.

Oil in the diverter switch chamber is maintained under a separate conservator head. The pipe leading to the conservator from the diverter switch chamber is fitted with a gas and oil operated relay, the normally open, velocity actuated contact of which is connected to the trip circuit of the transformer protection circuit breakers. In the event of faulty tap changing or if oil in the diverter switch chamber gushes into the conservator, the relay will give a trip signal to the circuit breakers. The minimum oil velocity for the operation of the relay is 100cm/sec. in 50 mm diameter pipe in the case of tap changers of types 3B2 & 3N and in 25mm pipe in the other types. In case, the pressure in the chamber rises abnormally, it is released by means of an explosion vent attached to the top of the mechanism case. A cushion of air or gas is always available on the mechanism case top, to absorb any shock due to sudden pressure rises.

A silicagel Breather is connected to the conservator to minimise absorption of atmospheric moisture by the oil in the conservator. The conservator is also provided with an oil level gauge, stop valve and drain valve.

For filling and draining oil from the diverter switch chamber valves are provided on the mechanism case. To release air trapped in the tap changer pocket during oil filling in the transformer tank, an air release pipe is fitted to the mechanism case.

TAP SELECTOR

The tap selector operates under no load condition and therefore, there need not be any fear of arc generation, damage of contacts or deterioration of main transformer oil.

The odd and even numbered contacts are fitted on either insulation cylinders or bars mounted vertically to prevent accumulation of metallic powder, on the surface of insulators, formed due to wear of contacts. Moving contacts are of clip type under spring pressure. In certain cases a change over selector is also provided to enable the main tap selector contacts and the connected tappings to be used more than once when moving from one extreme position to another.

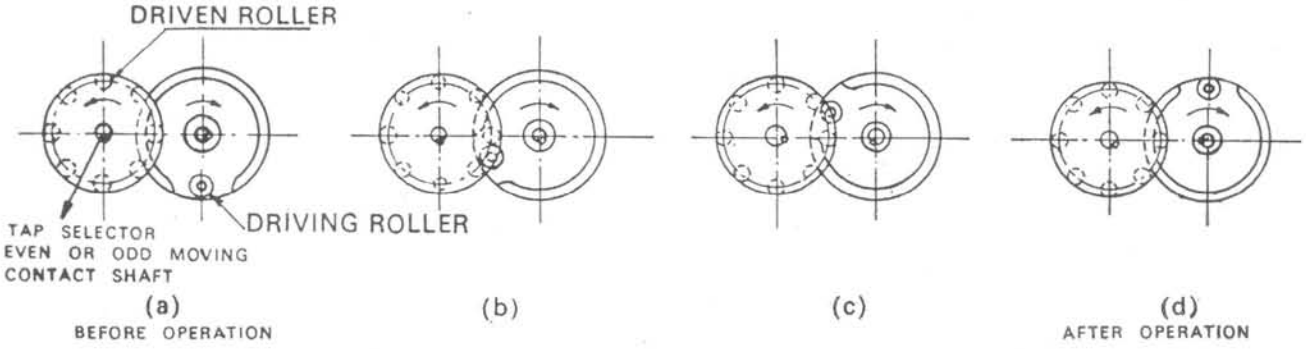
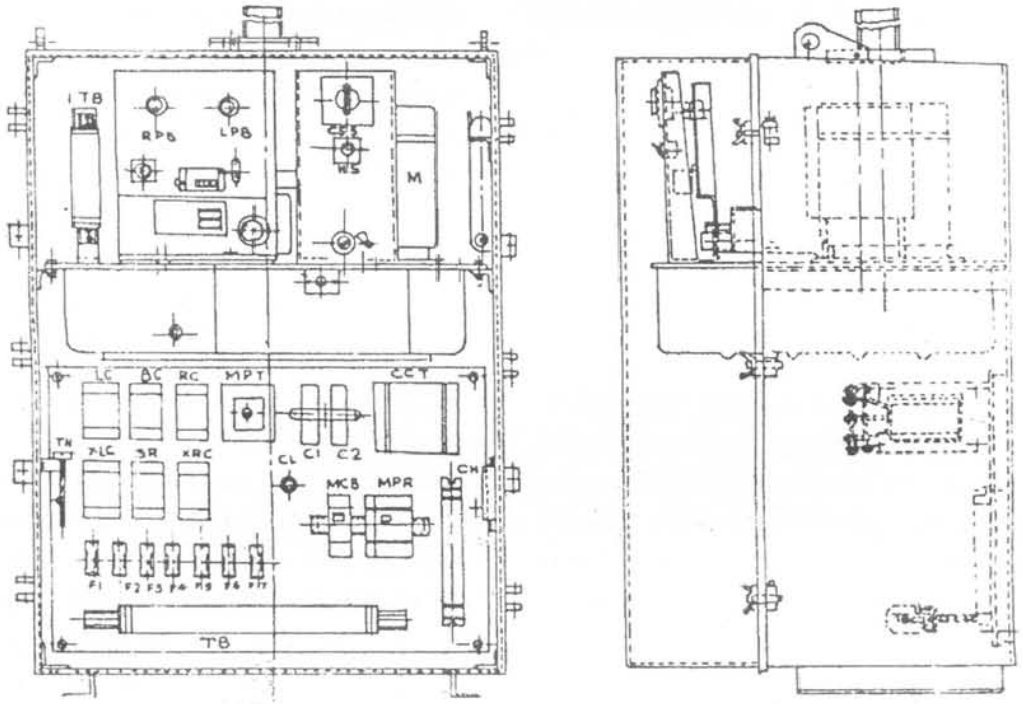


Fig. 8 Roller Gear Mechanism

The intermittent gear mechanism adopts roller system in place of the usual geneva gear stem. Rollers are arranged at equal intervals the intermittent gear. The roller gears are iven by a pinion roller which is directly onnected to the operating shaft. This rangement results in very little rolling friction nd ensures smooth operation.

DRIVING MECHANISM (D_2)



DRIVING MECHANISM (D_2)

CSS	-	OLTC CONTROL SELECTOR SWITCH
HS	-	HEATER CONTROL SWITCH
M	-	MOTOR
RPB/LPB	-	LOCAL RAISE & LOWER/PUSH BUTTONS SWITCH
RC/LC	-	MAGNETIC CONTACTOR FOR RAISE/ LOWER OPERATION
MPT	-	MOTOR PROTECTION TIMER RELAY
CCT	-	CONTROL CIRCUIT TRANSFORMER
XRC/XLC	-	AUX CONTACTORS FOR RAISE/ LOWER OPERATION
SR	-	AUX.CONTACTOR FOR STEP BY STEP OPERATION
C1-C2	-	CAPACITORS FOR TAP CHANGER MOTOR BRAKING
CL	-	CUBICLE LAMP
TH	-	THERMOSTAT
CH	-	SPACE HEATER
MCB	-	MINIATURE CIRCUIT BREAKER
TM	-	TERMINAL BLOCKS

DRIVING MECHANISM

The motor drive mechanism, which provides the driving forces for tap changing, is enclosed in a weather proof case. This is mounted on the side of the transformer and the ratings of the standard units are given below.

Ratings of the standard unit :-

Type	D1	D2
Motor	0.25 HP	0.5 HP
Synchronous speed of the motor	1500 r.p.m.	
Motor Supply	3Ø, 415V, 50 C/s	
Control circuit voltage (derived from 3 phase circuit)	1Ø, 110V, 50 C/s	
Control circuit transformer	1Ø, 415/110V, 500 VA	
Time for 1 Tap changing operation at 50 C/s	5 Secs. (10 Secs at run thro' taps)	
Revolutions of the hand crank for 1 Tap changing operation	24 (48 at run thro' taps)	
Approx. weight	170 Kg.	200 Kg.
Space Heater	1Ø, 240V, 50 C/s, 100 Watts	
Insulation Level	2 kv, r.m.s., 50 C/s, 1 minute	
Approx. quantity of lubricating oil in the gear box	20 Litres	

Components in the Standard Unit

Sl. No.	Description	Device No.
1.	Induction Motor	M
2.	Magnetic contactors for Raise Operation	RC XRC
3.	" for Lower operation	LC, XLC
4.	" for step by step operation	SR
5.	Motor Protection Relays	MPR
6.	Cam operated Raise/Lower Limit Switches	DRLS/ DLLS
7.	Tap Position Indicator/Out of Step Switches	PIS/OSS

Sl. No.	Description	Device No.
8.	Tap position Indicator Resistor	PIR
9.	Cam operated Sequence Switches	DSS 1&2
10.	Brake Contactor	BC
11.	Local-Remote Control Selector Switch	CSS
12.	Raise/Lower Push Bottom Switches	RPB/LPB
13.	Hand operation Interlock Switch	HIS
14.	Capacitors	CI, C2

Sl. No.	Description	Device No.
15.	Fuses	F
16.	Space Heater	H
17.	Heater Switch	HS
18.	Control Circuit Transformer	CCT
19.	Mechanism Protection Timer	MPT
20.	Terminal Blocks, Cables	-
21.	Mechanical Stroke Counter	-
22.	Mechanical Tap position Indicator	-
23.	Handle for Manual Cranking	-
24.	Reduction Gear Box	-
25.	Output Shaft	-
26.	Cable outlet	-
27.	Mechanical Overload Clutch	-
28.	Mechanical Stopper	-
29.	Oil filling plug	
30.	Oil draining plug	-
31.	Oil Level Gauge	

Design :

The Driving Mechanism is provided with a front door which can be opened for handle operation and control switch operation. Fuses, Power Supply ON/OFF Switch, Remote/Local Control Selector Switch and Raise/Lower Push Button Switches are mounted on two control boards. To Prevent electrical operation during manual cranking, the Hand operation Interlock Switch, which is mounted on the back of the Switchboard will open, when the motorhandle change over lever is turned to 'Handle' Position for inserting the hand crank into the shaft. The mechanical stroke counter for registering the total number of tap changing operation carried out and the heater switch are mounted on the fuse board. Readings on the counter can be made zero by turning the knob provided on it for the purpose. It is not necessary to open the door of the mechanism for reading the counter.

Each tap changing operation is mainly controlled by the two cam operated sequence switches, DSS 1 and DSS 2. Switch DSS 1 is used for self-holding the motor supply circuit till the completion of the tap changing operation, irrespective of whether the operation signal is maintained or not after initiating the operation. The second switch DSS 2 in association with the auxiliary relay ensures step by step operation of the tap changer.

A second operation is possible only if the first signal is removed and the second one is given after the first operation.

The cam of the sequence Switches, counter operating lever and the mechanical tap position indicator are fixed to the shaft behind the fuse board.

