Identify various parts of relay and ascertain the operation

Objectives: At the end of this exercise you shall be able to
- **identify the external controls and parts of a electromagnetic relay**
- **identify the external parts of the single pole over current relay.**

Requirements

Tools/Equipment

- Trainees tool kit - 1 No.
- Single pole over current/earth fault relay with instruction manual - 1 No.

PROCEDURE

TASK 1 : **Identify external controls and parts of a electromagnetic relay**

1 Locate the relay parts provided in front of the relay (Fig 1) and identify the parts and fill in Table 1.

2 Note down the tap setting of current ranges at Table 2.

3 Note down in Table 2 the Indication displayed in the dial, multiplier along with percentage of fault current tripping time.

4 Locate the tripping. Flag indicator resetting level provided in front panel.

Once the relay tripped the flag will indicate a red line once it is tripped needs manual resetting by operating the lever.

Fig 1

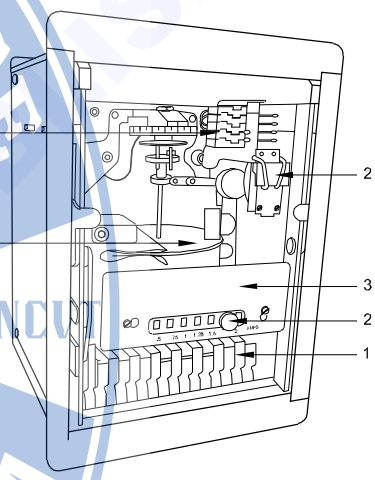


Table 1

Sl.No.	Part No.	Name of the external part	Function
1	1	Tripping flag indicator	Display tripping condition
2	2		
3	3		
4	4		
5	5		

Table 2

Sl.No	Current range	Multiplier of fault current	Time in seconds
1	Tap setting - 0.25A		

TASK 2 : **Identify internal parts of a single pole over current relay**

Instructor has to explain how to locate the internal parts and function of the circuit breaker and ask the trainees to tabulate the identified part of the available circuit breaker in your section.

1 Remove the front cover by loosening the four knobs provided in the corner of relay and preserve the cover with knobs carefully. (Fig 1)

Don't touch (or) try to operate any projected parts inside the relay.

2 Locate the aluminium disc fitted in the bottom of the spindle.

3 Locate the Time Multiplier Setting (TMS) fitted in the top of the spindle.

4 Check the divisions marked on the TMS disc used for time setting.

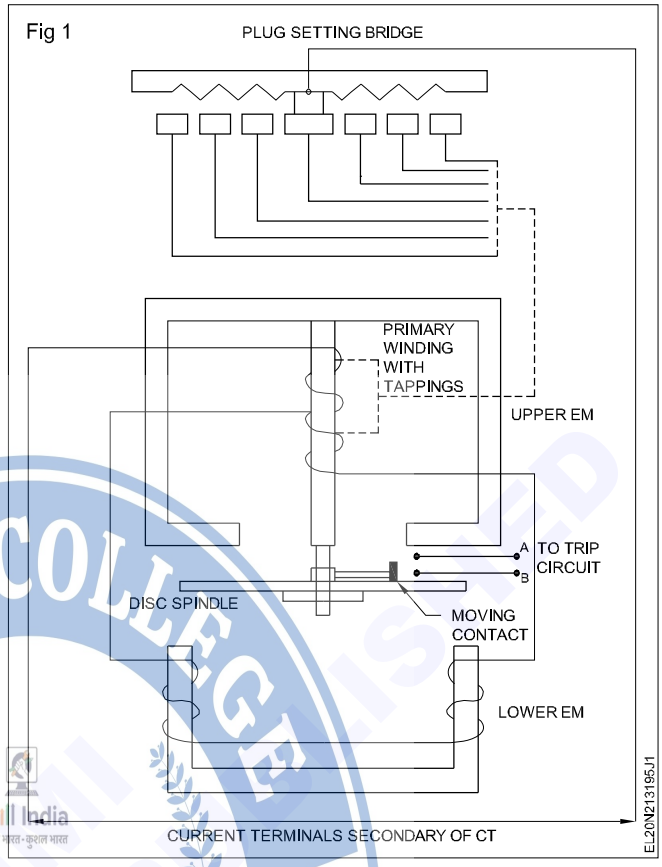
5 Locate the spiral spring mounted on the top of spindle to bring back the disc top its original position after tripping.

