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ENEE4105

Report of Experiment 4

Using Switch-relays in Control Circuits

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Abstract

This experiment proposes to identify the elements control circuits used in real life such as contactors, relays, overloads and timers. Three circuits will be considered in this report, the first one is used to reverse the direction of the three phase induction motor, the second one is used to switch the connection between Y and Δ by using the timer, the third one is used for made a simple model for traffic light also by using the timer.

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Theory

Contactors:

A contactor shown in Figure 1 [1] can stand on its own as a power control device, or as part of starter, it consists of one set of stationary contacts and one set of movable contacts which are brought together by means of the magnetic force of an electromagnet. Contactors are used in applications range from a light switch to the most complex automated industrial equipment, the function of the contactor is to make and break all power supply lines running to a load or to repeatedly establish and interrupt an electrical power circuit. Some major applications of contactors include lighting circuit, heaters, and transformers. Contactors operate when the coil is energized and becomes an electromagnet as shown in Figure 2.a when the coil is energized, the moveable contacts are pulled toward the stationary contacts, once the two sets of contacts meet, and power can flow through the contactor to the load as shown in figure 2.b



Figure 1: Contactor

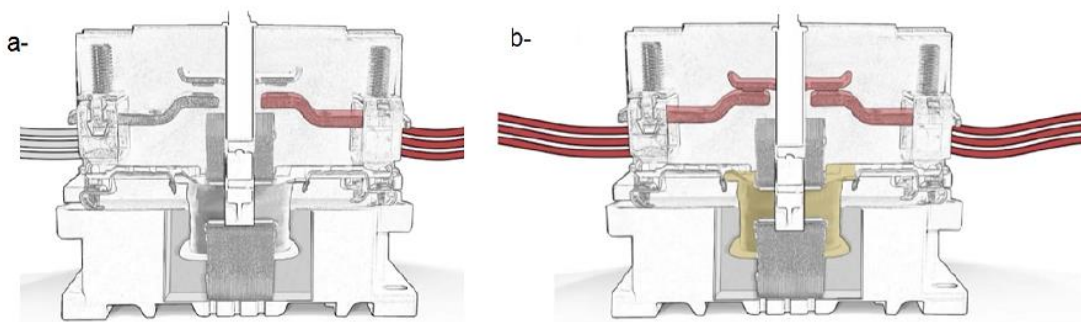


Figure 2: The contactor operating way (a) the static coil is energized (b) the movable coil pull through static coil and power is flow

Relays:

Relays (shown in Figure 3 [2]) are switches that open and close circuits when actuated with an electrical signal. They are used in applications where they are necessary to control one or more circuits by a power signal that may or may not be isolated from the circuits being controlled. Relay coils require a voltage source to be energized and the contacts are controlling a circuit of 380V or more [3], relay coils require only very low currents in their operation and this is the main difference between relay and the contactor. The actuation of the relay will change the state of the contact from open to closed or vice versus, depending on the contact configuration. They have one or more poles, the number of poles in a relay indicates the numbers of switches.



Figure 3: Relay

Timers:

The main advantage of using timers is allows a delay between pairs of events. Upon activation, a timer counts off a preset number of time units before powering the devices it controls. Timers are used widely in practice, a traffic light is a good example of a timer application. As the light cycles from green to yellow to red, there is a delay between each change. The lengths of these delays are controlled by timers [3].



Figure 4: Timer

Procedure

Part A: Switch relay

The control circuit shown in Figure 5-a [3] was connected, and then the circuit operation was checked by pressing on the ON push bottom which energized the coil of contactor C1, then for more insurance the second ON push bottom which energized the coil of contactor C2 was pressed and it was noticed that C2 did not operate because the normally close C1 was opened so the second branch cannot pass the current, in order to energized the second contactor the OFF push bottom should be pressed, then the second ON push bottom pressed. The parallel path is for latching, which aims to keep the circuit on, even if the ON push bottom was pressed again. After that the power circuit shown in Figure 5-b [3] was connected which aims to reverse the direction of the motor by reverse two phases, so the first ON push bottom which energized C1 was pressed then the motor was rotate in the clock wise direction, it was noticed that when the motor is running the direction cannot be reverse as it was mentioned before, after that the OFF push bottom was pressed and the motor was stopped, then the second ON push bottom was pressed and the motor is running again but in other direction, and this is the only way to reverse the direction.