Tap position of the transformer is indicated in two ways i.e. by a mechanical position indicator, which can be seen through the window on fuse board in the driving mechanism and by a tap switch, which conveys signals to either a facia or a meter type tap position indicator on the remote control panel. When a meter type indicator is provided, the potential divider resistor for connection to tap switch are fixed inside the driving mechanism. An indication wheel with a green zone is provided on the mechanical tap position indicator to indicate the point of completion of tap changing operation during manual cranking. Green zone on the indicator marks the rest position of the tap changer. The indication wheel makes one revolution per operation.

Following devices are provided to prevent tap changing operation beyond limit positions:-

(a) Limit Switches DLLS and DRLS connected to the motor control circuit, acts as the electrical lock at the Lower and Raise Limits respectively.

(b) A mechanical stopper to prevent manual cranking beyond the limit position. When the stopper acts, the mechanical overload clutch will operate to prevent damages to shafts and gears.

The relay board consisting of the magnetic contactors for Raise/Lower and step by step operations, thermal overload relay for motor protection and terminal blocks are mounted on the right hand side of the driving mechanism. When there is an overload, the overload relay will trip cutting off power supply to the motor through contactors RC/LC. The relay can be manually reset by means of a push button or lever provided on it for the purpose. For getting access to the relay board, the side cover of the driving mechanism type D1 can be pulled out after removing 4 bolts. In D2 type a door is provided for the purpose.

In certain driving mechanism a timer relay is fitted which will cut off supply to motor if the tap changing operation is not completed within the preset time.

The reduction gear assembly forms the lowest part of the driving mechanism. The gear box is filled with lubricating oil and provided with oil level gauge, filling and draining plugs. Specification and volume of oil used in the gear box are given on the lubricating chart in the driving mechanism.

Sequence of tap Changing Operation :-

The standard control schematic diagram is shown in fig. 11 Sequence of operation is as follows.

1. Power Supply Voltage at the terminals H 70 to 73-3Ø, 4 - wire, 415 V, 50 C/S
2. Miniature circuit breakers MCB1 and MCB4 closed.
3. Motor Protection Relay MPR closed.
4. Motor / Handle lever in "Motor" position.
5. Switch CSS in Local Position.
6. Raise Push Button RPB in the driving mechanism is pressed.
7. Coil of XRC gets supply and self holds through its own contact.
8. Push Button RPB is released.
9. Coil of RC gets supply through the contact of XRC.
10. Motor M and signal lamp SL 1 at the remote panel get supply through contacts of RC and tap changing operation begins in a direction raising the tap number.
11. Sequence Switch DSS 1 closes and retains RC.
12. Sequence Switch DSS 2 closes and energises coil of SR.
13. Contact of SR in the coil circuit of XRC opens and XRC is de-energised.
14. Sequence Switch DSS-2 opens and SR is de-energised.*
15. Sequence Switch DSS 1 opens at the end of tap changing operation, cutting off supply to RC.
16. Supply to the motor & signal lamp SL1 is cut off due to the opening of contacts of RC and motor comes to rest.

A brake contactor BC is provided to stop the over travel of motor. A capacitor braking arrangement with capacitors C1 and C2 is provided for this purpose. Sequence of operation is identical for lowering except that contactors XLC/LC will be used in place of XRC/RC. The tap changer can be operated through remote control push buttons RRPB and RLPB by putting Switch CSS in Remote position.

* If after initiating a tap changing operation, the push button switch is not released, stepping relay SR will remain energised as long as the push button switch is closed. This will prevent energisation of XRC/XLC as the contact of SR in their coil circuit is open.

EXTERNAL DRIVING SHAFT BETWEEN DRIVING MECHANISM & TAP CHANGER :-

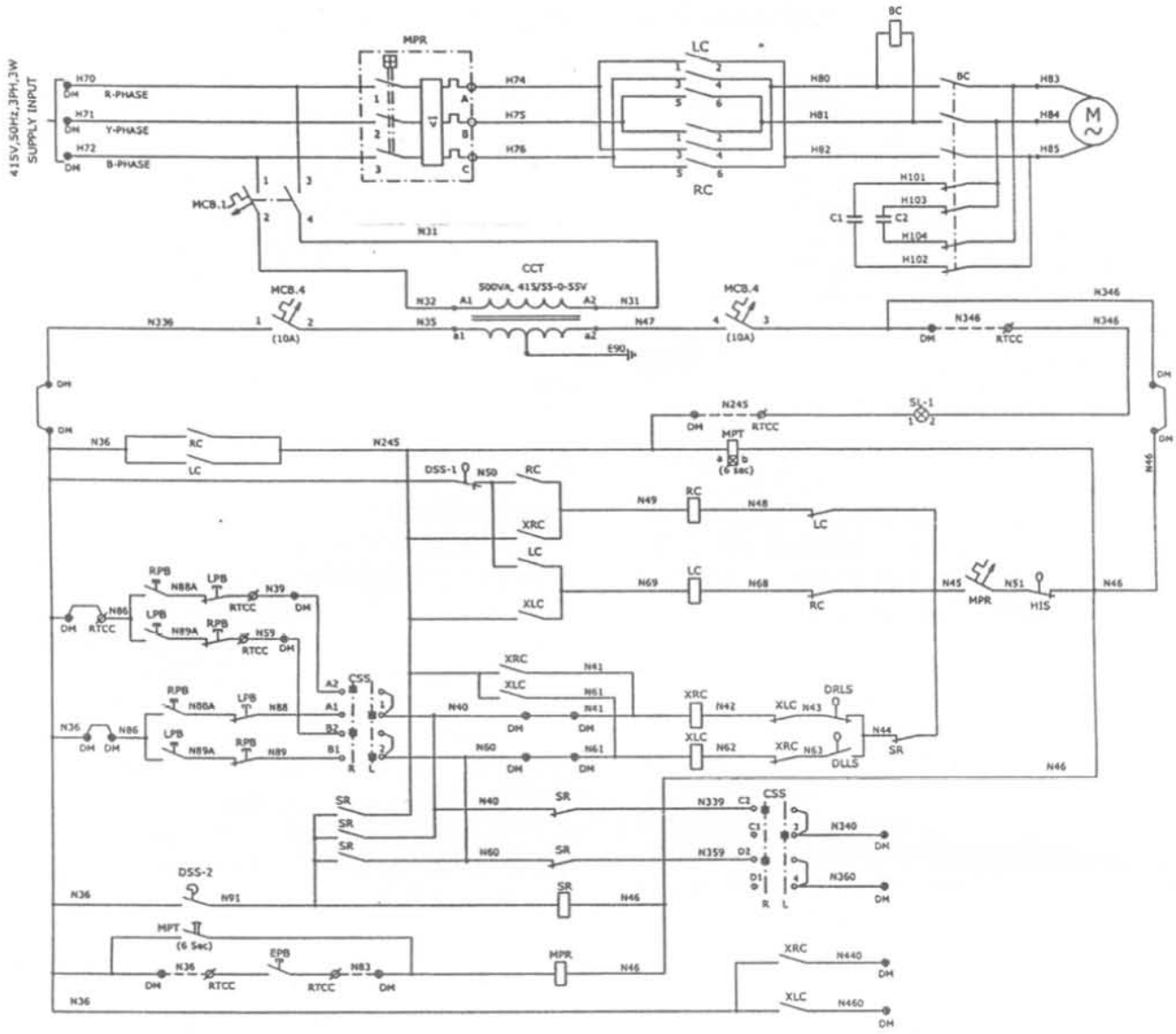
The driving power from the driving mechanism to the tap changer is transmitted by means of a set of vertical & horizontal shafts, which are coupled through bevel gears. Typical constructions of the bevel gear boxes are shown in Fig. 13. The transformer oil used in the gear box for lubrication will be in communication with the oil in the diverter switch chamber. To prevent leakage of oil from the gear box, special rubber "O: Rings are used for the gear box cover and the holes through which the rotating shafts pass. The "O" rings (9) in contact with the rotating shaft is subject to wear and therefore mounted on a holder (4) which can be easily taken out after disconnecting the shafts, for replacing the "O' rings, in case a leak develops.

In the single pole tap changers, there will be only one bevel gear box between driving mechanism and tap changer. But in multipole types, each pole will have its own gear box plus a common gear box above the driving mechanism for coupling horizontal and vertical shafts. Typical arrangements of driving shafts for various types of tap changers are shown in fig. 14. to 19. The couplings and joints in contact with air are greased to prevent rusting and for smooth operation. The coupling shafts between the gear boxes are protected against rain by covers.

SIZES OF STUDS, BOLTS & NUTS

Following sizes are generally used in the tap changer :-

	M5	M6	M8	M10	M12	M16	M20
N Series	X	X	X	X	X	X	X
B Series	X	X	X	X	X	X	
E Series	X	X	X	X	X	X	



SLI - Signal Lamp. DM - Driving Mechanism.
RCS - Remote Control Switch, RTCC - Remote tap Changer Control Cubicle.

Tap Changer is shown at the lower Limit Position.
*For 3Ø, 3 wire supply CCT Terminal A1 is connected to cable H 76 and the primary Voltage Rating of CCT will be 415 Volts