6 Locate the moving contact fitted along with the spindle on the top of disc enabling tripping circuit.

7 Locate the two terminals contact points acting as a switch to trip the circuit.

Do not allow any dust or tiny particles enter inside. Dust will deposit in the pinion and effect the disc movement.

Fig 1



8 Close the front panel and show the findings to your instructor.

9 Note down the identified parts in Table 1.

10 Get it checked by your instructor.

Table 1

Sl.No.	Part No.	Name of the internal part	Function

— — — — — — — —

Practice setting of pick up current and time setting multiplier for relay operation

Objectives: At the end of this exercise you shall be able to
- **calculate the fault current in different percentage**
- **set up current in injector unit for different fault current**
- **set the pick up current of a 50% fault current**
- **set the time multiplier for time setting under various fault condition.**

Requirements

Tools/Equipments

- Trainees tool kit - 1 No.
- Over current relay with manual (used in previous Ex.No.4.7.203) - 1 No.
- Current injection unit with manual - 1 No.

PROCEDURE

TASK 1 : **Identify of pickup current and trip the relay for different fault current**

1 Identify the supply voltage required for operating over current relay to its tripping coil.

2 Identify the current input terminals of relay.

3 Identify the shorting pins of NC/NO relay contacts.

The current Injector unit is required to provide different fault current levels. The fault current settings is done in tap setting provided in the relay along with percentage of fault current with time.

4 Connect the tripping coil voltage and fault current connections from current injector to relay as per the manual instruction. Keep all the controls at zero position in current injector unit.

Some coils requires DC supply that can be taken from current injector unit.

5 Set the tap on relay for one amp. Calculate the multiplier from the dial and set the current in current injector unit. Record the values in Table 1.

Note : A sample reading is recorded in Table 1 on the tap setting at 1A; and multiplies value-2. Trip time displayed in dial an 10 seconds

Note : Select multiplier 2, so that the total fault current is 2 amp. ensure the time multiplier disc kept at position 1.

6 Note down the corresponding time displayed on the dial for multiplier 2.

The current injection unit have different makes and specifications . Energise the relay using manual supplied along with current injection unit.

7 Switch on the current injector unit ensure that relay is energised.

8 Increase slowly the current which is the input of relay to pickup.

Table 1

Sl. No.	TMS Position	Tap set current (A)	Multiplier value	Time in seconds	Total fault current	Pickup current	Actual trip time
1	1	0.5	2 x 0.5 = 1A	10 Sec.	1A	<1A	
2	1	1.0					
3	1	1.5					
4	1	2.0					

9 Increase the current slowly, the disc of relay start to move that is the pickup current. Note down the value in Table 1.

10 Change the tap set current to some other current value and repeat the step 5 to 9.

11 Change the tap set for other value and repeat the steps 6 to 10 and record the readings.

12 Try few more tap set values and check the pickup current.

TMS position should not be changed while doing the exercise.

— — — — — — — —

TASK 2 : **Reduce the tripping time by setting time multiplier setting**

1 Keep all the controls knobs at zero position.

2 Set the TMS disc at 0.5 position by rotating TMS disc fitted on the main spindle.

3 Repeat the steps 5 to 10 for the new TMS value of 0.5. Enter all the readings in Table 1.

Note : It may be noted that when TMS set for 0.5 the actual trip time reduced by 50% of the trip time actual in Task 1.