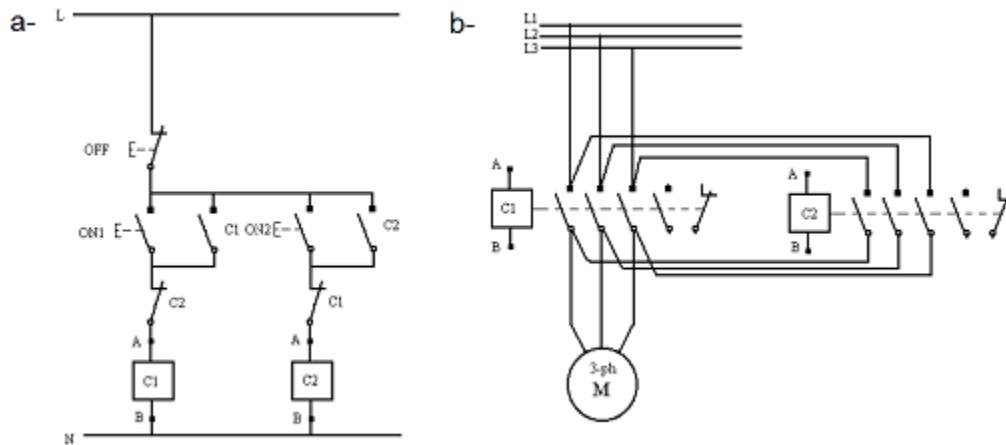


Figure 5: (a) control circuit (b) Power circuit for reverse the direction of 3 phase induction motor

After that the control circuit shown in Figure 6-a [3] was connected, and the circuit operation was checked just like the previous circuit, then the power circuit shown in Figure 6-b [3] was

connected which aims to switch the connection between Y and Δ , this operation is almost used when it was needed to turn on the motor, because of the high starting current in Δ connection it is better to start the running with Y connection which has low starting current, after that the connection switched to Δ in order to have a high torque which is proportional to the current, so to do this, the first ON push bottom was pressed then the timer was energized which energize C3 that responsible for made the motor in Y connection, then motor was running in low speed, after few second the timer will de-energize and normally-close T switch return to close position this will energized C2 which is responsible for made the motor in Δ connection, then the motor will speed up.

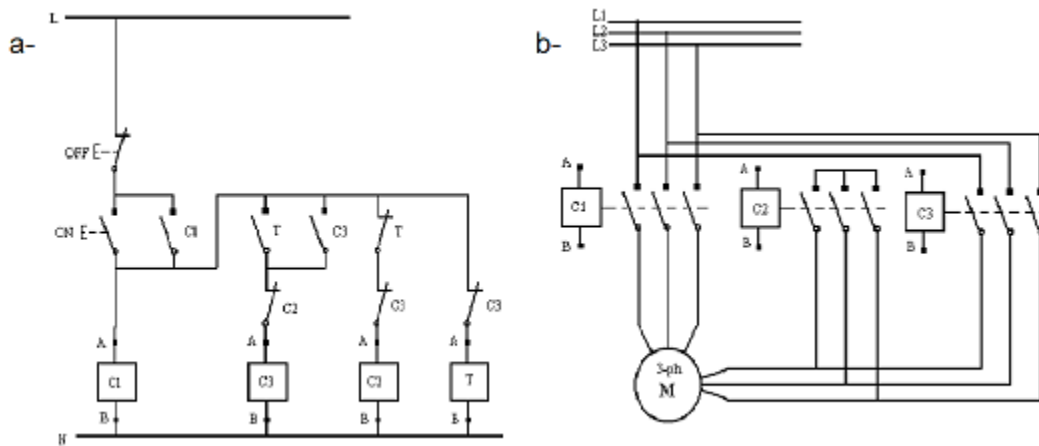


Figure 6: (a) control circuit (b) Power circuit for switching the connection Y to Δ