Fig. 11 Standard Scheme for Driving Mechanism Control

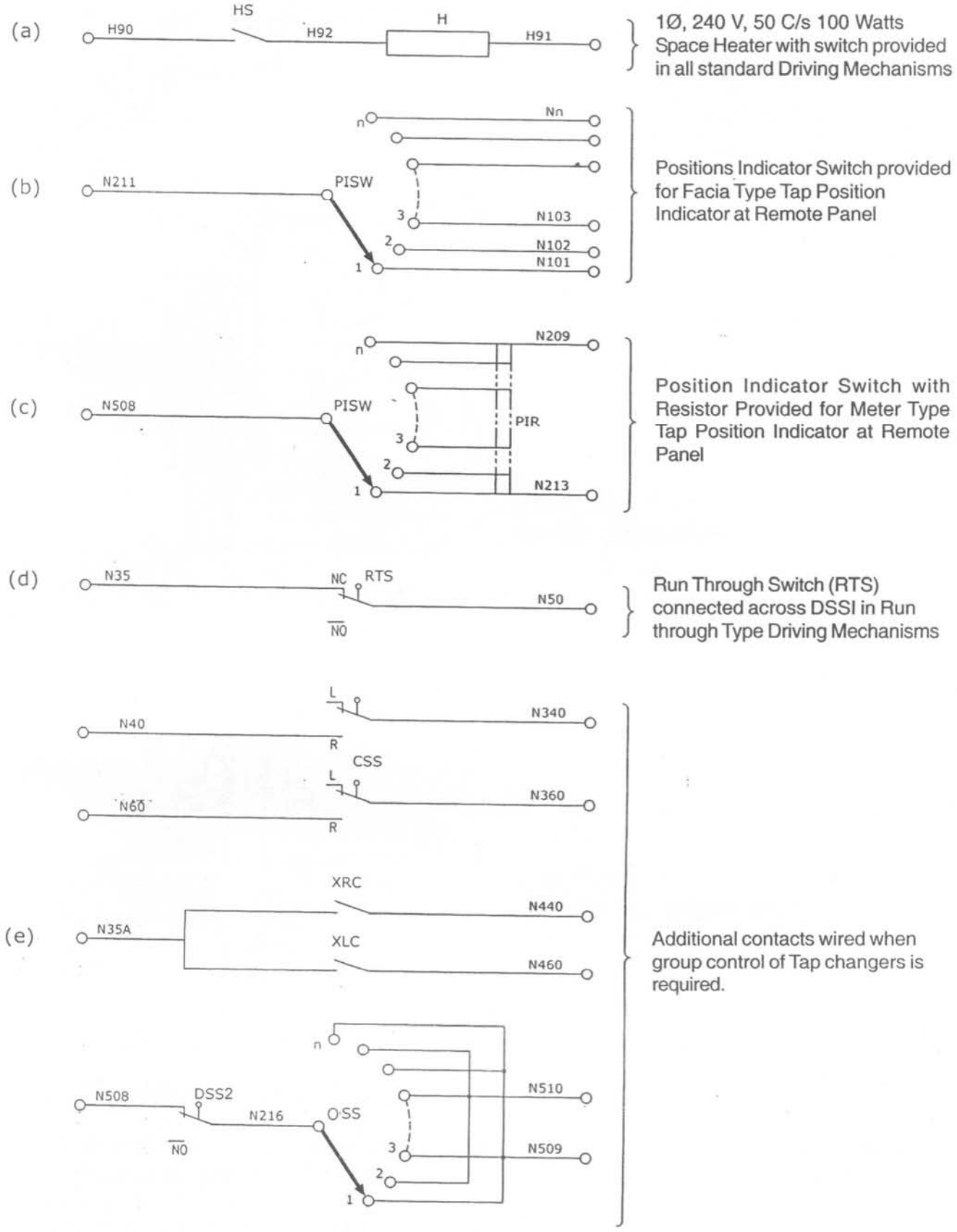


Fig. 12 Typical wiring - of additional accessories in Driving Mechanism

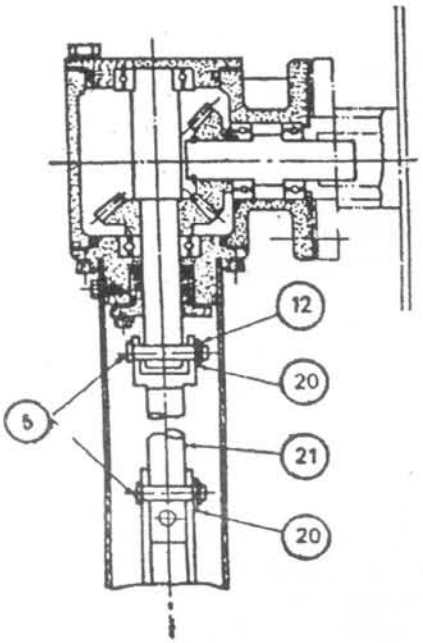


Fig. a. Gear box for 1 Pole OLTC

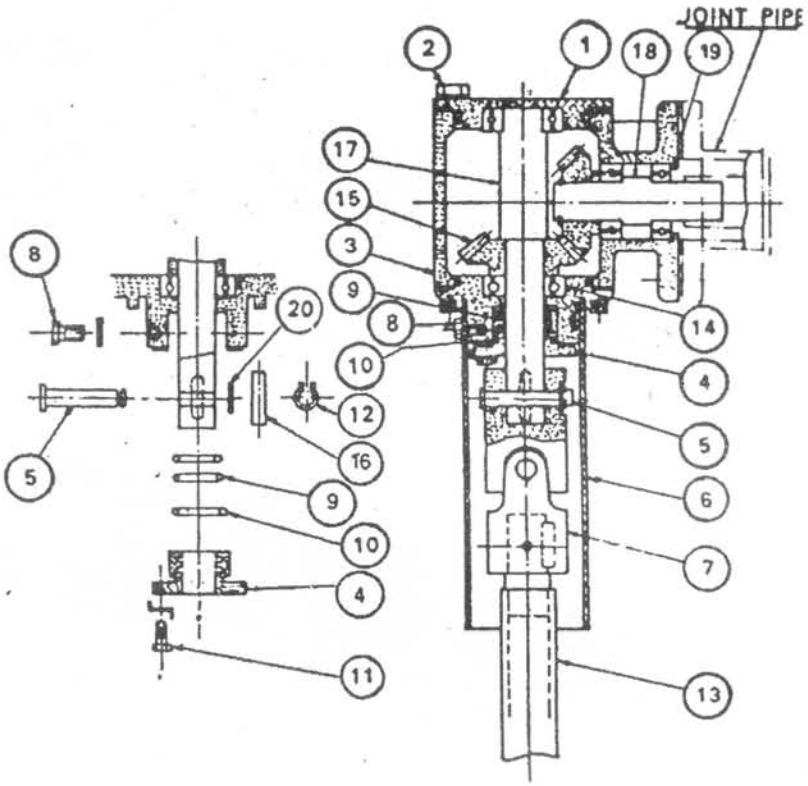


Fig. b. Gear box of Multipole OLTC

1. Bearing Housing
2. Bolt with Spring Washer
3. Gear Box
4. O-ring Holder
5. Pin
6. Protection Pipe
7. Universal Joint
8. Bolt with Spring Washer
9. O-Ring
10. O-Ring
11. Bolt with Lock Washer
12. Circlip
13. Driving Shaft
14. Ball Bearing
15. Bevel Gear
16. Straight Key
17. Gear Shaft
18. Gear Shaft
19. Gasket
20. Washer
21. Coupling Shaft

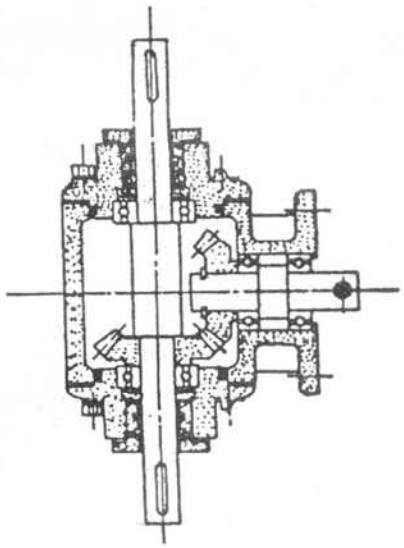
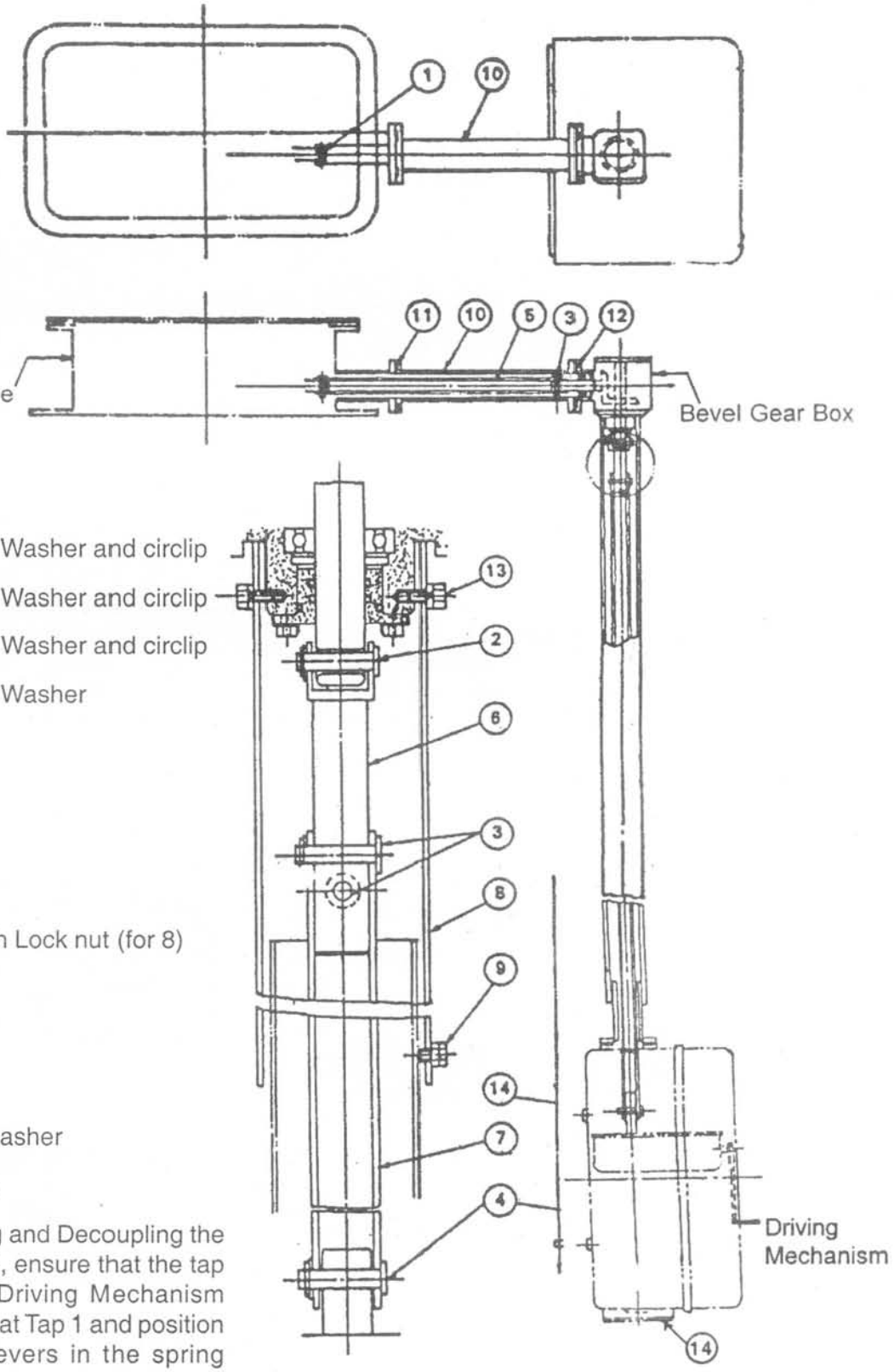


Fig. c. Gear box of Multipole OLTC

NOTE : For removing the cover and shaft Assembly between Driving Mechanism and Bevel Gear Box, first remove the Bolt at either ends of cover (6) and then remove pins (5) (3 nos. as per Fig. and 1 no. as per Fig b)