Table 1

Sl. No.	TMS Position	Tap set current (A)	Multiplier value	Time in seconds	Total fault current	Pickup current	Actual trip time
1	0.5	0.5 A	2 x 0.5 = 1A	10 Sec.	1A	<1A	
2	0.5	1.0 A					
3	0.5	1.5 A					
4	0.5	2 A					

— — — — — — — —

Identify the parts of circuit breaker, check its operation

Objectives: At the end of this exercise you shall be able to
- **identify the external parts of air circuit breaker**
- **identify the internal parts of air circuit breaker**
- **test the manual tripping of air circuit breaker.**

Requirements

Tools/Equipments

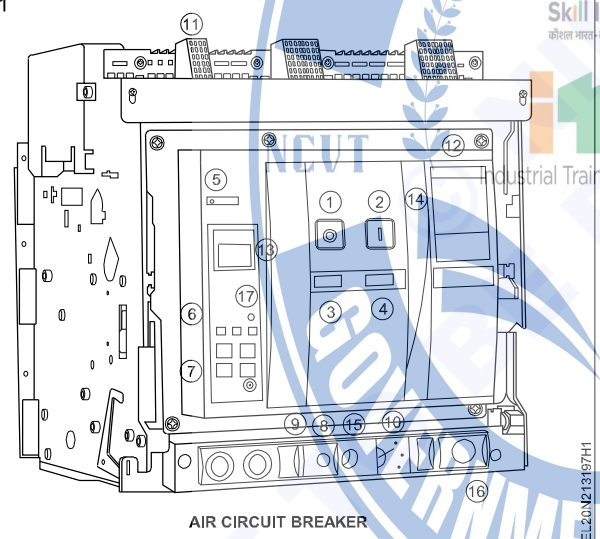
- Trainees tool kit - 1 No.
- Multimeter/ohm meter - 1 No.
- Air circuit breaker 3 phase 415V maximum capacity 400 KA with instruction manual - 1 No.

PROCEDURE

TASK 1 : **Identify the external parts and control switches of air circuit breaker**

1 Verify the specifications of air circuit breaker with instructions manual. (Fig 1)

Fig 1



AIR CIRCUIT BREAKER

Different makes of circuit breakers are available in the market. The air circuit breaker mentioned here is only a sample model for your guidance. The instructor may arrange the available model with necessary instructions if necessary.

2 Identify the label numbers of the external part mentioned in Fig 1.

3 Write the corresponding label numbers against the corresponding external parts names only given in Table 1.

Table 1

Name of external parts

Sl.No.	Parts label no	Name of the part
1	1	
2	2	
3	3	
4	5	
5	6	
6	7	
7	9	
8	13	
9	17	

4 Get it checked with your instructor.

TASK 2: **Identify the internal parts of air circuit breaker**

1 Remove the front cover carefully.

Do not remove any permanent parts of the breaker.

2 Identify the main internal parts (Fig 1) fitted in the breaker and note down in Table 1.

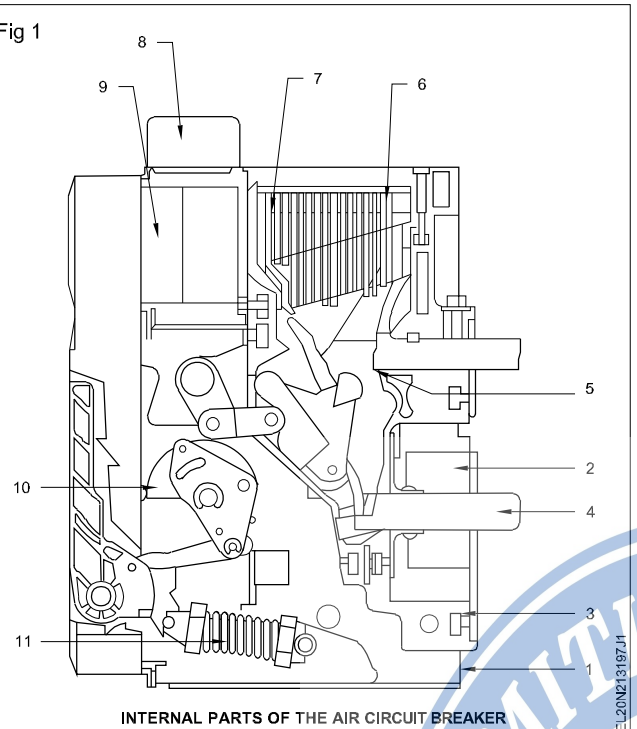
3 Locate the fixed main contact and movable main contacts.

