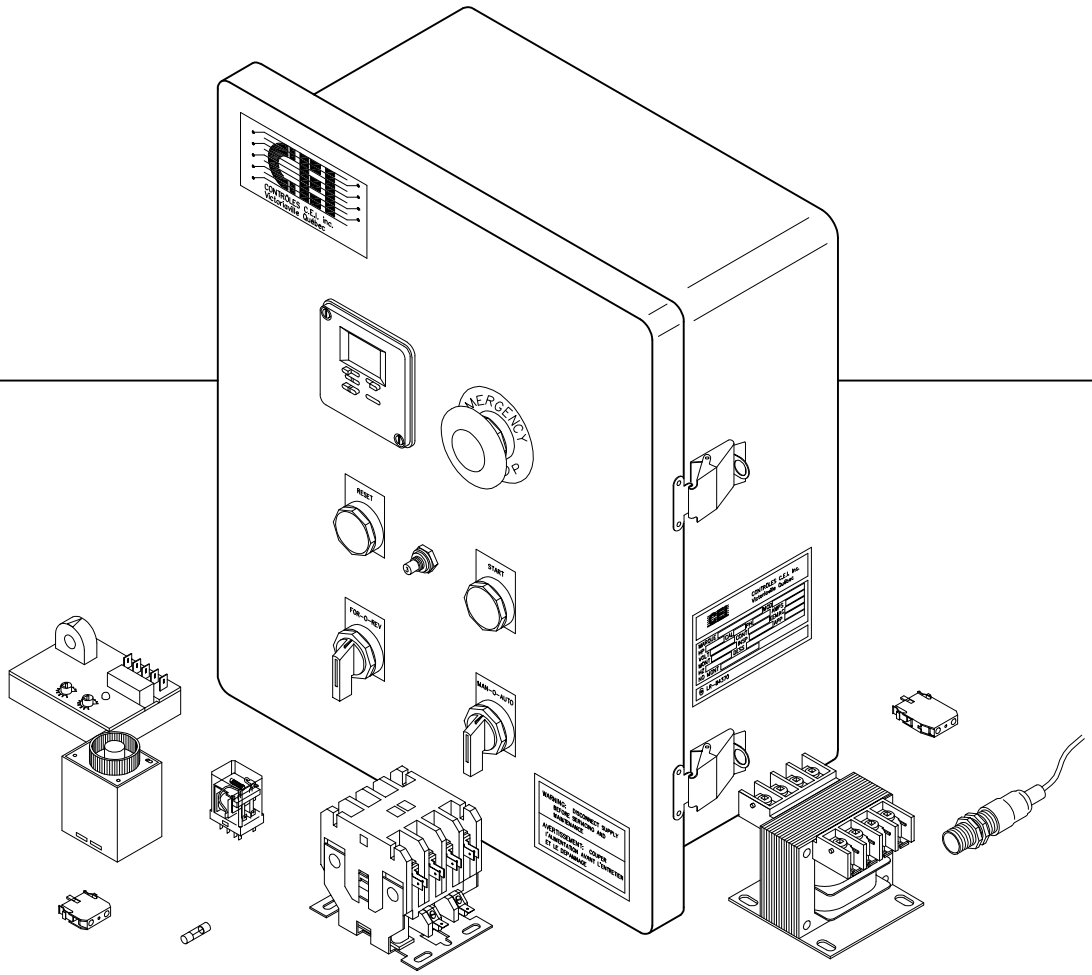
HOULE

FARM EQUIPMENT MANUFACTURER

STANDARD CONTROL PANELS HANDBOOK



Contents:

- Electric parts working principles;

- How to read a wiring diagram.

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WARNING

BEFORE DOING ANY REPAIR ON A CONTROL PANEL, YOU MUST CUT OFF ITS POWER AT ITS SOURCE. FAILURE TO FOLLOW THIS WARNING COULD RESULT IN DAMAGES TO EQUIPMENT AND/OR SERIOUS INJURIES.

HOULE'S RESPONSIBILITY

THIS DOCUMENT EXPLAINS THE FUNCTION OF THE CONTROL PANELS SOLD BY J. HOULE & FILS INC. THE INFORMATION PROVIDED HEREIN IS INTENDED FOR TROUBLESHOOTING ONLY.

ALWAYS REFER TO A COMPETENT ELECTRICIAN FOR REPAIR.

J. HOULE & FILS INC. CANNOT BE HELD RESPONSIBLE FOR ANY INJURY OR DAMAGE TO THE EQUIPMENT CAUSED BY A MISUNDERSTANDING OR A WRONG INTERPRETATION OF THE PRESENT DOCUMENT.

Introduction

The wiring diagram of a control panel is the schematic representation of all components and wires of that control panel. It is drawn in a way to ease the comprehension by simplifying the wiring between each electrical component. By reading the wiring diagram, the functions and working principles of the control panel can be understood and a better troubleshooting can be achieved.

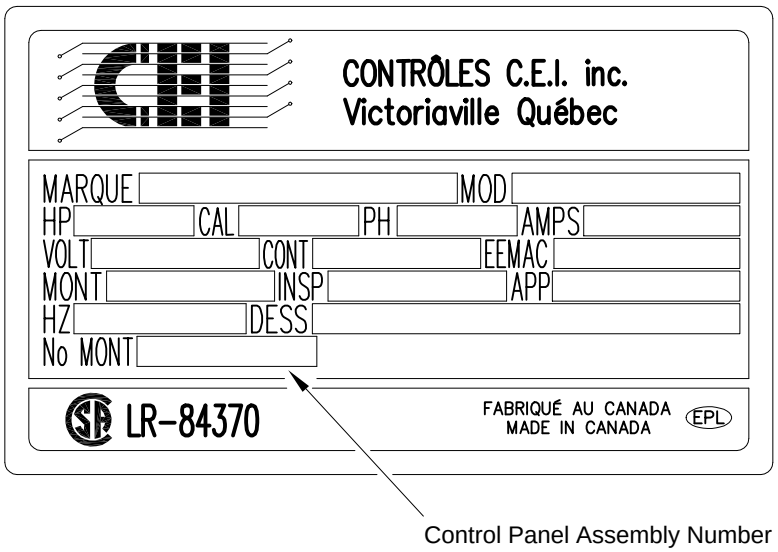
To read and understand the wiring diagram of a control panel, the working principle of each electrical component must be fully understood. The first part of this manual shows the schematic representation of each component found in a control panel and explains its functions. The second part of this manual shows a typical wiring diagram and its functioning is explained step by step.

A wiring diagram always shows all components unpowered, i.e. when the control panel is not fed with electricity. To understand the function of the control panel, you must imagine what is going to happen when the panel will be fed with electricity.

The second part of this manual shows you the wiring diagrams as you should imagine them when the control panel is running. Of course, you will not see these wiring diagrams anywhere else than in this manual, but once you have understood these diagrams, you will be able to read and understand other wiring diagrams.

The example shown in this manual is a control panel for a free stall cleaner with cable. It can be different from earlier versions and may be different in the future.

All control panels are supplied with their corresponding wiring diagram. Make sure you use these supplied wiring diagrams when you want to understand the functioning of the control panel. If the wiring diagram is missing, find the control panel assembly number which is written in the lower left corner of a sticker found on the side of the control panel or inside its cover. It is a four digits number written beside "NO MONT". With this number, you can ask J. Houle & Fils Inc. to fax you the wiring diagram corresponding to that control panel assembly number.



Control Panel Assembly Number

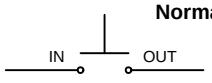
Contacts

Most components are equipped with contacts. Those contacts are simply switches that can be manually activated (knobs) or electrically activated (relays, timers, etc...).

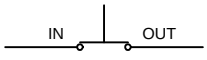
A contact can be either normally opened or normally closed, meaning that when the contact is not activated, a normally opened contact does not allow electricity to pass through and a normally closed contact allows electricity to pass through. Once activated, a normally opened contact will be closed and will let electricity go through, and a normally closed contact will be opened and will not let electricity go through.

Manually activated contact (knob)

Normally Opened



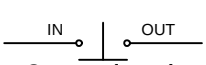
Normal position:
Electricity cannot pass



Once activated:
Electricity can pass

Normally Closed

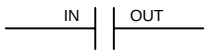
Normal position:
Electricity can pass



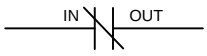
Once activated:
Electricity cannot pass

Electrically activated contact (relay, timer, etc...)

Normally Opened

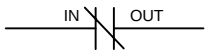


Normal position:
Electricity cannot pass

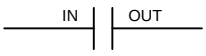


Once activated:
Electricity can pass

Normally Closed



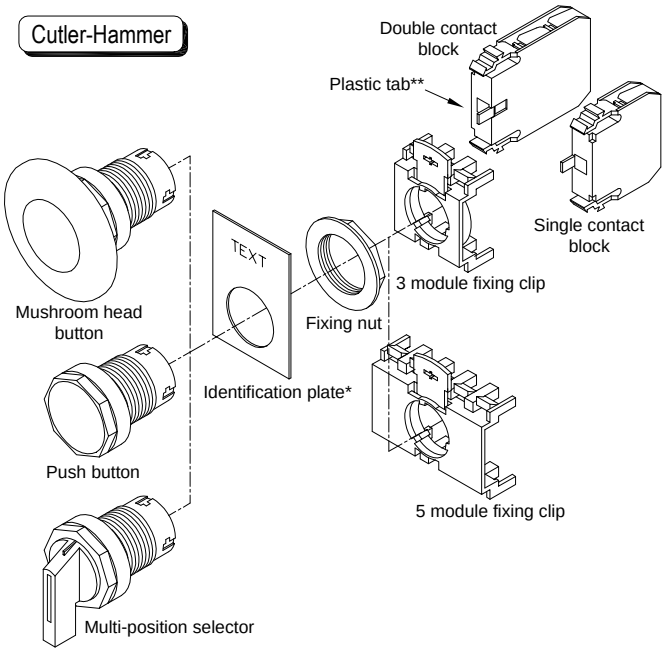
Normal position:
Electricity can pass



Once activated:
Electricity cannot pass

Push buttons and multi-position selectors

Cutler-Hammer

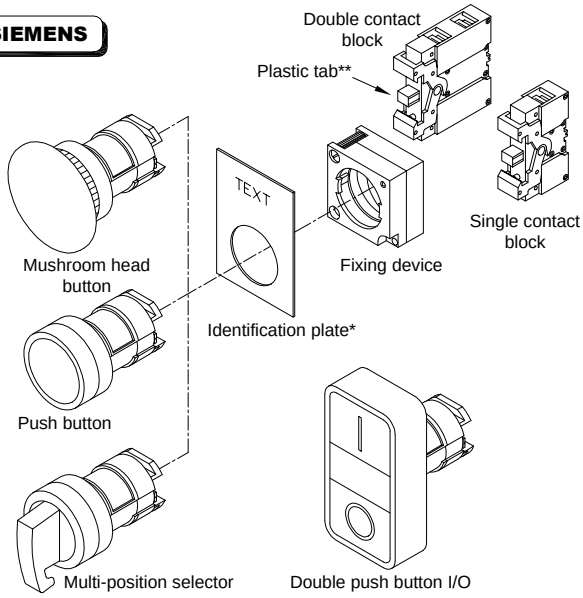


Part no. **Description**

E22JPL2 ..... Mushroom head button with fixing nut & 3 module fixing clip
E22P2 ..... Push button (red) with fixing nut & 3 module fixing clip
E22P3 ..... Push button (green) with fixing nut & 3 module fixing clip
E22V51 ..... Two-position selector with fixing nut & 3 module fixing clip
E22VG1 ..... Three-position selector with fixing nut & 3 module fixing clip
E22BA12 ..... 5 module fixing clip
E22B1 ..... Single contact block N/C ** red plastic tab
E22B2 ..... Single contact block N/O ** green plastic tab
E22B20 ..... Double contact block N/O ** green plastic tab

* The identification plate is available at Controles C.E.I. Inc. and the inscription needed must be specified when ordered. Part #PLQ-2101.