Fig. 13 Construction of Bevel Gear Boxes

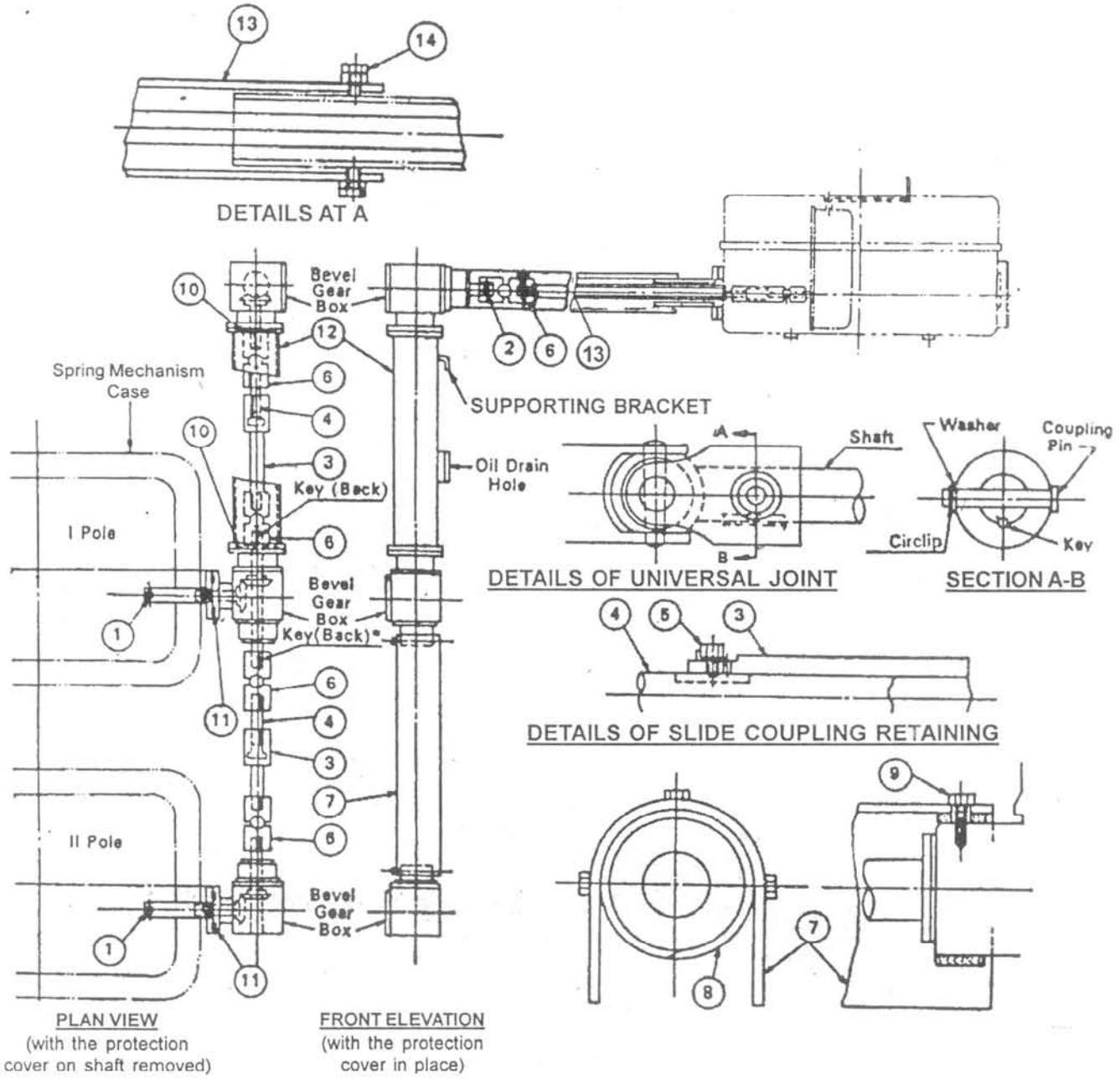


1. Coupling Pin with Washer and circlip
2. Coupling Pin with Washer and circlip
3. Coupling Pin with Washer and circlip
4. Coupling Pin with Washer
5. Shaft
6. Shaft
7. Shaft
8. Protection Pipe
9. Centering Bolt with Lock nut (for 8)
10. Joint Pipe
11. Gasket
12. Gasket
13. Bolt with Spring Washer
14. Cable Gland Plate

Note : Before Coupling and Decoupling the shaft with pins 1 and 2, ensure that the tap position indicator in Driving Mechanism indicates, Green Zone at Tap 1 and position of Springs and the levers in the spring mechanism case corresponding to those at tap 1.

DETAILS OF A & B

Fig. 14 Driving Shaft arrangement for YB1, YB2, 1B2, 1B2, DB2, IE and YE Type tap changer



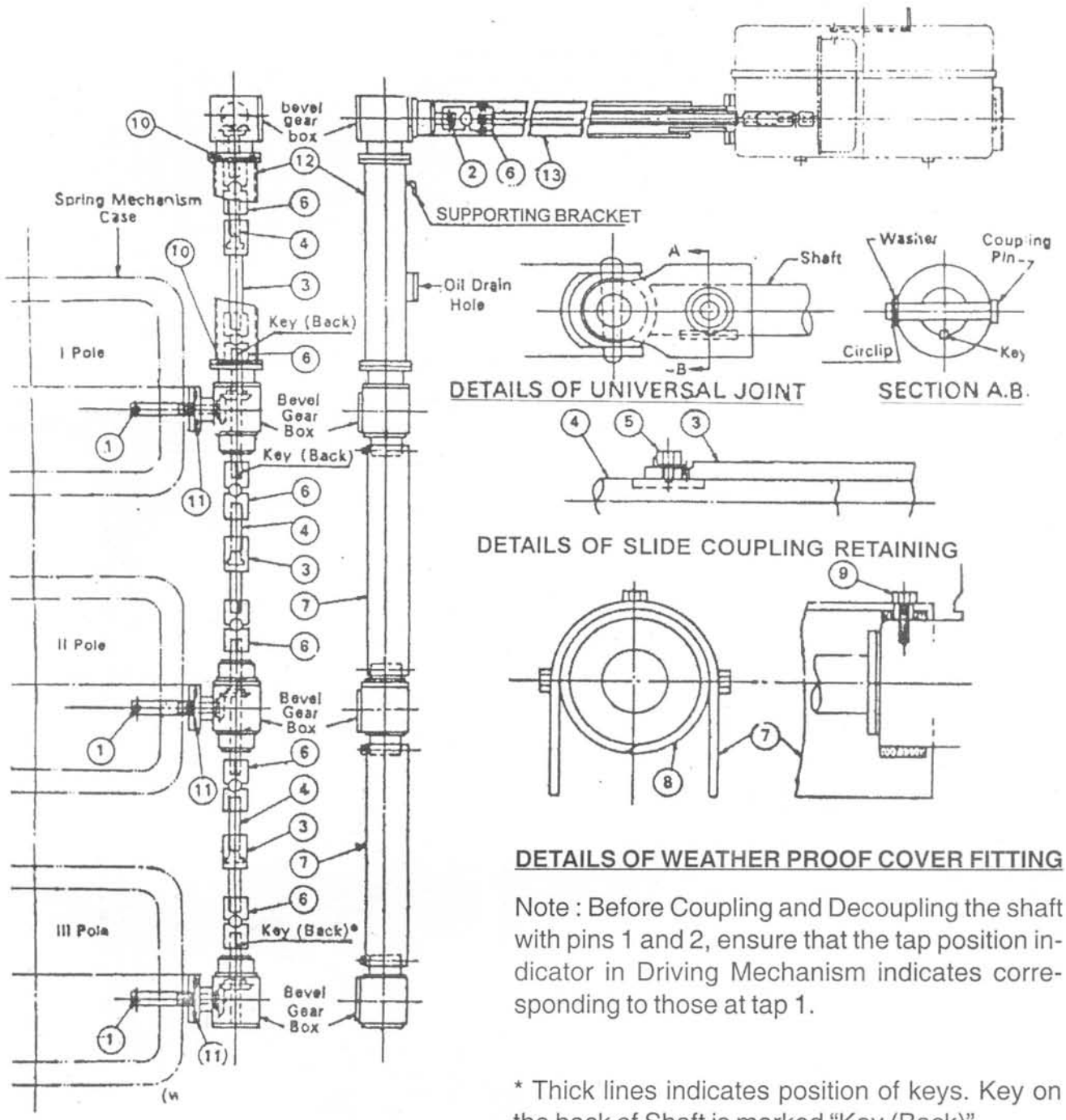
1. Coupling Pin with Washer and circlip
2. Coupling Pin with Washer and circlip
3. Slide Coupling Shaft (Hollow)
4. Slide Coupling Shaft (Solid)
5. Retain Bolt with Lock Washer
6. Universal Joint
7. Protection Cover
8. Packing
9. Bolt for 7
10. Gasket
11. Gasket
12. Joint Pipe
13. Protection Pipe
14. Centering Bolt with Lock nut for 13

DETAILS OF WEATHER PROOF COVER FITTING

Note : Before Coupling and Decoupling the shaft with pins 1 and 2, ensure that the tap position indicator in Driving Mechanism indicates Green Zone at Tap 1 and position of Springs and the levers in the spring mechanism case corresponding to those at tap 1.

* Thick lines indicates position of keys. Key on the back of Shaft is marked "Key (Back)"