4 Check the continuity of the contacts.

5 Locate the tripping coil terminals.

6 Remove the arcing chamber unit and test the arc chutes and diverters.

Fig 1



INTERNAL PARTS OF THE AIR CIRCUIT BREAKER

7 Locate the manual tripping lever to trip manually.

8 Connect the ACB to the main supply and switch ON.

9 Check the condition of indicating and tripping lamps.

10 Charge the breaker manually by operating handle.

11 Check the engaged main contact and confirm by checking its continuity.

12 Press the manual tripping switch and confirm its disengagement of the contacts.

13 Charge again the breaker and confirm the engagement of the main contacts.

14 Switch 'OFF' the AC mains, the arcing chamber and close the removed covers.

15 Submit the reports to your Instructor and get it approved.

Table 1

Name of internal parts

Sl. No	Parts no	Name of the part	Function
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			

Test tripping characteristic of circuit breaker for over current and short circuit current

Objectives: At the end of this exercise you shall be able to
- **connect relay and circuit breaker for test tripping**
- **set the current injection unit for tripping current**
- **set the tripping current for definite time lag (over current)**
- **set the current for extreme inverse characteristic (short circuit current).**

Requirements

Tools/Equipments

- Trainees tool kit - 1 No.
- Air circuit breaker 400 KA 415V with manual - 1 No.
- Over current relay with manual - 1 No.
- Current injection unit with manual - 1 No.

PROCEDURE

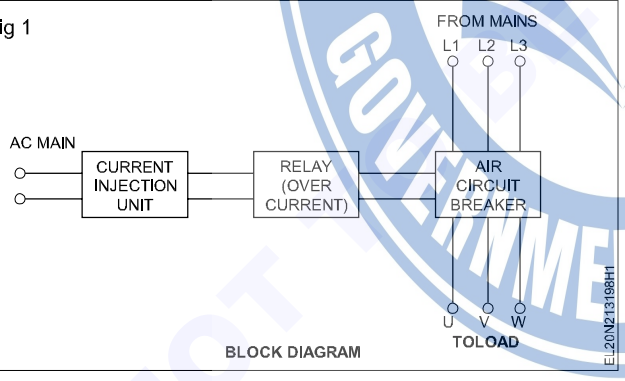
TASK 1: **Tripping of circuit breaker for definite time with set fault current**

This exercise is prepared to set the relay in definite time tripping in over current conditions and extreme inverse tripping in short circuit situations. This model relay is not having the facility of various tripping characteristics.

However short circuit current situation can be provided to trip the relay in short time by setting Time Multiplier Setting (TMS) to trip the relay instantly at high fault current situation.

1 Connect the relay, circuit breaker with the current injection unit by referring in block diagram. (Fig 1)

Fig 1



BLOCK DIAGRAM

2 Check all the connections as per the instruction manual.

3 Set the tap setting current in 1 amp and note down the multiplier, time in seconds in Table 1.

4 Set the TMS at position 1 marked in the dial.

5 Check the pick up current of the set value of tap setting current and note down values in table 1.

6 Set the fault current by selecting multiplier from the dial and note corresponding time in seconds and note the values in Table 1.

Now the fault current set value is 2 Amp and the relay should trip in the time as per the dial indication.

7 Switch 'ON' the current injection and note down the tripping indicated by the timer fitted on the current injection unit.

8 Reduce the time by setting TMS by 0.5.

Since the short circuit current cannot be generated practically the tripping time is reduced by taking the short circuit current is present now.

9 Ensure the rotating aluminium disc returns to its original position.

10 Switch ON the injection unit and note down the tripping time in seconds.

This time will be half time of the first reading.