SIEMENS

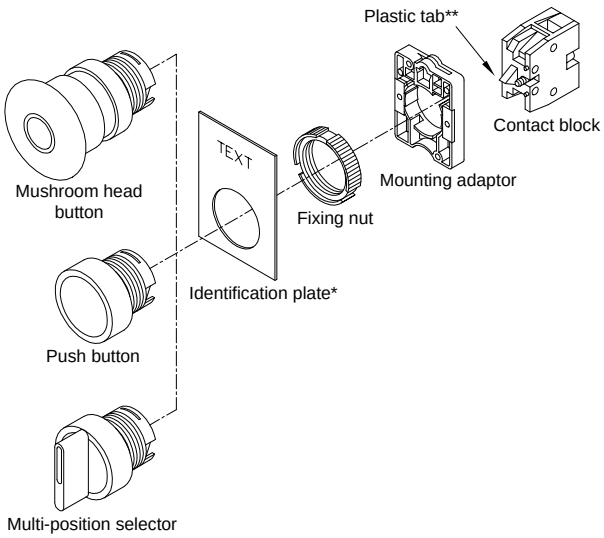


Part no. **Description**

3SB3500-1CA21 ..... Mushroom head button with fixing device
3SB3500-0AA21 ..... Push button (green) with fixing device
3SB3500-0AA41 ..... Push button (red) with fixing device
3SB3100-BAC21 ..... Double push button I/O with fixing device
3SB3500-3PA11 ..... Two-position selector with fixing device
3SB3500-3SA11 ..... Three-position selector with fixing device
3SB3501-3SA41 ..... Illuminated three-position selector (green) with fixing device
3SB3501-0AA21 ..... Illuminated push button (red) with fixing device
3SB3400-1A ..... Lamp holder
3SB3400-0B ..... Single contact block N/O ** black plastic tab
3SB3400-0C ..... Single contact block N/C ** red plastic tab
3SB3400-0D ..... Double contact block N/O ** black plastic tab

* The identification plate is available at Controles C.E.I. Inc. and the inscription needed must be specified when ordered. Part #PLQ-2101.

TELEMECANIQUE



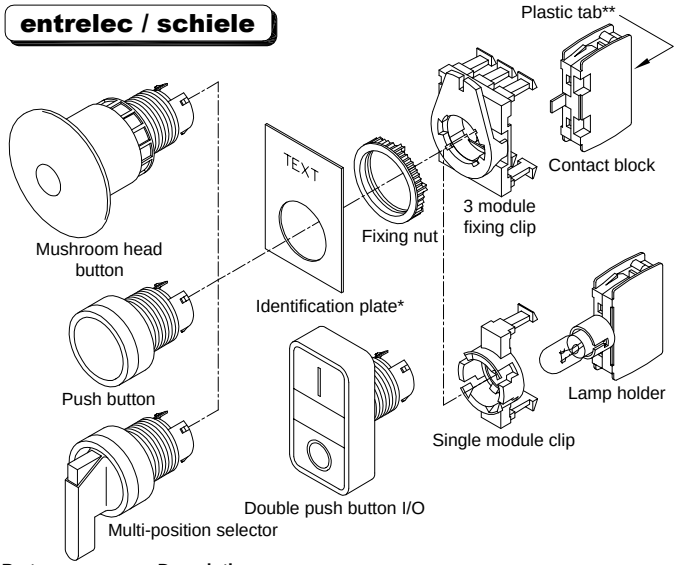
Part no. **Description**

ZA2BT4 ..... Mushroom head button with fixing nut
ZA2BA3 ..... Push button (green) with fixing nut
ZA2BA4 ..... Push button (red) with fixing nut
ZA2BD2 ..... Two-position selector with fixing nut
ZA2BD3 ..... Three-position selector with fixing nut
ZA2BZ009 ..... Mounting adaptor for contact blocks
ZB2BE101 ..... Contact block N/O ** green plastic tab
ZB2BE102 ..... Contact block N/C ** red plastic tab

* The identification plate is available at Controles C.E.I. Inc. and the inscription needed must be specified when ordered. Part #PLQ-2101.

N.B.: Parts for the older model of switch with mounting adaptor made of solid metal are no longer available. The complete switch must be replaced if any repair is required.

entrelec / schiele



Part no. **Description**

3724 202 01 ..... Mushroom head button with fixing nut
3720 100 01 ..... Push button (red) with fixing nut
3720 100 02 ..... Push button (green) with fixing nut
3720 700 02 ..... Double push button I/O with fixing nut
3723 207 03 ..... Two-position selector with fixing nut
3723 201 03 ..... Three-position selector with fixing nut
3723 141 02 ..... Illuminated three-position selector (green) with fixing nut
3722 100 01 ..... Illuminated push button (red) with fixing nut
3720 054 20 ..... Lamp holder
3720 086 20 ..... Single module clip with 1 lamp holder
3720 057 00 ..... 3 module fixing clip
3720 058 00 ..... Additional fixing clip (second row clip) - not shown
3720 059 00 ..... Additional fixing clip (side clip) - not shown
3720 051 20 ..... Contact block N/O ** green plastic tab
3720 052 20 ..... Contact block N/C ** red plastic tab

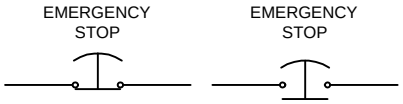
* The identification plate is available at Controles C.E.I. Inc. and the inscription needed must be specified when ordered. Part #PLQ-2101.

Push buttons and multi-position selectors

Mushroom head button (Emergency stop button)

Manually activated, this button is used to shut off the circuit of the control panel. The emergency stop button consists of one knob which activates one contact or more. Once pressed, it changes the state of the contact(s), say a normally opened contact will be closed and a normally closed contact will be opened.

Mushroom head button with 1 N/C contact



Normal position
Electricity can pass

Once pressed
Electricity cannot pass

Push button (Start, stop, reset button, etc...)

Manually activated, this button is spring loaded and goes back to normal position once released. It consists of one knob which activates one contact or more. When pressed, it changes the state of the contact(s), say a normally opened contact will be closed and a normally closed contact will be opened.

Push button with 1 N/O contact

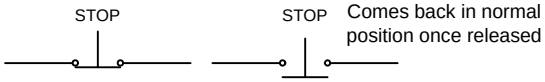
Normal position
Electricity cannot pass

When pressed
Electricity can pass

Double push button

This button is, in fact, two regular push buttons shown separated from each other on the wiring diagram. The existence of this double push button is only to reduce the number of hole on the panel door. Usually, this button is equipped with 1 N/O contact for the start function and 1 N/C contact for the stop function.

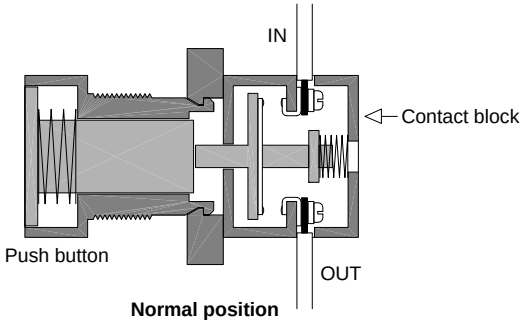
Push button with 1 N/C contact



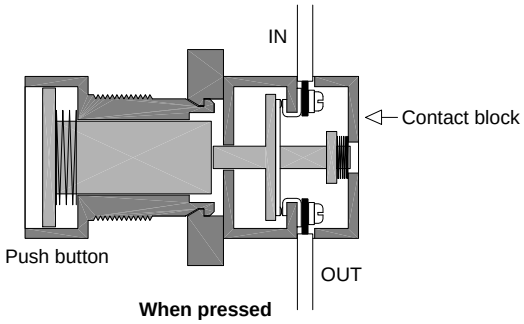
Normal position
Electricity can pass

When pressed
Electricity cannot pass

Example: Start button (Push button with 1 N/O contact)



Normal position
Electricity cannot pass

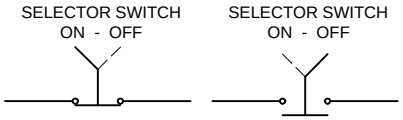


When pressed
Electricity can pass

Two-position selector

Manually activated, this selector switch is used to let electricity go through or not when equipped with one contact, or to direct electricity in one circuit or the other when equipped with two contacts. It consists of one selector knob which activates one contact or more. Once turned in one direction or the other, it changes the state of the contact(s), say a normally opened contact will be closed and a normally closed contact will be opened.

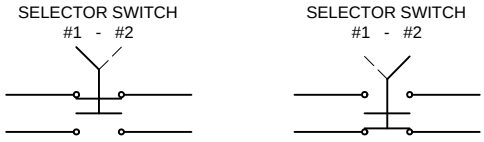
Two-position selector with 1 contact



"ON" position
Electricity can pass

"OFF" position
Electricity cannot pass

Two-position selector with 2 contacts



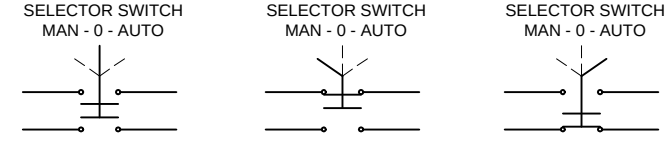
#1 position
Electricity can pass on top

#2 position
Electricity can pass on bottom

Three-position selector

Manually activated, this selector switch is used to direct electricity in one circuit or the other, or none of them. It consists of one selector knob which activates contacts. Once turned in one direction or the other, it changes the state of the contact(s), say a normally opened contact will be closed and a normally closed contact will be opened.