Fig. 15 Driving Shaft arrangement for 2B2 and 2E Tap Changer



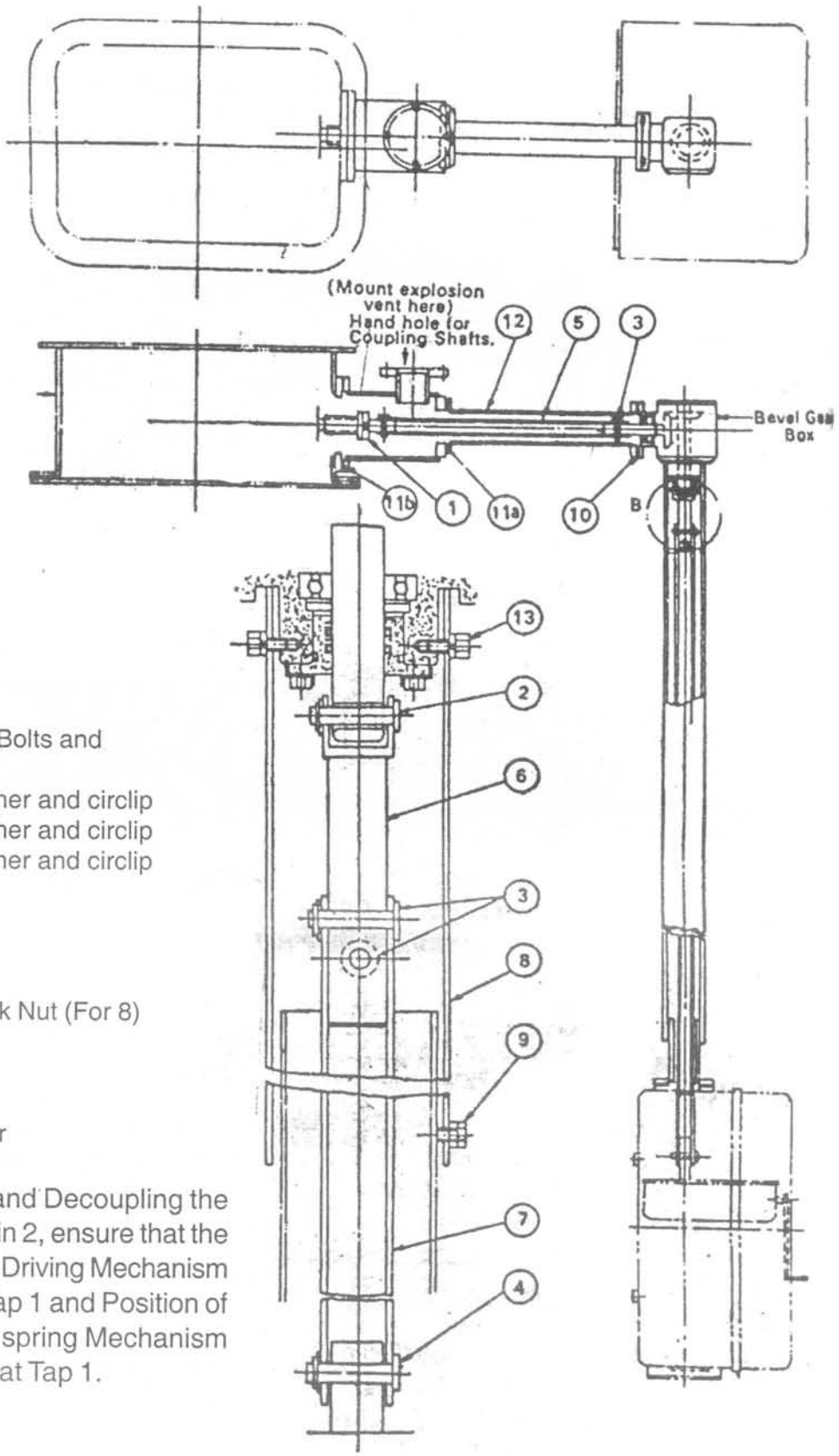
DETAILS OF WEATHER PROOF COVER FITTING

Note : Before Coupling and Decoupling the shaft with pins 1 and 2, ensure that the tap position indicator in Driving Mechanism indicates corresponding to those at tap 1.

* Thick lines indicates position of keys. Key on the back of Shaft is marked "Key (Back)"

1. Coupling Pin with Washer and circlip
2. Coupling Pin with Washer and circlip
3. Slide Coupling Shaft (Hollow)
4. Slide Coupling Shaft (Solid)
5. Retain Bolt with Lock Washer
6. Universal Joint
7. Protection Cover
8. Packing
9. Bolt for 7
10. Gasket

Fig. 16 Driving Arrangement for 3B2 and 3E Tap Changer

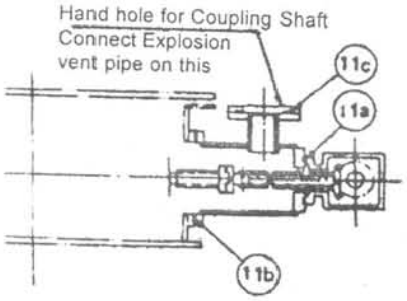


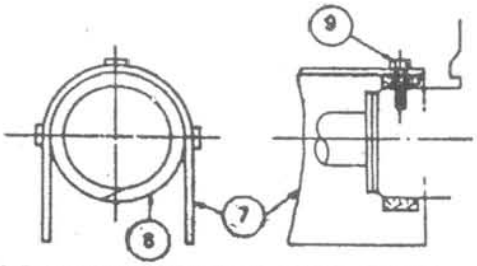
1. Coupling Flanges with Bolts and Spring Washers
2. Coupling Pin with Washer and circlip
3. Coupling Pin with Washer and circlip
4. Coupling Pin with Washer and circlip
5. Shaft
6. Shaft
7. Shaft
8. Protection Pipe
9. Centering Bolt with Lock Nut (For 8)
10. Gasket
11. 11a,b, Gasket
12. Joint Pipe
13. Bolt with Spring Washer

NOTE : Before Coupling and Decoupling the shaft with Flanges 1 and Pin 2, ensure that the tap position Indicator in the Driving Mechanism indicates Green Zone at Tap 1 and Position of Springs and Levers in the spring Mechanism case correspond to those at Tap 1.

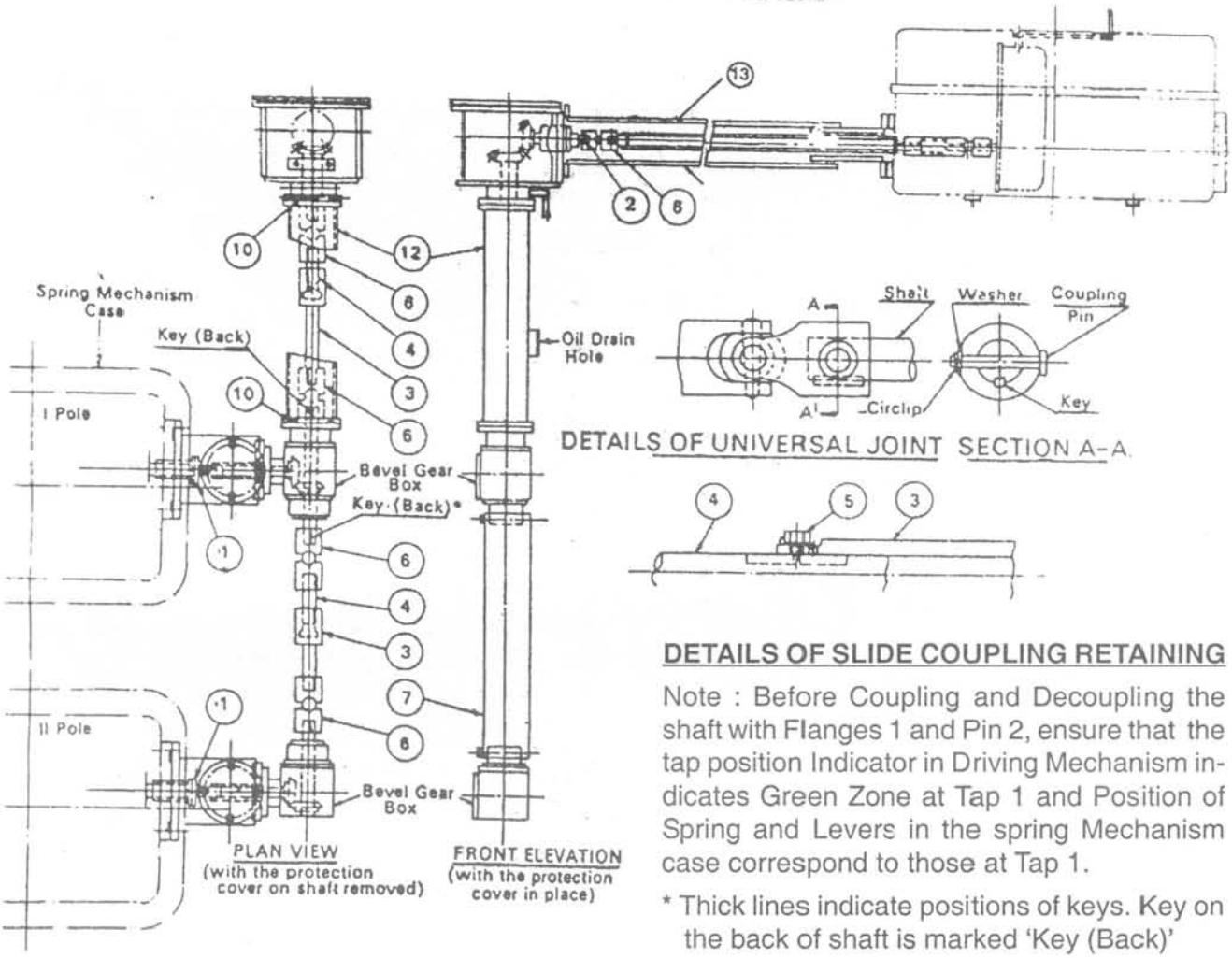
DETAILS OF A & B

Fig. 17 Driving Shaft Arrangement for YN & IN Type Tap Changer





DETAILS OF WEATHER PROOF COVER FITTING



DETAILS OF UNIVERSAL JOINT SECTION A-A

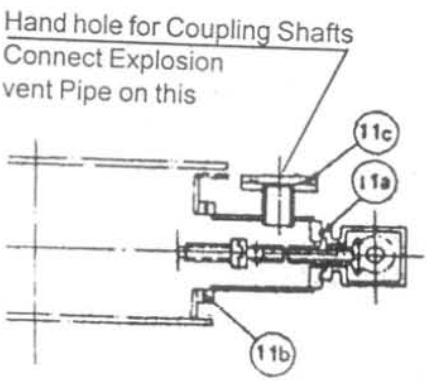
DETAILS OF SLIDE COUPLING RETAINING

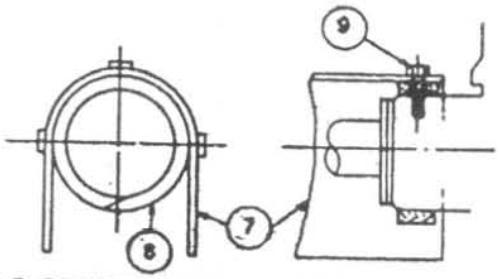
Note : Before Coupling and Decoupling the shaft with Flanges 1 and Pin 2, ensure that the tap position Indicator in Driving Mechanism indicates Green Zone at Tap 1 and Position of Spring and Levers in the spring Mechanism case correspond to those at Tap 1.