11 Change the tap setting at 2 amps slot in the relay and repeat the steps 4 to 9.

12 Record the readings in the table and get it approved by your instructor.

Table 1

Test tripping of circuit breaker definite time charts

Sl. No	Tap setting current	TMS value	Time	Multiplier	Total fault current	Actual tripping current	Error in %
1							
2							
3							
4							

— — — — — — — —

TASK 2: **Tripping circuit breaker in extreme inverse characteristic condition**

1 Repeat the step 1 to 3 in Task 1.

2 Set the TMS at 0.2 position.

3 Set the tap setting plug into maximum current input on the dial.

4 Select the maximum multiplier value in the dial record the fault current (plug set value 'X' multiplier) and the tripping time in Table 1.

5 Check the pickup current for the tap set value.

6 Set the fault current in the current injector unit

7 Switch 'ON' and note down the actual tripping time in Table 1.

8 Try to some higher value of fault current and repeat the step 5 to 7. Record the values in Table 1.

Table 1

Extreme inverse charts

Sl. No	Tap setting current	TMS value	Time	Multiplier	Total fault	Actual tripping	Error in %
1							
2							
3							
4							

— — — — — — — —

Practice on repair and maintenance of circuit breaker

Objectives: At the end of this exercise you shall be able to
- **follow the shut down procedure**
- **refer to service and operating manuals of a given circuit breaker to identify the parts and their functions (R)**
- **refer to previous maintenance records for carrying out routine maintenance checks**
- **locate the faulty part and replace it**
- **follow the general maintenance procedure on the circuit breaker.**

Requirements

Tools/Instruments

- Insulated cutting pliers 150 mm - 1 No.
- Screwdriver 150 mm - 1 No.
- Heavy duty screwdriver 300 mm - 1 No.
- Neon tester 150 mm 600V - 1 No.
- D.E. spanner set of 9 Nos. 5 mm to 20 mm - 1 Set
- Box spanner set of 9 Nos. 5 mm to 20 mm - 1 Set
- Megger 500V - 1 No.
- Multimeter 20 kilo ohm/volt - 1 No.
- Cleaning brush round 2.5 cm - 1 No.
- Plumb bob with thread - 1 No.
- Spirit level 300 mm - 1 No.
- Flat file bastard 250 mm - 1 No.

Equipment/Machines

- Circuit breaker of higher voltage and current rating - 1 No.

Materials

- Rubber or cork gasket as specified and reqd.
- Sand paper Grade "0" - 1 Sheet
- Grease - 10 g.
- Flexible cable 14/0.2 - 5 mts.
- Dash pot oil of specific grade - 200 ml.
- Contact cleaner oil - CRC 2-26 - 1 bottle
- Electro tube - 25 g.

PROCEDURE

As it is impracticable to get a switch gear of high voltage and current rating in a vocational institute, it is recommended that the trouble shooting procedure is followed in a circuit breaker, having similar facilities like the rotor resistance starter used in a slip ring induction motor. However, the manufacturers instruction for the trouble-shooting should be followed for larger circuit breakers when the trainee is employed in an industry. The working steps given there are of a generalized nature and could be used with slight modification for any circuit breaker.

Caution: Before taking up the maintenance work on any circuit breaker which is in operation, it is utmost necessary to take permission from the engineer in-charge. He only decides whether alternative arrangement is required to maintain supply to the consumer or a shut down is to be effected.

Permission for shut down is given by the engineer in the approval forms. Follow all the instructions contained in the shut down form before taking up the maintenance work on the circuit breaker. The concerned control switch of the circuit breaker should be switched OFF and locked and caution boards should be displayed in the control panel. The key should be kept in the custody of the engineer in-charge. A caution board should also be displayed predominantly near the circuit breaker which is under maintenance.

1 Collect the service and operating manuals of the circuit breaker and read them carefully.

2 Collect the maintenance record sheet of the circuit breaker.

It is desirable that you read the service and operating manuals carefully and thoroughly before starting the actual maintenance work.