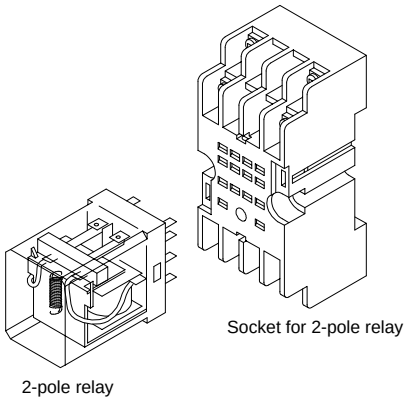
Three-position selector with 2 contacts



"O" position
Electricity cannot pass

"MAN" position
Electricity can pass on top

"AUTO" position
Electricity can pass on bottom



CARLO GAVAZZI

Part no.	Description
RMID0026024AC	2-pole relay - 24 VAC coil
RMID0026024AC	3-pole relay - 24 VAC coil
RMID0026024AC	4-pole relay - 24 VAC coil
RMID0026024AC	2-pole relay - 120 VAC coil
RMID0026024AC	3-pole relay - 120 VAC coil
RMID0026024AC	4-pole relay - 120 VAC coil
ES15/2N	Socket for 2-pole relay
ES15/3N	Socket for 3-pole relay
ES15/4N	Socket for 4-pole relay

NAiS / Aromat

Part no.	Description
HC2-H-AC24V	2-pole relay - 24 VAC coil
HC3-H-AC24V	3-pole relay - 24 VAC coil
HC4-H-AC24V	4-pole relay - 24 VAC coil
HC2-H-AC115V	2-pole relay - 120 VAC coil
HC3-H-AC115V	3-pole relay - 120 VAC coil
HC4-H-AC115V	4-pole relay - 120 VAC coil
HC2-SFD-K	Socket for 2-pole relay
HC3-SFD-K	Socket for 3-pole relay
HC4-SFD-K	Socket for 4-pole relay

ADVANCE CONTROLS INC

Part no.	Description
9566A024	2-pole relay - 24 VAC coil
9568A024	4-pole relay - 24 VAC coil
9566A120	2-pole relay - 120 VAC coil
9568A120	4-pole relay - 120 VAC coil
PYF08A	Socket for 2-pole relay
PYF14A	Socket for 4-pole relay

omron

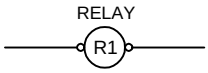
Part no.	Description
MY2-AC24V	2-pole relay - 24 VAC coil
MY4-AC24V	4-pole relay - 24 VAC coil
MY2-AC120V	2-pole relay - 120 VAC coil
MY4-AC120V	4-pole relay - 120 VAC coil
PYF08A-E	Socket for 2-pole relay
PYF14A-E	Socket for 4-pole relay

Working principle

A relay can be compared to a push button, except that its contacts are activated by an electromagnetic coil instead of a finger push. Once powered, the electromagnetic coil pulls down a lever to change the state of the contacts, say a normally opened contact will be closed and a normally closed contact will be opened, for as long as the coil remains powered.

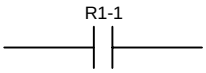
Because one coil and several contacts are enclosed in a same relay, the functional circuit would be hard to understand if contacts were drawn as they physically appear. The control panel wiring diagram has to represent the coil and each contact individually for better comprehension of the electrical circuit. Keep in mind that, even if they are separated from each other on the wiring diagram, a coil identified as **R1** and its corresponding contacts **R1-1**, **R1-2**, etc..., work together and are physically enclosed in the same relay housing.

Electromagnetic coil

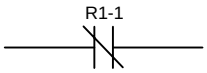


When the coil is powered, contacts are activated

Normally opened contact

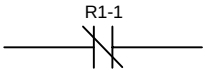


Normal position: Electricity cannot pass

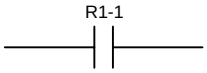


When the coil is powered: Electricity can pass

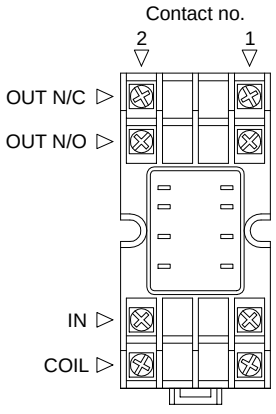
Normally closed contact



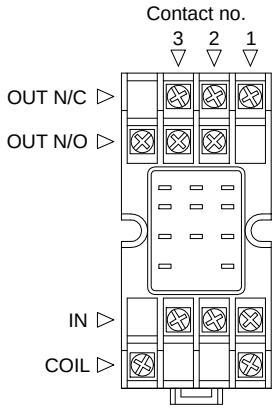
Normal position: Electricity can pass



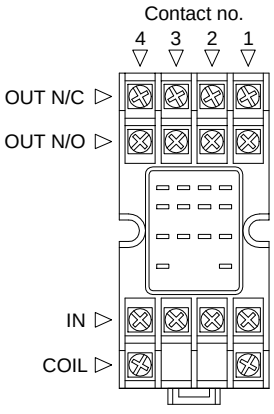
When the coil is powered: Electricity cannot pass



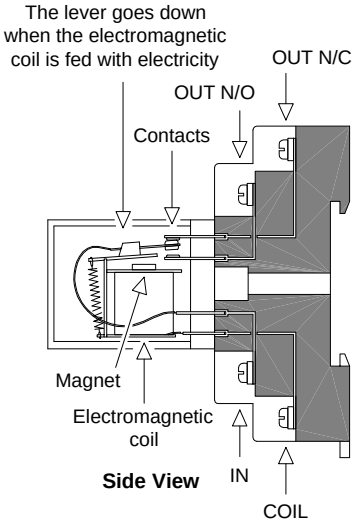
Front View
2-pole relay socket



Front View
3-pole relay socket

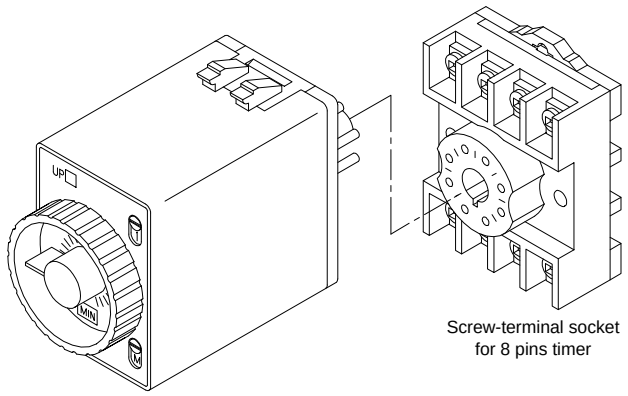


Front View
4-pole relay socket



Side View

Timer



ON-delay timer 0-10 hrs

Screw-terminal socket for 8 pins timer

NAiS / Aromat

Part no.	Description
PMH-10H-AC24V	ON-delay timer 0-10 hrs (24 VAC)
PMH-10H-AC120V	ON-delay timer 0-10 hrs (120 VAC)
AT8-RFD	Screw-terminal socket for 8 pins timer

ADVANCE CONTROLS INC

Part no.	Description
8621A240	ON-delay timer 0-10 hrs (24-250 volts AC/DC)
PF083A	Screw terminal socket for 8 pins timer

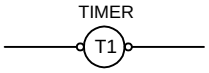
CUSTOM CONNECTOR

Part no.	Description
OT08-PC	Screw-terminal socket for 8 pins timer

Working principle

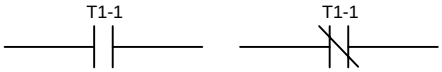
A timer can be compared to a relay, except that it activates its contacts only after a time delay. Once powered, the timer starts counting until the time set at the dial has elapsed. The electromagnetic coil then changes the state of the contacts, say a normally opened contact will be closed and a normally closed contact will be opened, for as long as the coil remains powered.

Electromagnetic coil



When the coil is powered, after time has elapsed, contacts are activated.

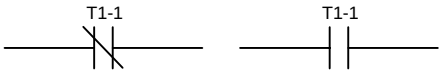
Normally opened contact



Normal position: Electricity cannot pass

When activated by the coil after elapsed time: Electricity can pass

Normally closed contact



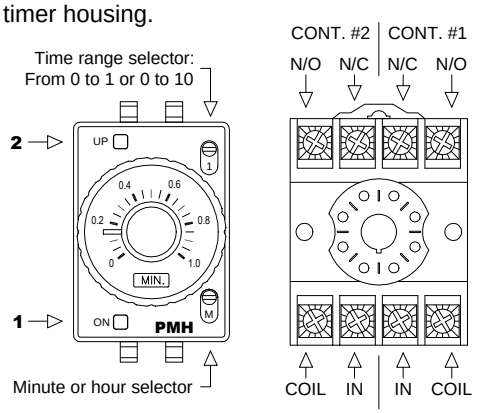
Normal position: Electricity can pass

When activated by the coil after elapsed time: Electricity cannot pass

Keep in mind that, even if they are separated from each other on the wiring diagram, a coil identified as **T1** and its corresponding contacts **T1-1**, **T1-2**, etc..., work together and are physically enclosed in the same timer housing.

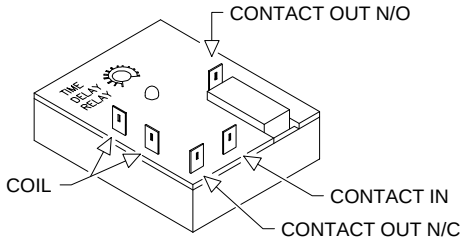
1. When the coil is powered, the "ON" light turns red and the timer starts counting to reach the time set at the dial.

2. After the time set at the dial has elapsed, the "UP" light turns red indicating the contacts are activated.



The timer shown on this page is the model from "NAiS / Aromat". The model from "Advance Controls Inc." is slightly different but works exactly the same way.

Time delay relay



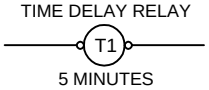
entrelec / SSAC

Part no.	Description
KRDM415M	Time delay relay 5 min. ON-delay 120 VAC

Working principle

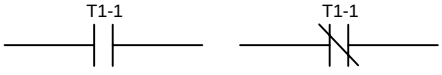
A time delay relay can be compared to a timer, except that the delay is factory set. Once powered, the timer starts counting until the preset time has elapsed. The electromagnetic coil then changes the state of the contacts, say a normally opened contact will be closed and a normally closed contact will be opened, for as long as the coil remains powered.