* Thick lines indicate positions of keys. Key on the back of shaft is marked 'Key (Back)'

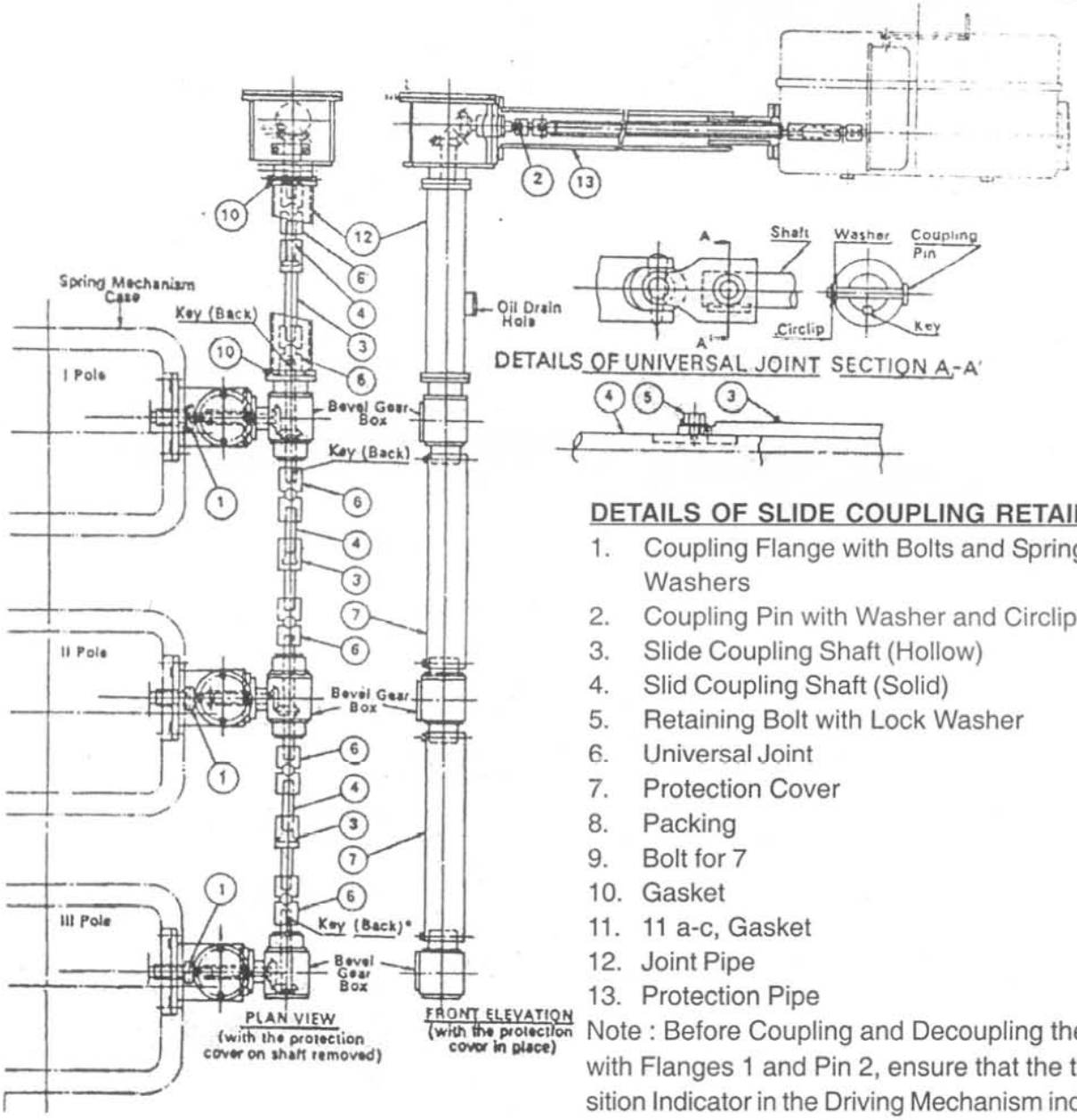
1. Coupling Flange with Bolts and Spring Washers
2. Coupling Pin with Washer and Circlip
3. Slide Coupling Shaft (Hollow)
4. Slid Coupling Shaft (Solid)
5. Retaining Bolt with Lock Washer
6. Universal Joint
7. Protection Cover
8. Packing
9. Bolt for 7
10. Gasket
11. 11 a-c, Gasket
12. Joint Pipe
13. Protection Pipe

Fig. 18 Driving Shaft Arrangement for 2N Type Tap Changer





DETAILS OF WEATHER PROOF COVER FITTING



DETAILS OF UNIVERSAL JOINT SECTION A-A'

DETAILS OF SLIDE COUPLING RETAINING

1. Coupling Flange with Bolts and Spring Washers
2. Coupling Pin with Washer and Circlip
3. Slide Coupling Shaft (Hollow)
4. Slid Coupling Shaft (Solid)
5. Retaining Bolt with Lock Washer
6. Universal Joint
7. Protection Cover
8. Packing
9. Bolt for 7
10. Gasket
11. 11 a-c, Gasket
12. Joint Pipe
13. Protection Pipe

Note : Before Coupling and Decoupling the shaft with Flanges 1 and Pin 2, ensure that the tap position Indicator in the Driving Mechanism indicates Green Zone at Tap 1 and Positions of Springs and Levers in the Spring Mechanism case correspond to those at Tap 1.

* Thick Lines indicate positions of keys. Key on the back of shaft is marked "Key (Back)"

Fig. 19 Driving Shaft Arrangement for 3N Type Tap Changer

TRANSPORTATION OF TAP CHANGER :-

The tap changer shall never be transported without supporting the tap selector gear box rigidly to the transformer tank or to the transportation tanks by means of transportation brackets. While fixing the bracket, the tap changer cylinders shall not be subjected to any stress however light it may be. Excessive stress will result in the cracking of the cylinders at the fixing points.

The cover of explosion vent shall be suitably fastened at the time of transit, to prevent damages to the diaphragm plate. If it is broken when fitted on the tap changer during transport, the tap changer will come in contact with atmospheric moisture.

During the transportation, the tank containing the tap changer and the diverter switch chamber shall be filled either with dry and pure nitrogen or transformer oil. However when filled with oil, care shall be taken to see that there is provision for expansion of oil, without abnormal pressure rise, due to ambient temperature variations. It is advisable not to fill the diverter switch chamber alone with oil and the tank with nitrogen during transportation.

If the tap changer is transported by road, care shall be taken to see that it is not subjected to any Jerk or impact forces. The speed of the transportation Vehicle shall be restricted to avoid jerks on rough roads and sudden braking. The insulation materials used are fragile and therefore the equipment shall be handled very carefully.

The driving mechanism is packed in wooden crate. The gear box is filled with lubrication oil, and therefore it shall not be tilted or rested on its sides, to avoid leakage of oil.

The parts of external driving shaft, are also packed in wooden cases. Those parts which are not painted, are greased or oiled and covered with waterproof paper before packing. Transformer oil is to be used for oiling parts which come in contact with diverter switch oil during service. Such parts are not greased.

INSPECTION OF TAP CHANGER ON ITS RECEIPT

As soon as the transformer or the package containing the tap changer is received, following inspections shall be done positively.

1. Checking the nitrogen gas pressure inside and outside the diverter switch chamber. A positive pressure will be indicated if there is no leak.
2. Checking whether the transportation bracket fixed between the tap selector intermittent gear box and the tank is intact.
3. Checking of the insulation cylinders and plates especially at the bolted positions for any cracks occurred during transportation. Since the upper end of the diverter switch cylinder fixed to the mechanism case from inside, the inspection of the upper bolting positions can be carried out only by opening the mechanism case cover.

Before releasing the nitrogen gas, care shall be taken to see that the tap changer is impregnated with good transformer oil. As soon as the inspection is over, the tap changer shall be either kept in an atmosphere of nitrogen or immersed in good transformer oil. Under no circumstances it shall be kept in atmospheric conditions for more than 8 hours. In case it is exposed to such conditions for more than prescribed time, the insulation strength can be regained to some extent by drying under vacuum for about 24 hours at 100^0 C and then by impregnating with transformer oil. Vacuum shall be applied simultaneously both outside and inside the diverter switch chamber. The tap changer under storage shall be kept completely sealed from air and moisture before and after drying.

When the tap changer is taken out from the tank, the tap changer parts, especially the insulation parts, shall not rub against the tank and other materials.

If long storage of parts of the driving shaft is required on receipt at site, same shall be oiled periodically to prevent rusting. The bevel gear box shall be filled with transformer oil. Oil filling can be done through the bearings on the output shaft. The main cover of the gear box need not be opened for this purpose. In case any transit damage or missing of any part is noticed, it shall be reported to the insurance company and the supplier immediately.

INSTALLATION AND COMMISSIONING OF THE TAP CHANGER ON TRANSFORMER

1. The tap changer despatched in nitrogen or oil filled tank is ready for service in the transformer without any drying process, provided it is not exposed to atmospheric conditions for more than 8 hours. The tap changer, if despatched in nitrogen filled tanks shall be impregnated with good transformer oil, before breaking the N2 sealing. If drying is required it can be carried out along with the transformer also. But the tap changer once dried shall be operated only after impregnation with oil. Please note the application of heat external to the tap changer alone is not sufficient to dry the contact compartment which is mounted inside the sealed chamber of diverter switch.
2. Remove transportation bracket of the tap selector gear box and the clamp, if any, used for the cover of the explosion vent. However the chain used for tying the cover shall not be removed.
3. Inspect all the bolted points of insulation plates and cylinders for any cracks. This inspection need not be carried out if it has been already done and the tap changer is not transported afterwards.
4. Connect all the tap lead wires to the tap changer as shown in the transformer internal assembly drawing. While connecting the lead wires, care should be taken to see that the tap selector is not pulled to one side due to tension in the lead wires. If the connections are already there ensure that these are not loose. Permissible torque for tightenting the M 12 nuts on tap changer terminals is 3 kg.m.
5. Mount the driving mechanism, bevel gear boxes and couple all the horizontal shafts between gear boxes and mechanism cases as per the relevant drawing (figs to 14 to 19). For coupling, ,use the pins, washers and circlips provided. Circlips rusted or cracked, or which has lost the spring action shall not be used. The top surface of the driving mechanism gear box shall be perfectly on the horizontal plane. In type DI driving mechanism tie roads of adjustable lengths are provided for correctly aligning the gear box. In D2 type, the supporting brackets shall be suitably adjusted to set the gear box on the horizontal plane. All the shafts shall be correctly aligned so that there is no excessive torque on the shaft. The rotating shafts and their parts shall not rub against shaft covers.

AT THIS STAGE, DO NOT COUPLE THE VERTICAL SHAFTS FROM THE DRIVING MECHANISM TO THE BEVEL GEAR BOX

6. The air release pipe of the tap changer pocket and the pipe to the tap changer conservator may be connected as indicated in the transformer drawing.
7. Fill the diverter switch with good transformer oil, till the level of the oil just touches the inside top surface of the pipe leading to the gas and oil operated relay. A cushion of air shall be left on the top of the mechanism case. Break Down Voltage of the oil shall be more than 50 KV when tested as per I.S.335. Close the mechanism case and fill the tap changer conservator with oil.

BEFORE COUPLING THE VERTICAL SHAFTS BETWEEN THE BEVEL GEAR BOX AND THE DRIVING MECHANISM, FOLLOWING WORK SHALL BE CARRIED OUT

8. Check whether there is lubricating oil in the driving mechanism gear box. If the oil level is low, add more oil, specifications of which are given in the lubricating chart on the gear box.
9. Check whether all the control cabling between the driving mechanism and the remote control panel are as per the schematic diagram supplied. Ensure that the 3 phase power supply given to driving the mechanism is in correct phase sequence.