Part B: Timers:

The control circuit shown in figure 7 was connected, then the time sitting for every timer was chosen as following in order to make a simple traffic light, the red light was set to be on for 10s, and both red and yellow were set to be on for 5s (this mean that the red light only will be turned on for 10s and yellow and red will be turned on for 5s), then the green light was set to be turned on for 5s, after that the yellow light was set to be turned on again for 5s, in totally this operation was taken 25s to repeat itself. After the sitting was set, the on push bottom was pressed, this will turned on the red light and after 10 s red and yellow timer T(R+Y) was energized thus red and yellow lights were turned on for 5s, after that timer T(Y) was energized then the green light was turned on for another 5s , then T(G) was energized this will turn on the

yellow light for another 5s, after all of this T(R) will be energized, as a result of this the reset timer was energized, and the operation was repeated itself.

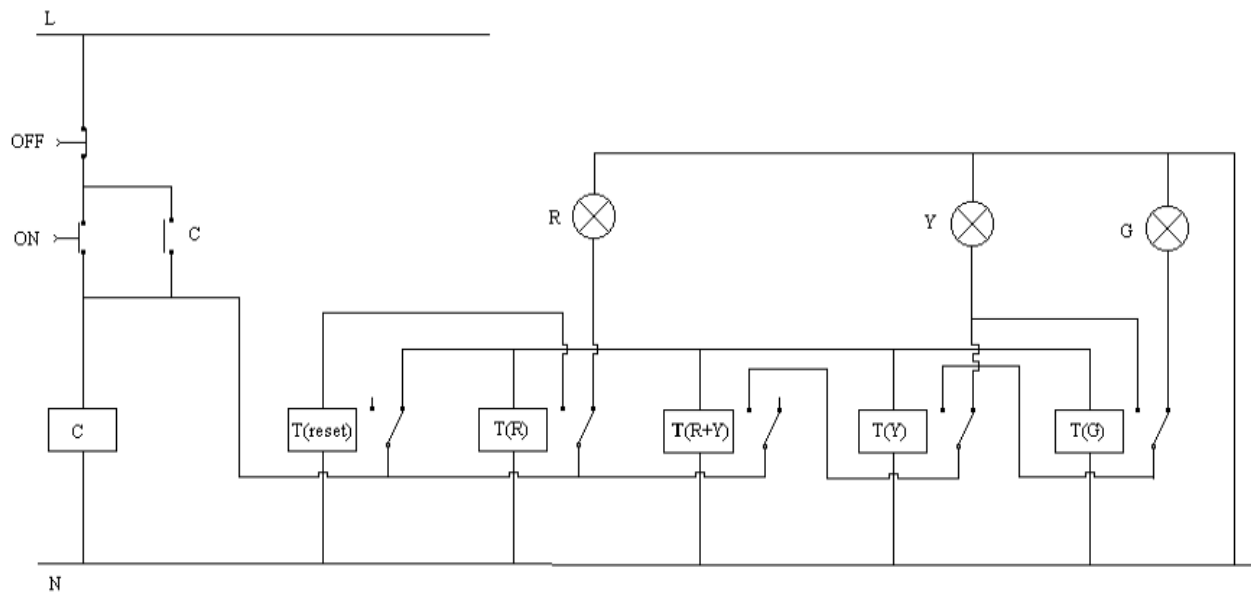


Figure 7: The traffic light control circuit.

Conclusion

This experiment purposes to realize the elements control circuits used in practice, such as contactors, relays, overloads and timers. As shown in procedure parts, firstly the contactor were used to reverse the direction of the motor be switching two phases, this operation can use windily in realistic life, such as motoring and breaking in electric cars. The second circuit aims to get rid of the high starting current by switching the motor internal winding connection from Δ to Y. finally the practical model was applied which is traffic lights that are basically depending on timers.

References

- [1] <http://www.actrol.com.au>
- [2] www.aliexpress.com/w/wholesale-5a-relay.html
- [3] Control and Power Electronics Lab Manual, Birzite University, Ramallah, 2016/2017.
- [4] <http://www.tlauk.net/shop/gic-12odt4-on-delay-timer>