Electromagnetic coil



5 MINUTES
When the coil is powered, after time has elapsed, contacts are activated.

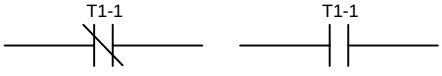
Normally opened contact



Normal position: Electricity cannot pass

When activated by the coil after elapsed time: Electricity can pass

Normally closed contact

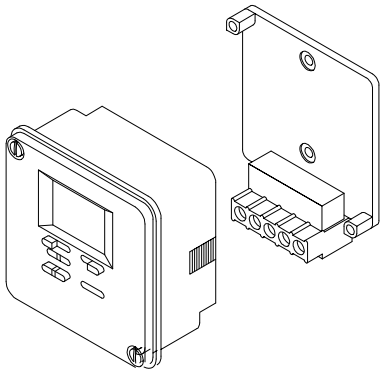


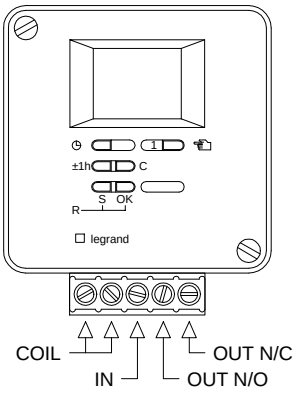
Normal position: Electricity can pass

When activated by the coil after elapsed time: Electricity cannot pass

Keep in mind that, even if they are separated from each other on the wiring diagram, a coil identified as **T1** and its corresponding contacts **T1-1**, **T1-2**, etc..., work together and are physically enclosed in the same time delay relay housing.

8 Programmable clock





legrand

Part no.	Description
496 83 MaxiRex D1	Programmable clock 120 VAC

Working principle

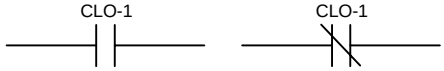
A programmable clock has an electromagnetic coil which activates contact(s) as per programs entered to the clock. At the start of a program, the electromagnetic coil changes the state of the contacts, say a normally opened contact will be closed and a normally closed contact will be opened. At the end of a program, the contacts come back in their normal position.

Keep in mind that, even if they are separated from each other on the wiring diagram, a coil identified as **CLO** and its corresponding contacts **CLO-1**, **CLO-2**, etc..., work together and are physically enclosed in the same clock housing.

Electromagnetic coil

When the coil is powered, contacts are activated as per entered programs.

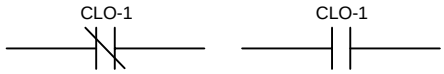
Normally opened contact



Normal position: Electricity cannot pass

When activated by the coil at the start of a program: Electricity can pass

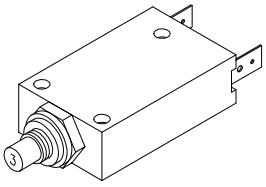
Normally closed contact



Normal position: Electricity can pass

When activated by the coil at the start of a program: Electricity cannot pass

Circuit breaker

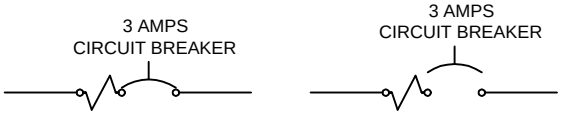


Manufacturer	Part no.	Description
SIEMENS	W58-XB1A4A-3	3 amps circuit breaker
E.T.A.	H-2241	3 amps circuit breaker

Working principle

Used to protect the whole control panel circuit, the circuit breaker pops out when an amperage overdraw occurs.

3 amps circuit breaker

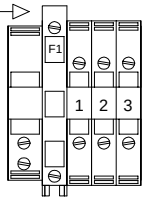


Normal position: Electricity can pass

Popped out after amperage overdraw: Electricity cannot pass

Fuse (fast acting 5mm x 20 mm)

The fuse is hidden in the first terminal, next to those used to wire all external components. To access the fuse, simply pull the tab at the top of the terminal to swivel it down.

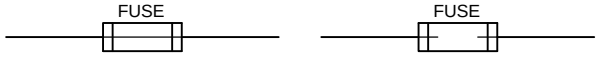


Working principle

Used to protect the transformer, the fuse shuts off the circuit if an amperage overdraw occurs.

Manufacturer	Part no.	Description
BUSS / EDISON	GMA-1	1 amp fuse 120 VAC
BUSS / EDISON	GMA-2	2 amps fuse 120 VAC
BUSS / EDISON	GMA-3	3 amps fuse 120 VAC
BUSS / EDISON	GMA-5	5 amps fuse 120 VAC
LITTLE FUSE	235-1	1 amp fuse 120 VAC
LITTLE FUSE	235-2	2 amps fuse 120 VAC
LITTLE FUSE	235-3	3 amps fuse 120 VAC
LITTLE FUSE	235-5	5 amps fuse 120 VAC

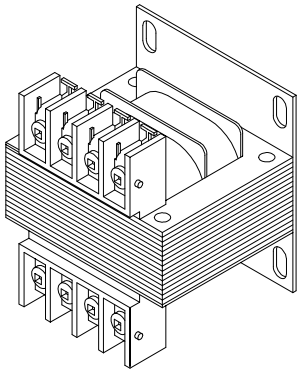
Fuse



Normal state: Electricity can pass

After amperage overdraw: Electricity cannot pass

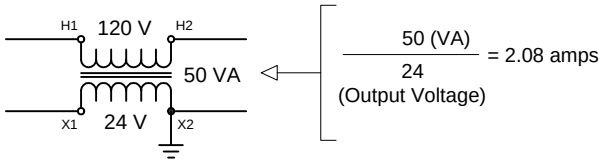
Transformer



Working principle

A transformer is used to decrease the input voltage. The "VA" corresponds to the maximum amperage available from the transformer. To calculate the maximum amperage output, you must divide the "VA" by the output voltage.

Transformer from 120 volts to 24 volts



SQUARE - D

Part no.	Description
9070T50D23	Transformer 120-240 volts @ 24 volts - 50 VA
9070T75D23	Transformer 120-240 volts @ 24 volts - 75 VA
9070T100D23	Transformer 120-240 volts @ 24 volts - 100 VA
9070T150D23	Transformer 120-240 volts @ 24 volts - 150 VA
9070T200D23	Transformer 120-240 volts @ 24 volts - 200 VA
9070T250D23	Transformer 120-240 volts @ 24 volts - 250 VA
9070T100D19	Transformer 380 volts @ 24 volts - 100 VA
9070T50D31	Transformer 240-480 volts @ 120 volts - 50 VA
9070T75D31	Transformer 240-480 volts @ 120 volts - 75 VA
9070T100D31	Transformer 240-480 volts @ 120 volts - 100 VA
9070T150D31	Transformer 240-480 volts @ 120 volts - 150 VA
9070T200D31	Transformer 240-480 volts @ 120 volts - 200 VA
9070T50D37	Transformer 600 volts @ 120 volts - 50 VA
9070T75D37	Transformer 600 volts @ 120 volts - 75 VA
9070T100D37	Transformer 600 volts @ 120 volts - 100 VA
9070T150D37	Transformer 600 volts @ 120 volts - 150 VA
9070T200D37	Transformer 600 volts @ 120 volts - 200 VA

SIEMENS

Part no.	Description
MT0050C	Transformer 120-240 volts @ 24 volts - 50 VA
MT0075C	Transformer 120-240 volts @ 24 volts - 75 VA
MT0100C	Transformer 120-240 volts @ 24 volts - 100 VA
MT0150C	Transformer 120-240 volts @ 24 volts - 150 VA
MT0200C	Transformer 120-240 volts @ 24 volts - 200 VA
MT0250C	Transformer 120-240 volts @ 24 volts - 250 VA
PT100MSG	Transformer 380 volts @ 24 volts - 100 VA
MT0050A	Transformer 240-480 volts @ 120 volts - 50 VA
MT0075A	Transformer 240-480 volts @ 120 volts - 75 VA
MT0100A	Transformer 240-480 volts @ 120 volts - 100 VA
MT0150A	Transformer 240-480 volts @ 120 volts - 150 VA
MT0200A	Transformer 240-480 volts @ 120 volts - 200 VA
MT0050E	Transformer 600 volts @ 120 volts - 50 VA
MT0075E	Transformer 600 volts @ 120 volts - 75 VA
MT0100E	Transformer 600 volts @ 120 volts - 100 VA
MT0150E	Transformer 600 volts @ 120 volts - 150 VA
MT0200E	Transformer 600 volts @ 120 volts - 200 VA

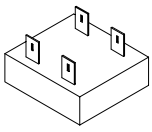
HAMMOND

Part no.	Description
SL50PG	Transformer 120-240 volts @ 24 volts - 50 VA
SL75PG	Transformer 120-240 volts @ 24 volts - 75 VA
SL100PG	Transformer 120-240 volts @ 24 volts - 100 VA
SL150PG	Transformer 120-240 volts @ 24 volts - 150 VA
SL200PG	Transformer 120-240 volts @ 24 volts - 200 VA
SL250PG	Transformer 120-240 volts @ 24 volts - 250 VA
SL50QJ	Transformer 240-480 volts @ 120 volts - 50 VA
SL75QJ	Transformer 240-480 volts @ 120 volts - 75 VA
SL100QJ	Transformer 240-480 volts @ 120 volts - 100 VA
SL150QJ	Transformer 240-480 volts @ 120 volts - 150 VA
SL200QJ	Transformer 240-480 volts @ 120 volts - 200 VA
SL50AP	Transformer 600 volts @ 120 volts - 50 VA
SL75AP	Transformer 600 volts @ 120 volts - 75 VA
SL100AP	Transformer 600 volts @ 120 volts - 100 VA
SL150AP	Transformer 600 volts @ 120 volts - 150 VA
SL200AP	Transformer 600 volts @ 120 volts - 200 VA

MARCUS

Part no.	Description
MTC 50-20	Transformer 120 volts @ 24 volts - 50 VA
MTC 75-20	Transformer 120 volts @ 24 volts - 75 VA
MTC 100-20	Transformer 120 volts @ 24 volts - 100 VA
MTC 150-20	Transformer 120 volts @ 24 volts - 150 VA
MTC 200-20	Transformer 120 volts @ 24 volts - 200 VA
MTC 250-20	Transformer 120 volts @ 24 volts - 250 VA
MTC 50-36	Transformer 480 volts @ 120 volts - 50 VA
MTC 75-36	Transformer 480 volts @ 120 volts - 75 VA
MTC 100-36	Transformer 480 volts @ 120 volts - 100 VA
MTC 150-36	Transformer 480 volts @ 120 volts - 150 VA
MTC 200-36	Transformer 480 volts @ 120 volts - 200 VA
MTC 50-39	Transformer 600 volts @ 120 volts - 50 VA
MTC 75-39	Transformer 600 volts @ 120 volts - 75 VA
MTC 100-39	Transformer 600 volts @ 120 volts - 100 VA
MTC 150-39	Transformer 600 volts @ 120 volts - 150 VA
MTC 200-39	Transformer 600 volts @ 120 volts - 200 VA

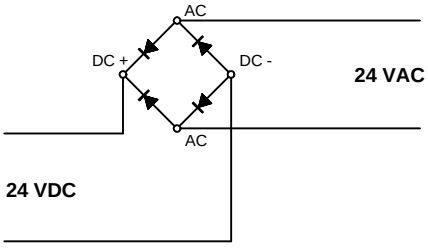
Rectifier bridge



Working principle

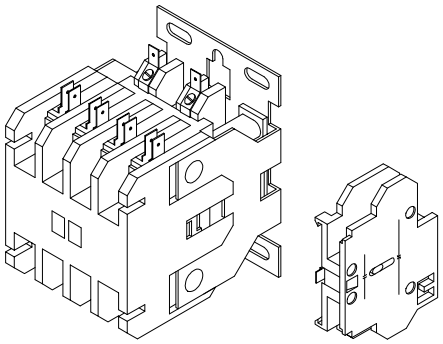
A rectifier bridge is used to convert alternating current (AC) into direct current (DC).