10. Turn the "Motor - Handle" lever to "handle" position. This will open the motor start up circuit. However it is safer to switch off the supply to the motor circuit also before operating the tap changer mechanically. Insert the handle into the slot in the hand operating shaft and operate the tap changer from the first tap to the last tap and vice - versa. When the handle makes 24 turns, one tap changing operation is completed. Check whether the mechanical stopper and clutch act after the extreme taps.
11. Prepare the driving mechanism for motor operation by setting it on the mid tap position. Note that the green zone on the tap position indication wheel should be under the arrow mark. Change the "Motor - Handle" lever to "Motor" position and close the tap changer supply isolator switch. The driving mechanism is to be set on the mid tap position because emergency measures can be taken even if the tap changer operates in the wrong direction.
12. Check whether the mechanical tap position indicator and the remote tap position indicate the same tap number.

DO NOT COUPLE THE SHAFTS OF THE BEVEL GEAR BOX AND THE DRIVING MECHANISM AT THIS STAGE

13. Motor protection timer (MPT), if provided for the detection of delayed operation of the tap changer is to be checked next. For this mechanically operate the raise magnetic contactor RC. The motor will start running till the power supply is cut off by the timer which will operate after the preset time. Note down the time from the instant of RC contact closing to the timer contact opening in the motor circuit. The time setting shall be 20% more than the normal time required for one tap changing operation. If it is not correct adjust the timer.
14. After checking the timer bring back the driving mechanism to the middle tap by manual cranking. Then operate it through all tap position in Raise/Lower directions by local electrical control. When a raise signal is given, the tap changer shall move in a direction raising the tap number. Check the step by step operation and the operation of the limit switches at the extreme taps. If the limit switches do not act at the extreme positions, supply to the motor shall be cut off immediately and the faulty connection to the limit switches rectified. Do not operate the driving mechanism for more than 3 or 4 operations at a stretch as otherwise the motor protection relay (MPR) will operate due to the starting current of the motor, cutting of supply to motor.
15. As the next step, remote electrical operation is to be checked. For this put the Remote-Local selector switch in remote position and operate the driving mechanism by means of the control switch mounted on the remote control panel. Operate the driving mechanism through all tap positions both in the raise and lower directions.
16. After the above checks, position of the tap selector and diverter switch in the transformer shall be determined before coupling the driving mechanism. For this, apply a low A.C. voltage of 200 volts or 400 volts to the H.V. side and measure the L.V. side voltage. See whether the ratio thus obtained tallies with the ratio on the first tap as per the transformer rating plate. Normally the tap changer is set on the first tap before despatching. The diverter switch main springs and levers, have only 2 rest positions as shown in Fig. 18 through out the operating range of the tap changer. The position corresponding to the First tap and Second tap are indicated on the tap changer name plate.
17. Set the driving mechanism on tap No. 1. The green zone of the tap position indicator wheel shall be under the arrow mark. With the driving mechanism set in this manner and the position of diverter switch springs and levers corresponding to those at tap I, couple the vertical shaft between the bevel gear box and the driving mechanism.
    While coupling shafts between the different poles of multipole tap changers, it has

to be ensured that all the poles are on the first tap.

IF COUPLING IS DONE WHEN THE DRIVING MECHANISM AND THE TAP SELECTOR ARE ON DIFFERENT TAPS, IT WILL RESULT IN WRONG VOLTAGE RATIOS ON ALL TAPS.

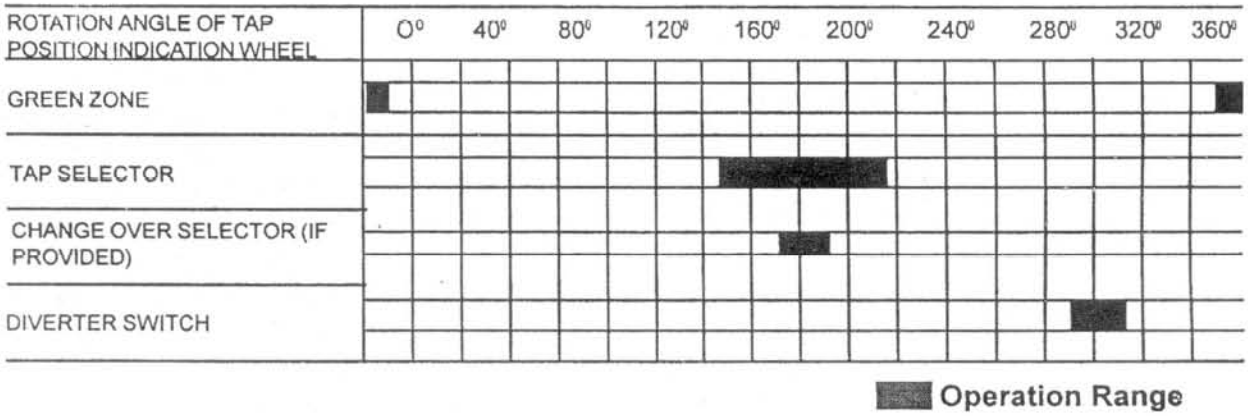
18. Operate the tap changer mechanically from the first tap and then bring back to the first tap to the last tap and then bring back to the first tap. Take voltage ratios on all tap by applying a low voltage (200 V or 400V AC) on the H.V. side and verify whether the values are as per the specification of the transformer. The voltage on the L.V. side must not drop to zero while changing taps and voltmeter shall be observed during the operation for verifying this. DO NOT APPLY MORE THAN 400 VOLTS FOR TAKING THE VOLTAGE RATIOS. While operating the tap changer, heaviness will be experienced at the position where the tap selector and diverter switch operate. For one tap changing operation, the tap position indication wheel with green zone will rotate through 360°. Normally the tap selector operates at about 180° and the diverter switch at 310°.

The tolerance zone for the operation of tap selector and diverter switch are giving in fig. 20. Take care to see that the number of crank handle rotations from the centre of green zone to the point of the diverter switch operation is almost the same for both raise and lower tap changing operations.

If the operation does not take place within the tolerance zone, it can be only due to the wrong coupling of diverter switch and driving mechanism shafts and may result in wrong voltage ratios on all taps.

Abnormal heaviness shall not be felt in any of the tap while operating the tap changer mechanically. If it is there, it can be only due to improper alignment of external shafts and its supports. After the satisfactory mechanical operation, the tap changer can be operated first by local electrical and then by remote electrical controls.

19. After completing all the above checks on the tap changer, the transformer can be vacuum oil filled. Out side and inside of the diverter switch chamber shall be evacuated simultaneously after closing



NOTE : Tap selector and change over selector will not operate during the first tap changing operation in the reverse 20 direction.

Fig. Sequence diagram for tap changing operation.

the stop valve between the tap changer conservator and the mechanism case. The valve shall be opened after vacuum filling. The explosion vent of the tap changer is capable of withstanding vacuum.

A high voltage shall be applied only if the voltage ratios and sequence of the tap selector and diverter switch operations are correct. The gas and oil operated relay of the tap changer shall also be checked for correct functioning.

When two or more tap changers are to be operated in parallel, it is necessary to ensure smooth individual operation before putting them to parallel control. All wirings between the driving mechanism and control cubicles shall be done as per the schematic diagram. If any connections is wrong or missing, it will result in the mal-operation and out of step alarm will be given.

When the remote control cubicle is equipped with an Automatic Voltage Regulating Relay, the tap changer can be put in automatic control by means of Auto/Manual selector switch.

PRECAUTIONS

1. Before disconnecting mechanically coupled parts, bring the driving mechanism to tap no.1. The center of green zone on the tap position indication wheel shall be under the arrow mark. While re-coupling ensure that the selector, diverter switch and driving mechanism are on tap 1 with centre of the green zone against the arrow mark.

Avoid indiscriminate overhauling. It is advisable not to disconnect the mechanically coupled parts unless it is absolutely necessary. Mating marks shall be made to denote the position of all moving components with respect to stationary parts before disassembly. Surface of insulation materials shall not be scratched for the purpose of marking.

In the B series tap changer, a name plate with an arrow mark is fixed inside the mechanism case, for correctly inserting the contact compartment into the diverter switch chamber. The white mark given on the edge of the contact compartment cylinder shall be against the arrow mark while inserting into the diverter switch chamber.

Whenever a moving part is disconnected, Voltage ratio of the transformer on all taps shall be checked after re-assembly, giving special attention, that there is no discontinuity at the time of operation and tap selector and diverter switch.

Voltage ratios shall also be taken whenever the tap lead wires, which are disconnected at the tap selector terminals, are reconnected.

High Voltage to the transformer shall be applied, only if the voltage ratios obtained are correct. Any miscoupling or misconnection will result in wrong voltage ratios.

2. The gases collected in the conservator and the mechanism case are combustible and hence adequate precaution is to be taken to avoid fire hazards while releasing gas during inspection.
3. Before recommissioning the tap changer after inspection, ensure that the cushion of air is left on the top of the mechanism case.
4. Whenever possible, inspect coupling pins bolts, nuts and other fasteners. Tighten the parts which are loose. Replace cracked or rusted or missing components and take action to avoid the recurrence of the same defects. All the bolts and nuts used shall be locked whenever a reassembly is required. Failure to lock fasteners or improper locking may lead to the failure of the equipment itself. All joints of current carrying parts except the spring loaded contact points shall be rigidly connected.
5. Filtering or replacing oil under certain circumstances may cause static charge to

build up which may cause explosion. To prevent this, inject nitrogen in to the gas spaces of mechanism case for diluting the explosive gases, before filtering oil.

6. When replacing oil in the diverter switch chamber, thoroughly clean it before re-filling with good oil.
7. If dirt is seen on the insulation materials or on contact points, clean with them soft cloth without leaving scratches on the materials.
8. If abnormal noise is heard during the operation of the tap changer, It shall be investigated and remedial measures taken.
9. Eventhough the tap changer is capable of satisfactory operation at the maximum capacity, from one extreme tap to other at a stretch, large amount of heat is generated in the contact compartment due to the switching action. Therefore to reduce thermal stresses, It will be better to allow a time gap of a few seconds between successive operations when consecutive operations are required in an energised but unloaded transformer, in which case switching of circulating current will take place.
10. If the transformer with On-load Tap changer is kept in the de-energised state for a long time, check the BDV of the diverter switch oil before recharging the transformer.
11. The power supply voltage to the driving mechanism shall be maintained within 110% and 85% of the nominal voltage, for its satisfactory working. Voltage variations out side this range, will reduce the life of control equipments.