3 Note the name-plate details of the circuit breaker.

Example of work permit and shut down

4 Switch 'OFF' the incoming and outgoing bus bars, and then disconnect the circuit breaker from the bus bars.

5 Follow the instructions contained in the service manual to open the top covers of the circuit breaker.

6 Identify the parts and compare with the service manual.

7 Identify and trace the tripping circuits.

8 Carefully inspect the parts for burnt smell, visible indication of burns, pitting and discolouring.

9 Interpolate your finding with the maintenance record sheet information to pin point the faulty part.

10 Identify the part number from the service manual and draw the parts from the stores.

11 Check the correctness of the part received from the stores and then replace the part in the circuit breaker.

General maintenance procedure (Table 1)

12 Check the mounting bolts/studs for correct tightness.

13 Check the verticality of the circuit breaker with the help of a plumb bob, and horizontality with the help of spirit level.

If necessary correct them by mounting bolts.

14 Check the stationary, fixed, arcing, intermediate and main contacts. Clean them with a steel wire brush or sandpaper grade '0' to remove any deposit due to oxidation. Figs 1 and 2 are given for your guidance.

Fig 1

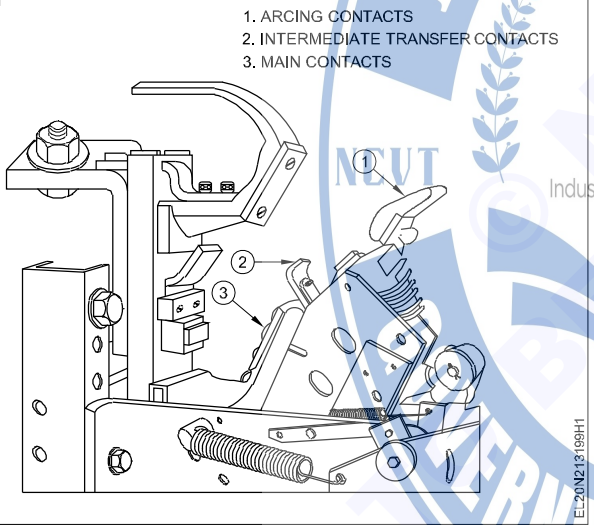
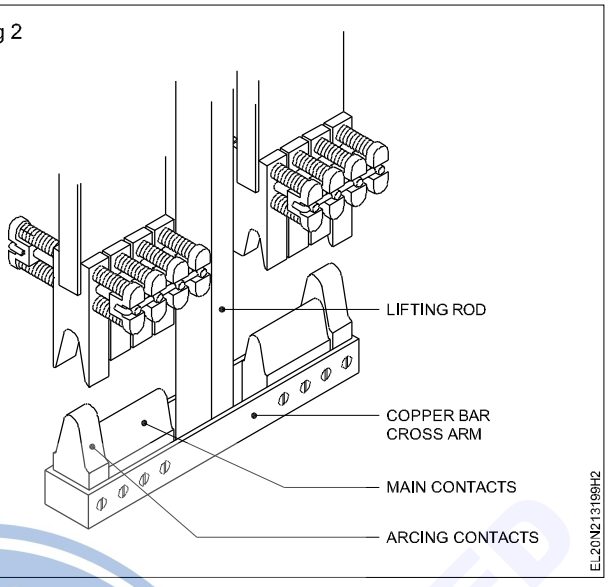


Fig 2



If pitting are heavy, use a flat file to remove the pitting. If the surface area is reduced more than ten percent due to pitting it will be better to replace the contact points.

15 Clean the contact by using CTC solution.

16 Check the internal control wiring along with the given wiring diagram of the manual.

17 Use a continuity tester to test the continuity of each wire from point to point.

If the internal wiring cables are damaged replace them. Check for loose terminations and tighten them.

18 Measure the trip coil resistance and compare with the earlier measurement.

There should not be any change in coil resistance.

19 Check that the tripping rod and the armatures of the tripping releases, move freely without blocking or friction.

If the releases are found to be under friction clean the relevant part thoroughly.

Table 1

Maintenance record sheet for circuit breaker

Sl.No.	Date	Particulars	Complained by	Attended by	Description of fault	Particulars of replacement	Signature of the engineer in-charge
1							
2							
3							
4							
5							