Rectifier bridge for 24 volts



Manufacturer	Part no.	Description
GENERAL	GBPC3510	Rectifier bridge 35 amps 1000 volts
VISHAY-LITEON POWER	KBPC3510	Rectifier bridge 35 amps 1000 volts
INTERNATIONAL RECTIFYING	KBPC3510	Rectifier bridge 35 amps 1000 volts

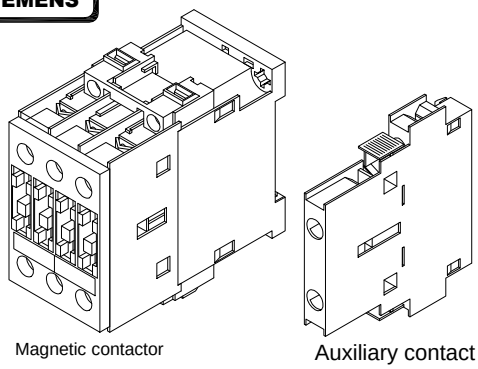
Cutler-Hammer



Magnetic contactor Auxiliary contact

Part no.	Description
C25DND315A	Magnetic contactor - 3 poles - 15 amps (120 VAC)
C25DND325A	Magnetic contactor - 3 poles - 25 amps (120 VAC)
C25DND330A	Magnetic contactor - 3 poles - 30 amps (120 VAC)
C25DNF340A	Magnetic contactor - 3 poles - 40 amps (120 VAC)
C25FNF350A	Magnetic contactor - 3 poles - 50 amps (120 VAC)
C25FNF360A	Magnetic contactor - 3 poles - 60 amps (120 VAC)
C25END425A	Magnetic contactor - 4 poles - 25 amps (120 VAC)
C25END430A	Magnetic contactor - 4 poles - 30 amps (120 VAC)
C25DND315T	Magnetic contactor - 3 poles - 15 amps (24 VAC)
C25DND325T	Magnetic contactor - 3 poles - 25 amps (24 VAC)
C25DND330T	Magnetic contactor - 3 poles - 30 amps (24 VAC)
C25DNF340T	Magnetic contactor - 3 poles - 40 amps (24 VAC)
C25FNF350T	Magnetic contactor - 3 poles - 50 amps (24 VAC)
C25FNF360T	Magnetic contactor - 3 poles - 60 amps (24 VAC)
C25END425T	Magnetic contactor - 4 poles - 25 amps (24 VAC)
C25END430T	Magnetic contactor - 4 poles - 30 amps (24 VAC)
C320KG1	Auxiliary contact 1 N/O (side mounted)
C320KG2	Auxiliary contact 1 N/C (side mounted)
C320KG3	Auxiliary contact 1 N/O - 1 N/C (side mounted)
C320KG4	Auxiliary contact 2 N/O (side mounted)
C320KG5	Auxiliary contact 2 N/C (side mounted)
C321KM60	Mechanical interlock - not shown

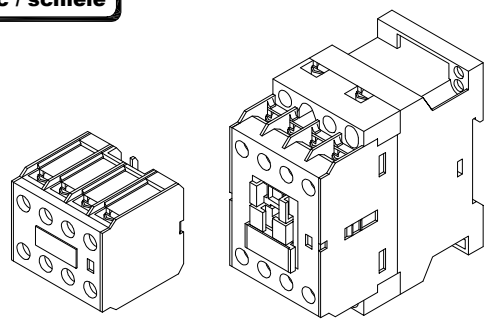
SIEMENS



Magnetic contactor Auxiliary contact

Part no.	Description
3RT1023-1AK60	Magnetic contactor - 3 poles - 12 amps (120 VAC)
3RT1024-1AK60	Magnetic contactor - 3 poles - 15 amps (120 VAC)
3RT1025-1AK60	Magnetic contactor - 3 poles - 20 amps (120 VAC)
3RT1026-1AK60	Magnetic contactor - 3 poles - 25 amps (120 VAC)
3RT1033-1AK60	Magnetic contactor - 3 poles - 30 amps (120 VAC)
3RT1034-1AK60	Magnetic contactor - 3 poles - 40 amps (120 VAC)
3RT1035-1AK60	Magnetic contactor - 3 poles - 50 amps (120 VAC)
3RT1023-1AC20	Magnetic contactor - 3 poles - 12 amps (24 VAC)
3RT1024-1AC20	Magnetic contactor - 3 poles - 15 amps (24 VAC)
3RT1025-1AC20	Magnetic contactor - 3 poles - 20 amps (24 VAC)
3RT1026-1AC20	Magnetic contactor - 3 poles - 25 amps (24 VAC)
3RT1033-1AC20	Magnetic contactor - 3 poles - 30 amps (24 VAC)
3RT1034-1AC20	Magnetic contactor - 3 poles - 40 amps (24 VAC)
3RT1035-1AC20	Magnetic contactor - 3 poles - 50 amps (24 VAC)
3RH1921-1EA20	Auxiliary contact 2 N/O (side mounted)
3RH1921-1EA11	Auxiliary contact 1 N/O - 1 N/C (side mounted)
3RH1921-1EA02	Auxiliary contact 2 N/C (side mounted)

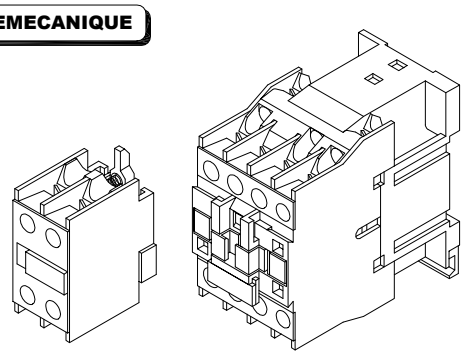
entrelec / schiele



Auxiliary contact Magnetic contactor

Part no.	Description
1 366 001 28	Magnetic contactor - 3 poles - 15 amps (120 VAC)
1 366 013 28	Magnetic contactor - 3 poles - 25 amps (120 VAC)
1 366 201 28	Magnetic contactor - 3 poles - 35 amps (120 VAC)
1 366 213 28	Magnetic contactor - 3 poles - 50 amps (120 VAC)
1 366 001 06	Magnetic contactor - 3 poles - 15 amps (24 VAC)
1 366 013 06	Magnetic contactor - 3 poles - 25 amps (24 VAC)
1 366 201 06	Magnetic contactor - 3 poles - 35 amps (24 VAC)
1 366 213 06	Magnetic contactor - 3 poles - 50 amps (24 VAC)
3 369 035 01	Auxiliary contact 1 N/O - 1 N/C (front mounted)
3 369 036 01	Auxiliary contact 2 N/O - 2 N/C (front mounted)
3 369 037 01	Auxiliary contact 3 N/O - 1 N/C (front mounted)
3 359 018 01	Mechanical interlock - not shown

TELEMECANIQUE

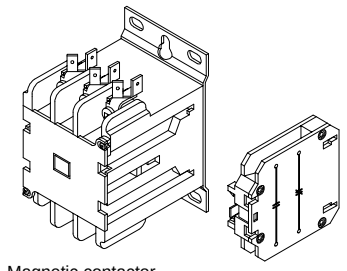


Auxiliary contact Magnetic contactor

Part no.	Description
LC1D0910G6	Magnetic contactor - 3 poles - 20 amps (120VAC)
LC1D1210G6	Magnetic contactor - 3 poles - 25 amps (120VAC)
LC1D1810G6	Magnetic contactor - 3 poles - 35 amps (120VAC)
LC1D0910B6	Magnetic contactor - 3 poles - 20 amps (24VAC)
LC1D1210B6	Magnetic contactor - 3 poles - 25 amps (24VAC)
LC1D1810B6	Magnetic contactor - 3 poles - 35 amps (24VAC)
LA1DN11	Auxiliary contact 1 N/O - 1 N/C (front mounted)
LA1DN20	Auxiliary contact 2 N/O (front mounted)
LA1DN02	Auxiliary contact 2 N/C (front mounted)
LA1DN22	Auxiliary contact 2 N/O - 2 N/C (front mounted)
LA1DN31	Auxiliary contact 3 N/O - 1 N/C (front mounted)
LA1DN40	Auxiliary contact 4 N/O (front mounted)
LA1DN04	Auxiliary contact 4 N/C (front mounted)

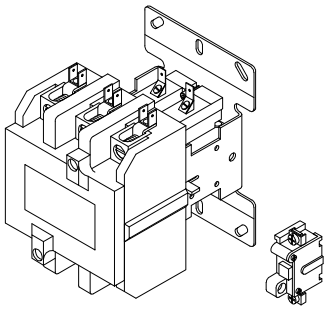
Magnetic contactor

FURNAS



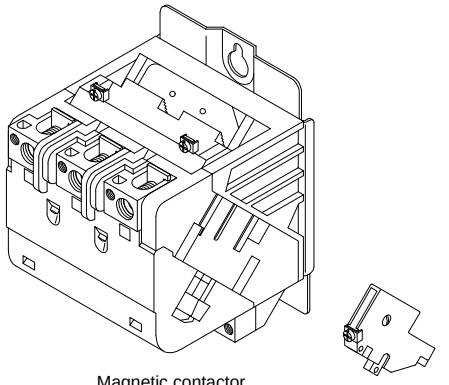
Magnetic contactor
25 - 60 amps

Auxiliary contact



Magnetic contactor
75 - 90 amps

Auxiliary contact



Magnetic contactor
120 - 150 amps

Auxiliary contact

Part no.	Description
42AF35AF	Magnetic contactor - 3 poles - 25 amps (120 VAC)
42BF35AF	Magnetic contactor - 3 poles - 30 amps (120 VAC)
42CF35AF	Magnetic contactor - 3 poles - 40 amps (120 VAC)
42DF35AF	Magnetic contactor - 3 poles - 50 amps (120 VAC)
42EF35AF	Magnetic contactor - 3 poles - 60 amps (120 VAC)
42AF25AF	Magnetic contactor - 4 poles - 25 amps (120 VAC)
42BF25AF	Magnetic contactor - 4 poles - 30 amps (120 VAC)
42AF35AJ	Magnetic contactor - 3 poles - 25 amps (24 VAC)
42BF35AJ	Magnetic contactor - 3 poles - 30 amps (24 VAC)
42CF35AJ	Magnetic contactor - 3 poles - 40 amps (24 VAC)
42DF35AJ	Magnetic contactor - 3 poles - 50 amps (24 VAC)
42EF35AJ	Magnetic contactor - 3 poles - 60 amps (24 VAC)
42AF25AJ	Magnetic contactor - 4 poles - 25 amps (24 VAC)
42BF25AJ	Magnetic contactor - 4 poles - 30 amps (24 VAC)
49ACR6	Auxiliary contact 1 N/O - 1 N/C (side mounted)
49ACR7	Auxiliary contact 2 N/O (side mounted)
49ACR8	Auxiliary contact 2 N/C (side mounted)
49D70035001	Mechanical interlock - not shown