TAP CHANGER MAINTENANCE SCHEDULE

Sl No.	Inspection Frequency	Inspection Item	Check	Remarks
1.	Daily	Digital Counter on the Driving Mechanism	No. of Tap changing operation carried out	Record the cumulative no. of operations carried out from the date of first commissioning of the transformer.
2.	"	Tap changer conservator	Oil Level	If low,top up with new dry oil, if the level is going up without adding oil, report the matter to TELK
3.	"	Explosion Vent	Diaphragm Plate	Repalce if cracked or broken.
4.	"	Space Heater in the Driving Mechanism	-	Switch on the heater if the ambient temperture falls below 20°C. Heater need be switched off only when the ambient temperature goes above 30°C
5.	Half yearly or after every 5000 operations	Oil in the Diverter Switch	(1) Dielectric strength	Filter or replace if BDV is less than (a) 30 kv (min) for Neutral end (b) 40 kv (min) for line end at gap of 2.5 mm between spheres of 12.7 mm diameter. Inspection frequency is to be increased if rate of deterioration of oil is faster.
			(2) Water Content	(a) 40 ppm for Neutral end (b) 30 ppm for line end of Oil should be replaced or reconditioned if ppm value exceeds the limit. Measure the water content of oil by using Karl Fisher method.
6.	Yearly	Gasket Joint	Oil leak	Tighten the bolts evenly to avoid uneven pressure or replace the gaskets.
7.	"	"O" rings in the Bevel Gear Box	-	Replace "O" rings if there is leak. Dip the "O" rings in transformer oil before inserting in to the "O" ring grooves.
8.	"	Universal Joint and other driving shaft parts which are not painted, but in contact with air	-	Apply grease to prevent rusting Lubricant - Servo Gem Ep2

Sl No.	Inspection Frequency	Inspection Item	Check	Remarks
9.	Yearly	Gas and oil operated relay	Correct Working	Rectify defects if any observed
10.	"	Aux. relays and contactors	Rusting of core, dirt on contacts, chattering etc.	Clean or Replace
11.	"	Time relays	Time Setting	Adjust if the setting is too low or high.
12.	"	Control cable connections	Loose cable connections at the terminal of relays, rotary and push button switches cam switches, hand operation interlock switch, motor, aux. transformer, terminal blocks etc.	Tighten the terminal screws if found loose.
13.	"	Lubricating oil in the gear box of driving mechanism	Low oil level	Add or replace oil. Lubricating oil - ISO. No. 68 (Bharat Hydrol 68 - BP Enklo 68 - HP, Servo System 68-10C Perfector 68 - Castrol) SAE 30
14.	"	Electrical resistance of driving mechanism.	The resistance shall be more than 2M. Ohms at 20°C on a 500 V megger	If the reading is too low, investigate and recifty
15.	"	Feed Back Data	-	Please supply the information sought in the feed back data sheet to TELK every year positively.

Sl No.	Inspection Frequency	Inspection Item	Check	Remarks
16.	After every 50,000 operations or every 5 years after commissioning whichever is earlier	Diverter switch contact compartment	Thickness of arcing contacts	Replace all the contacts if thickness of any one of the arcing tips is reduced to 2 mm. This inspection may be carried out in the presence of TELK's authorised representatives.
17.	Every 10 Year	Tap Selector	Electric discharges on the surface of insulators, moving and stationary contacts, smooth operation of gear and other moving parts.	If any thing abnormal is observed, report to TELK

CHECK LIST FOR LOCATING SOURCES OF TROUBLE IN THE TAP CHANGER CONTROL CIRCUIT

This is prepared based on the standard control scheme given in fig. 11. The actual scheme employed in the tap changer supplied be slightly different. However, the approach for solving th eproblem remains the same. Before checking electrical control, ensure that the mechanical operation of tap changer from first tap to last tap and vice-versa is free.

Sl No.	Nature of fault	Direction of Operation	Reasons for the fault	Remedial measures
1.	Tap change operation not taking place on giving a signal from the driving mechanism and there is no 'Tap change Progress' lamp indication	Both in Raise and Lower directions	(a) Power failure (b) Blown fuses (c) Switch TCSIS open (d) Hand operation Interlock switch (HIS) open (e) Motor Protection Relay (MPR) not reset after an overload tripping (f) Remote/Local change over switch (CSS) in remote position (g) Normally closed contact of SR in the coil circuit of XRC/XLC open (h) Loose cable connections	(a) Restore Supply (b) Replace fuses (c) Close the Switch (d) Reset the motor/handle lever to Motor position (e) Reset the relay manually (f) Put the switch on local position (g) Clean the Core & Contacts of SR and check the operation. If the trouble persists replace the relay. (h) Check for loose cable connections in the circuit of Raise/ Lower switches and availability of control voltage on the switch terminals. Rectify defective connections.

Sl No.	Nature of fault	Direction of Operation	Reasons for the fault	Remedial measures
2.	Same as 1.	Only in Raise direction	(a) Coil of XRC not getting supply when a signal is given, (b) Coil of R.C. " (c) Terminal of the XRC coil is getting supply when a signal is given. But the contactor not operating. (d) Terminal of the RC coil is getting supply when a signal is given. But the contactor not operating.	(a) Check for loose cable connections and improper making of contacts of relays and switches in XRC coil circuit and rectify defects, if any. (b) Check for loose cable connections and improper making of contacts of relays and switches in RC coil circuit and rectify defects, if any. (c) Clean the core & contacts of the contactor and try to operate it separately. In case after cleaning, the working is not satisfactory or there is chattering, replace the contactor. (d) Clean core & contacts of the contactor and try to operate it seperately. In case after cleaning, the working is not satisfactory or there is chattering, replace the contactor.
3.	Same as 1.	Only in Lower direction	Similar to 2a to 2d. But the defect may be either in the coil circuits of contactors XLC/LC or in the contactors themselves in place of XRC/RC	Actions similar to 2a to 2d

Sl No.	Nature of fault	Direction of Operation	Reasons for the fault	Remedial measures
4.	The Tap changing operation not taking place on giving a signal from driving mechanism. But there is "Tap change in Progress" lamp indication.	Both in Raise & Lower directions	(a) Blowing of fuse in the motor circuit. (b) Loose cable connections in the motor circuit (c) Mechanism Protection Timer (MPT) (If provided) is in the energised state with its contact in the motor circuit open.	(a) Replace fuse (b) Rectify faulty connections. (c) Check the time setting of the relay. If it is not correct, adjust, Please note that (a) & (b) will also lead to the operation of MPT.
5.	Do	Only in Raise direction	Chattering of Magnetic contactor XRC or RC	Clean the core and contact or XRC or RC as the case may be. If trouble persists, replace the defective contactor.
6.	Do	Only in Lower direction	Chattering of Magnetic contactor XLC or LC	Clean the core and contacts or XLC or LC as the case may be. If trouble persists, replace the defective contactor.

Sl No.	Nature of fault	Direction of Operation	Reasons for the fault	Remedial measures
7.	Driving Mechanism does not stop after an operation and the "In Progress" lamp continues to burn.	Both in Raise & Lower directions	(a) Relay SR not getting supply during an operation. (b) Relay SR getting supply at the middle of operation, but it is not operating to de-energiese XRC/XLC	Check the coil circuit of SR for improper closing of cam switch DSS-2 and loose cable connections and rectify defects, if any. Clean the core & contacts of SR and check the working separately. If the defects persists, replace the contactor.
8.	Do	In Raise direction only.	(a) XRC not resetting after an operation. (b) RC not resetting after an operation.	(a) Check whether XRC is mechanically stuck. If so, clean the contactor and test its working separately. Replace the contactor in case it is necessary. (b) Some procedure as in the case of (a)
6.	Do	Only in Lower direction	(a) XLC not resetting after an operation. (b) LC not resetting after an operation.	(a) Same procedure as in the case of 8(a) (b) Do

TAP CHANGER FEED BACK DATA

(To be filled and returned to TELK by the user of Tap changer in the first week of January every year)

Date :

Period : Jan 1, 20..... to Dec. 31, 20..... Customer's Name.....Sub station.....

Specification of the Equipment	Make	Sl. No.	No. of Phases	Capcity	Voltage Rating of the winding with the tap changer (Phase Value)	Rate of Voltage Variations	Range of Voltage Variation
Transformer				.....MVA	.....kV	.....%	.....%

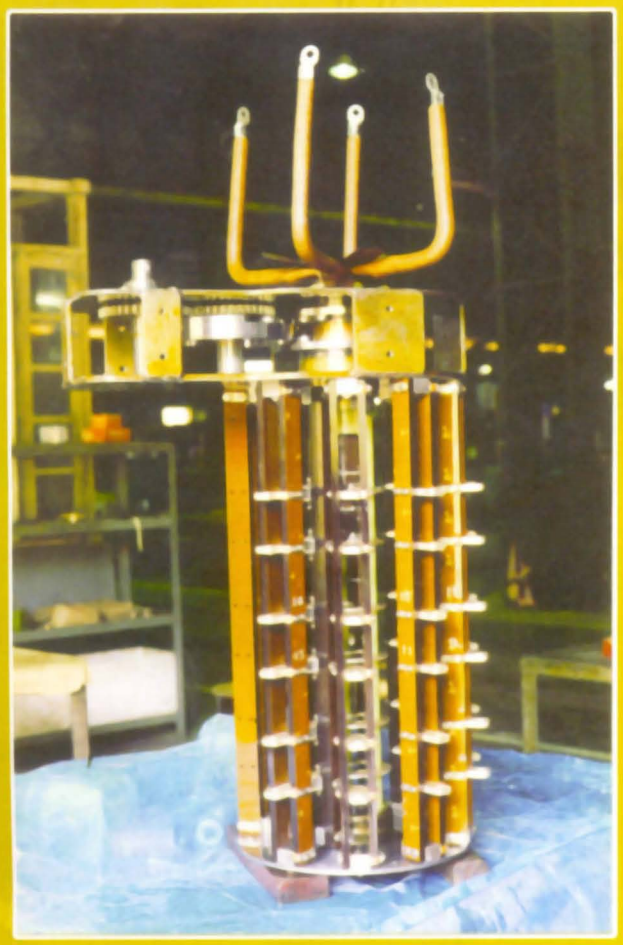
	Make	Serial No.		Type		No. of Taps	Date of First Commis-sioning	Cumulative no. of tap changing operations carried out till date
		Tap Changer	Driving Mecha-nism	Tap Changer	Driving Mecha-nism			
Tap Changer								

MONTHLY DATA		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
No. of Tap changing operations carried out													
Load current thro' the tap Changer Amps	Max.												
	Min.												
Control Supply Voltage ..... Volts	Max.												
	Min.												
Ambient Temperature.....^{0}C	Max.												
	Min.												
BDV of Divertor Switch Oil_kV													
Total No. of hours kept in the de-energised state													
No. of trippings of transformer protection Circuit breakers due to overload or short circuit in the system													
Tap used	Max.												
	Min.												

DETAILS OF TROUBLES NOTICED / REMEDIAL ACTION TAKEN / REPLACEMENTS & INSPECTION CARRIED OUT

Sl.No.	Item	Date	Remarks
1.	Diaphram Plate		
2.	Oil in the Conservator		
3.	Lubricating Oil in the Driving Mechanism		
4.	Magnetic Contactors / Relays		
5.	Gaskets		
6.	Arcing Contacts of Diverter Switch		
7.	Others		

TAP SELECTOR



DB2 CONTACT COMPARTMENT

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