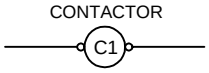
Part no.	Description
42FE35AJ	Magnetic contactor - 3 poles - 75 amps (24 VAC)
42GE35AJ	Magnetic contactor - 3 poles - 90 amps (24 VAC)
49D22125001	Auxiliary contact 1 N/O (side mounted)
42HF35AJ	Magnetic contactor - 3 poles - 120 amps (24 VAC)
42IF35AJ	Magnetic contactor - 3 poles - 150 amps (24 VAC)
49D54682NO	Auxiliary contact 1 N/O (side mounted)

Working principle

A magnetic contactor is used to start an electric motor. It has an electromagnetic coil which activates the normally opened main contacts (and sometimes auxiliary contacts) when fed with electricity. Once powered, the electromagnetic coil pulls down the main contacts to close them. As for the auxiliary contacts, say a normally opened contact will be closed and a normally closed contact will be opened, for as long as the coil remains powered. (Main contacts can only be normally opened.)

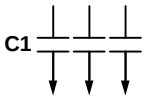
Keep in mind that, even if they are separated from each other on the wiring diagram, a coil identified as "C1" and its corresponding contacts "C1-1", "C1-2" or "C1-3", etc... are enclosed in the same contactor housing.

Electromagnetic coil



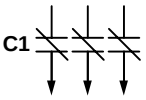
When the coil is powered, contacts are activated

Main Contacts



To electric motor

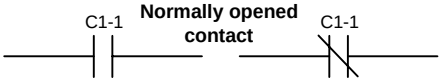
Normal position:
Electricity cannot pass



To electric motor

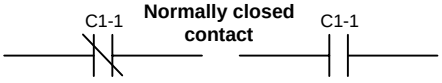
When the coil is powered:
Electricity can pass

Auxiliary Contacts



Normal position:
Electricity cannot pass

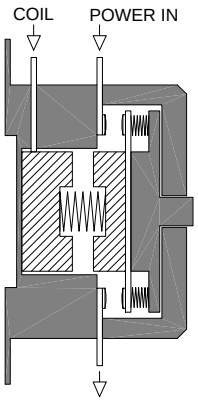
When the coil is powered:
Electricity can pass



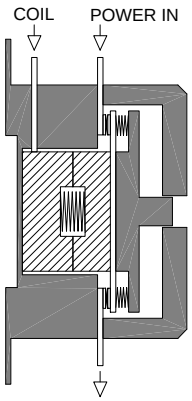
Normal position:
Electricity can pass

When the coil is powered:
Electricity cannot pass

Sectional side view of a magnetic contactor



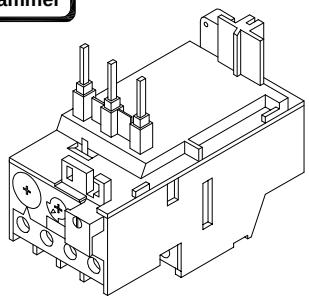
Normal position:
Electricity cannot pass



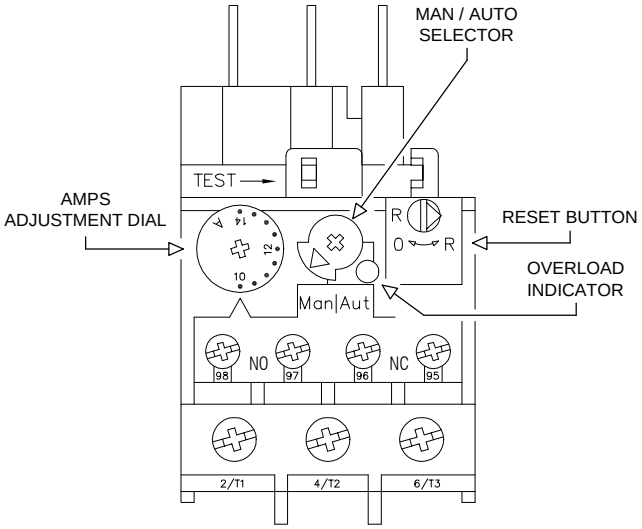
When the coil is powered:
Electricity can pass

Thermal overload relay

Cutler-Hammer



Part no.	Description
C316FNA3E	Thermal overload relay 0.63 - 1.00 amps
C316FNA3F	Thermal overload relay 1.00 - 1.40 amps
C316FNA3G	Thermal overload relay 1.30 - 1.80 amps
C316FNA3H	Thermal overload relay 1.70 - 2.40 amps
C316FNA3J	Thermal overload relay 2.20 - 3.10 amps
C316FNA3K	Thermal overload relay 2.80 - 4.00 amps
C316FNA3L	Thermal overload relay 3.50 - 5.00 amps
C316FNA3M	Thermal overload relay 4.50 - 6.50 amps
C316FNA3N	Thermal overload relay 6.00 - 8.50 amps
C316FNA3P	Thermal overload relay 7.50 - 11.0 amps
C316FNA3Q	Thermal overload relay 10.0 - 14.0 amps
C316FNA3R	Thermal overload relay 13.0 - 19.0 amps
C316FNA3S	Thermal overload relay 18.0 - 24.0 amps
C316FNA3T	Thermal overload relay 24.0 - 32.0 amps
C316KNA3C	Thermal overload relay 29.0 - 42.0 amps



- **Amps adjustment dial**

  The adjustment must be set equal to the amps written on the electric motor specification plate.

- **Man / Auto selector**

  Manual: If an overload occurs, the operator must restart the system by pressing the reset button.

  Automatic: When set on automatic, the system will automatically restart after the thermal sensor has cooled down.

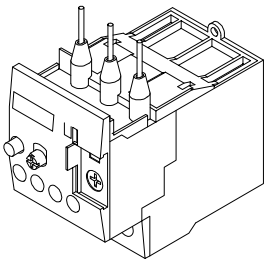
- **Reset button**

  R / O: The system resets **once the button is released**.
  R: The system resets **when pressing the button**.

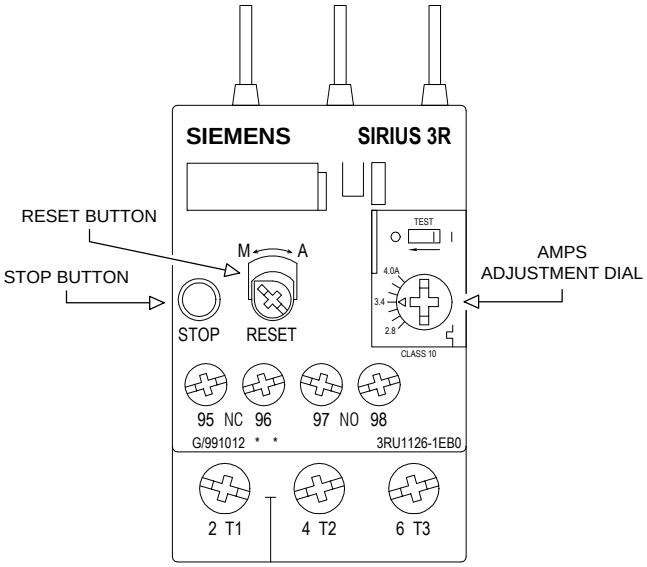
- **Overload indicator**

  Indicates if the system has reset because of an overload.

SIEMENS



Part no.	Description
3RU1126-1CB0	Thermal overload relay 1.80 - 2.50 amps
3RU1126-1DB0	Thermal overload relay 2.20 - 3.20 amps
3RU1126-1EB0	Thermal overload relay 2.80 - 4.00 amps
3RU1126-1FB0	Thermal overload relay 3.50 - 5.00 amps
3RU1126-1GB0	Thermal overload relay 4.50 - 6.30 amps
3RU1126-1HB0	Thermal overload relay 5.50 - 8.00 amps
3RU1126-1JB0	Thermal overload relay 7.00 - 10.0 amps
3RU1126-1KB0	Thermal overload relay 9.00 - 12.5 amps
3RU1126-4AB0	Thermal overload relay 11.0 - 16.0 amps
3RU1126-4BB0	Thermal overload relay 14.0 - 20.0 amps
3RU1126-4CB0	Thermal overload relay 17.0 - 22.0 amps
3RU1126-4DB0	Thermal overload relay 20.0 - 25.0 amps
3RU1136-4EB0	Thermal overload relay 22.0 - 32.0 amps
3RU1136-4FB0	Thermal overload relay 28.0 - 40.0 amps
3RU1136-4GB0	Thermal overload relay 36.0 - 45.0 amps
3RU1136-4HB0	Thermal overload relay 40.0 - 50.0 amps



- **Amps adjustment dial**

  The adjustment must be set equal to the amps written on the electric motor specification plate.

- **Reset button**

  Manual: If an overload occurs, the operator must restart the system by pressing the reset button.

  Automatic: When set on automatic, the system will automatically restart after the thermal sensor has cooled down.

- **Stop button**

  The stop button stops the electric motor when pressed down.

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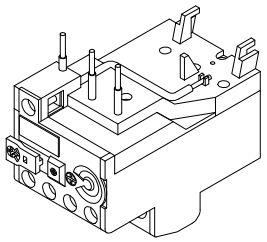
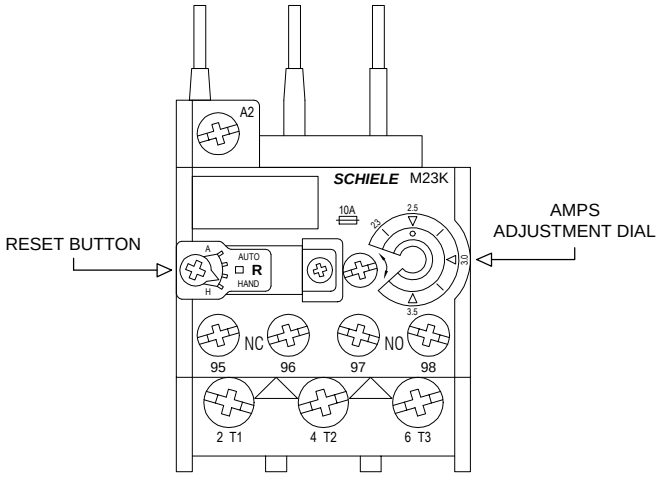


Part no.	Description
1 245 505 27	Thermal overload relay 0.63 - 1.00 amps
1 245 508 27	Thermal overload relay 1.00 - 1.50 amps
1 245 509 27	Thermal overload relay 1.20 - 1.80 amps
1 245 510 27	Thermal overload relay 1.50 - 2.30 amps
1 245 511 27	Thermal overload relay 1.80 - 2.80 amps
1 245 512 27	Thermal overload relay 2.30 - 3.50 amps
1 245 513 27	Thermal overload relay 2.80 - 4.00 amps
1 245 514 27	Thermal overload relay 3.50 - 5.00 amps
1 245 515 27	Thermal overload relay 4.00 - 6.30 amps
1 245 517 27	Thermal overload relay 5.60 - 8.00 amps
1 245 518 27	Thermal overload relay 7.00 - 10.0 amps
1 245 519 27	Thermal overload relay 8.00 - 12.5 amps
1 245 521 27	Thermal overload relay 11.0 - 17.0 amps
1 245 522 27	Thermal overload relay 15.0 - 23.0 amps
1 245 636 27	Thermal overload relay 20.0 - 32.0 amps
1 245 637 27	Thermal overload relay 25.0 - 40.0 amps



- **Amps adjustment dial**

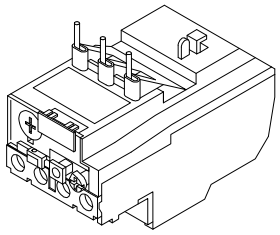
  The adjustment must be set equal to the amps written on the electric motor specification plate.

- **Reset button**

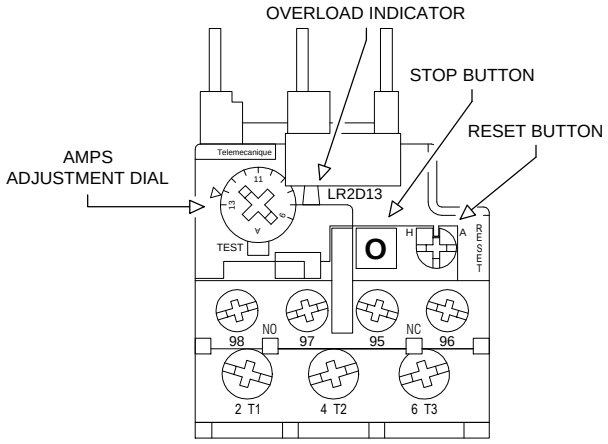
  Manual: If an overload occurs, the operator must restart the system by pressing the reset button.

  Automatic: When set on automatic, the system will automatically restart after the thermal sensor has cooled down.

TELEMECANIQUE



Part no.	Description
LR2D1305	Thermal overload relay 0.63 - 1.00 amps
LR2D1306	Thermal overload relay 1.00 - 1.60 amps
LR2D13X6	Thermal overload relay 1.25 - 2.00 amps
LR2D1307	Thermal overload relay 1.60 - 2.50 amps
LR2D1308	Thermal overload relay 2.50 - 4.00 amps
LR2D1310	Thermal overload relay 4.00 - 6.00 amps
LR2D1312	Thermal overload relay 5.50 - 8.00 amps
LR2D1314	Thermal overload relay 7.00 - 10.0 amps
LR2D1316	Thermal overload relay 9.00 - 13.0 amps
LR2D1321	Thermal overload relay 12.0 - 18.0 amps
LR2D1322	Thermal overload relay 17.0 - 25.0 amps
LR2D2353	Thermal overload relay 23.0 - 32.0 amps
LR2D2355	Thermal overload relay 28.0 - 36.0 amps
LR2D3355	Thermal overload relay 30.0 - 40.0 amps
LR2D3357	Thermal overload relay 37.0 - 50.0 amps



- **Amps adjustment dial**

  The adjustment must be set equal to the amps written on the electric motor specification plate.

- **Reset button**

  Manual: If an overload occurs, the operator must restart the system by pressing the reset button.

  Automatic: When set on automatic, the system will automatically restart after the thermal sensor has cooled down.

- **Stop button**

  The stop button stops the electric motor when pressed down.

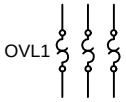
- **Overload indicator**

  Indicates if the system has reset because of an overload.

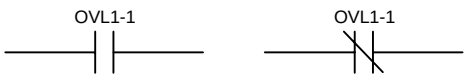
Working principle

Used to protect the motor, the overload relay has a thermal sensor which activates two contacts when amperage overdraw occurs. Once the amperage overdraw detected, the thermal sensor changes the state of the contacts, say a normally opened contact will be closed and a normally closed contact will be opened.

Thermal sensor



Normally opened contact

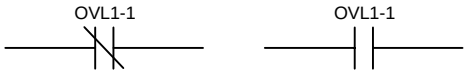


Normal position: Electricity cannot pass

When activated by the thermal sensor after amperage overdraw: Electricity can pass

Keep in mind that, even if they are separated from each other on the wiring diagram, a thermal sensor identified as "OVL1" and its corresponding contacts "OVL1-1" or "OVL1-2" are physically enclosed in the same overload relay housing.

Normally closed contact

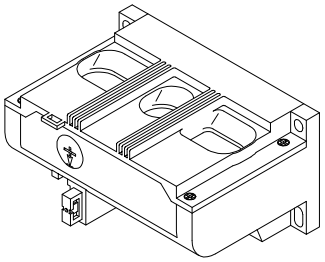


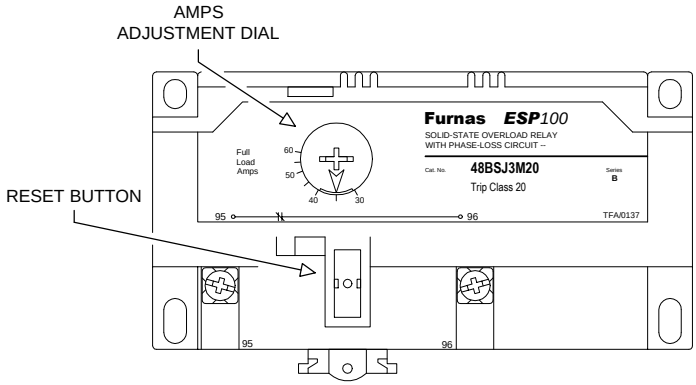
Normal position: Electricity can pass

When activated by the thermal sensor after amperage overdraw: Electricity cannot pass

14 Solid-state overload relay

FURNAS





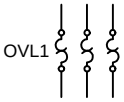
Part no.	Description
48BSF3M20	Solid-state overload relay 13.0 - 27.0 amps
48BSH3M20	Solid-state overload relay 22.0 - 45.0 amps
48BSJ3M20	Solid-state overload relay 30.0 - 60.0 amps
48BSK3M20	Solid-state overload relay 45.0 - 90.0 amps
48BSL3M20	Solid-state overload relay 57.0 - 115.0 amps
48BSM3M20	Solid-state overload relay 67.0 - 135.0 amps
48BSN3M20	Solid-state overload relay 81.0 - 162.0 amps

- **Amps adjustment dial**
  The adjustment must be set equal to the amps written on the electric motor specification plate.
- **Reset button**
  If an overload occurs, the operator must restart the system by pressing the reset button.

Working principle

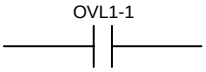
Used to protect the motor, the overload relay reads the electromagnetic field arround the wires going to the motor and activates one normally closed contact when amperage overdraw occurs. Once the amperage overdraw detected, the overload relay changes the state of the contact, say the normally closed contact will be opened.

Overload relay



Normally closed contact

Normal position:
Electricity can pass

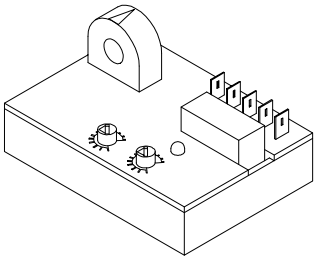


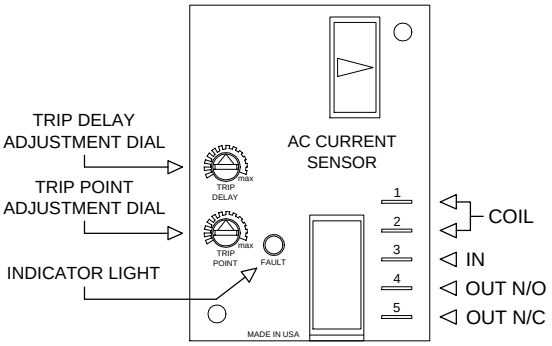
When activated by the overload relay after amperage overdraw:
Electricity cannot pass

Keep in mind that, even if they are separated from each other on the wiring diagram, a overload relay identified as "OVL1" and its corresponding contact "OVL1-1" are physically enclosed in the same overload relay housing.

Current sensor

entrelec / SSAC





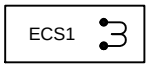
- **Trip point adjustment dial**
  To set the level from which the current sensor must shut the circuit off.
- **Trip delay adjustment dial**
  To set the time the current sensor must wait before shutting the circuit off during an amperage overdraw. (factory set to 3 sec.)
- **Indicator light**
  Lit up when the current sensor reads amperage over the preset trip point.

Part no.	Description
ECSH40AC	AC current sensor 0.5 - 5.0 amps (120 VAC)
ECSH41AC	AC current sensor 2.0 - 20.0 amps (120 VAC)

Working principle

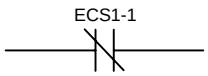
Used to protect the motor, the current sensor has an electromagnetic coil which activates one contact when amperage overdraw occurs. Once an amperage overdraw detected, the electromagnetic coil changes the state of the contact, say a normally opened contact will be closed and a normally closed contact will be opened.

Electromagnetic coil



Normally opened contact

Normal position:
Electricity cannot pass



When activated by the coil after amperage overdraw:
Electricity can pass

Normally closed contact

Normal position:
Electricity can pass

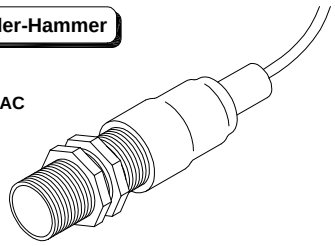
When activated by the coil after amperage overdraw:
Electricity can pass

Keep in mind that, even if they are separated from each other on the wiring diagram, a coil identified as "ECS1" and its corresponding contact "ECS1-1" are physically enclosed in the same current sensor housing.

Proximity switch (metal detector)

Cutler-Hammer

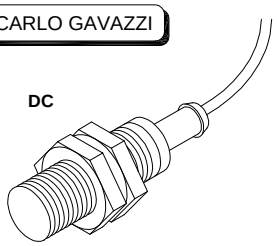
AC



Part no.	Description
E57LBL18A2	N/C inductive proximity switch - 24 VAC

CARLO GAVAZZI

DC

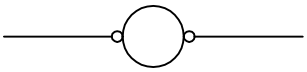


Part no.	Description
EI1805NPOSS	N/C inductive proximity switch - 24 VDC

Working principle

J. Houle & Fils Inc. is using proximity switches with a normally closed contact. When a metal surface comes within 3/16" of the front of the switch, the contact opens and does not allow electricity to pass through it.

PROXIMITY SWITCH

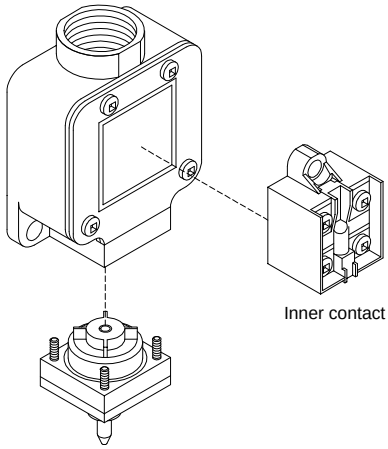


Normal position: Electricity can pass

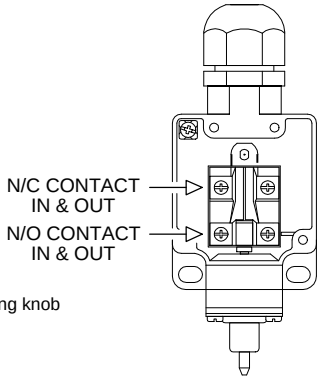
When detecting metal: Electricity cannot pass

Limit switch

TELEMECANIQUE



Part no.	Description
XCK-L108H7	Complete limit switch
ZCK-L1H7	Limit switch without activating knob
ZCK-D08	Activating knob alone
XES-P2151	Inner contact alone



Working principle

Manually activated, this switch is used to let electricity go through or not when used with one contact or to direct electricity in one circuit or the other when used with two contacts. It consists of one tip which activates two contacts. Once activated, it changes the state of the contacts, say a normally opened contact will be closed and a normally closed contact will be opened.

Limit switch
used with one contact (N.C.)

LIMIT SWITCH

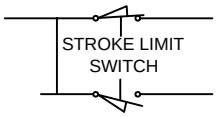
Normal position: Electricity can pass

LIMIT SWITCH

When activated: Electricity cannot pass

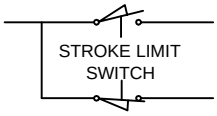
Limit switch
used with two contacts (1 N.O. and 1 N.C.)

STROKE LIMIT SWITCH



Normal position: Electricity can pass on top

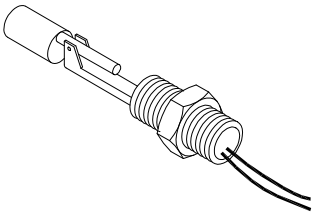
STROKE LIMIT SWITCH



When activated: Electricity cannot pass on bottom

Liquid level switch

Madison

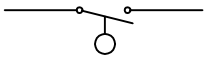


Part no.	Description
2XC13	Liquid level switch

Working principle

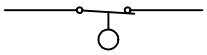
The oil level float is a switch that lets the electricity pass only when oil level is sufficient.

OIL LEVEL FLOAT
FL1-1



Not enough oil: Electricity cannot pass

OIL LEVEL FLOAT
FL1-1



Enough oil: Electricity can pass

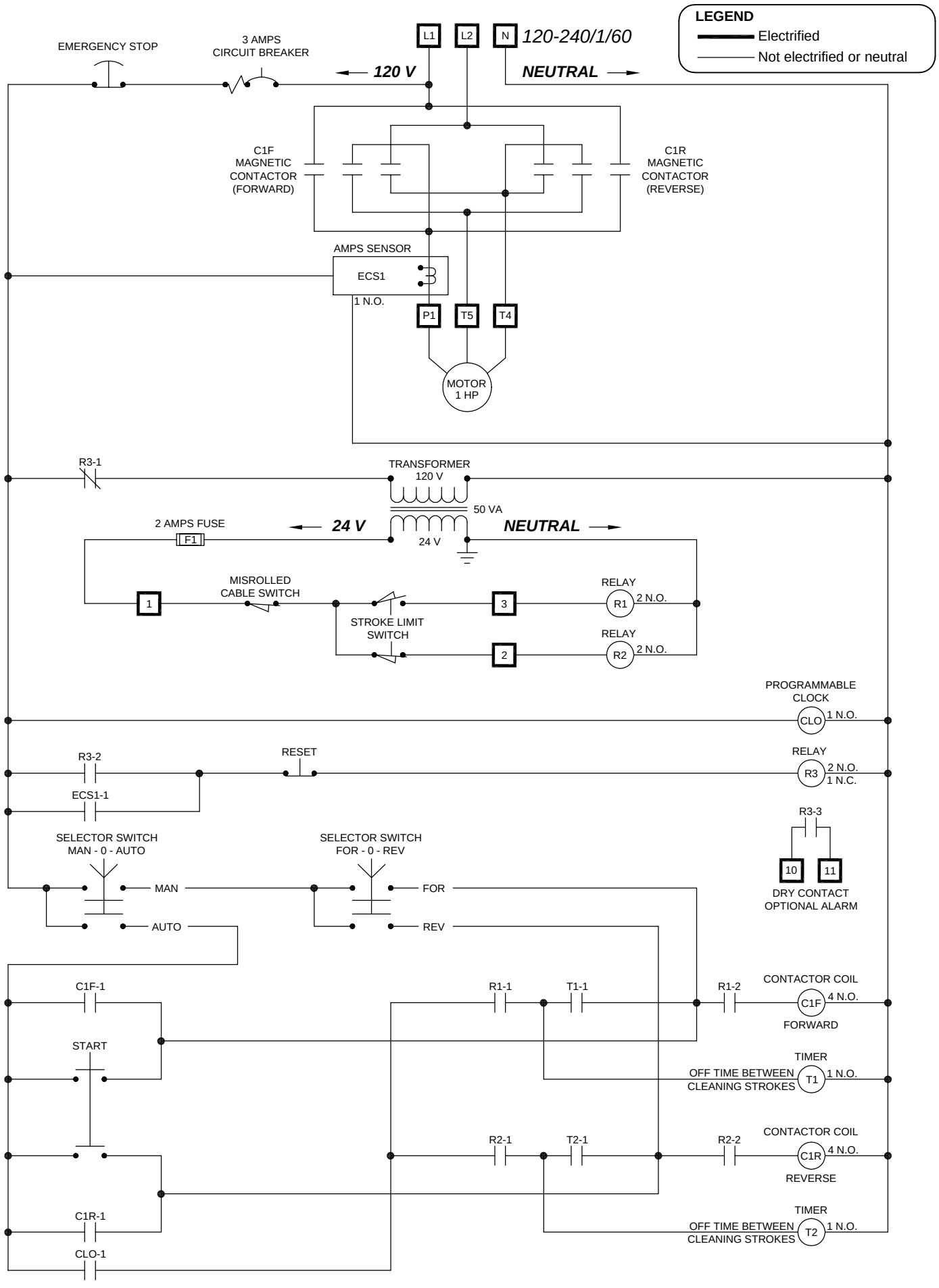
When control panel is unpowered

This wiring diagram shows all components unpowered. This is the wiring diagram that you must start with, to understand the functions of a control panel.

Always refer to this wiring diagram to know if a contact is normally opened or normally closed.

Each part works as per the following:

1. The **circuit breaker** pops out when an amperage overdraw occurs.
2. The **emergency stop button** opens its contact when pressed down.
3. The **amps sensor ECS1** reads the amperage going to the motor and closes its contact **ECS1-1** when it detects an amperage overdraw.
4. The **transformer** makes 24 VAC from incoming 120 VAC.
5. The **fuse** breaks when an amperage overdraw occurs.
6. The **misrolled cable switch** opens its contact if the cable double wraps around the drum.
7. The **stroke limit switch** directs the electricity in one circuit or the other depending on its position.
8. Relay coil **R1** activates its corresponding contacts **R1-1** and **R1-2** when fed with electricity. (**R1-1** and **R1-2** are normally opened)
9. Relay coil **R2** activates its corresponding contacts **R2-1** and **R2-2** when fed with electricity. (**R2-1** and **R2-2** are normally opened)
10. The programmable clock coil **CLO** activates its corresponding contact **CLO-1** as per entered programs. (**CLO-1** is normally opened)
11. The **reset button** opens its contact when pressed down. (Comes back in normal position once released.)
12. Relay coil **R3** activates its corresponding contacts **R3-1**, **R3-2** and **R3-3** when fed with electricity. (**R3-1** is normally closed, **R3-2** and **R3-3** are normally opened)
13. The **MAN - O - AUTO** selector directs electricity in one circuit or the other or none of them depending of its position.
14. The **FOR - O - REV** selector directs electricity in one circuit or the other or none of them depending of its position.
15. The **start button** closes its contacts when pressed down. (Comes back in normal position once released.)
16. Contactor coils **C1F** and **C1R** activates their corresponding contacts when fed with electricity. (All contacts are normally opened)
17. The timer coil **T1**, when fed with electricity, activates its corresponding contact **T1-1** after the time set at the dial has elapsed. (**T1-1** is normally opened)
18. The timer coil **T2**, when fed with electricity, activates its corresponding contact **T2-1** after the time set at the dial has elapsed. (**T2-1** is normally opened)


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
L1
L2
N
120-240/1/60
120 V
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
NEUTRAL
24 V
MISROLLED
CABLE SWITCH
1
3
RELAY
R1
2 N.O.
STROKE LIMIT
SWITCH
2
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
RESET
RELAY
R3
2 N.O.
1 N.C.
ECS1-1
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
SELECTOR SWITCH
FOR - 0 - REV
MAN
AUTO
FOR
REV
C1F-1
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
START
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
C1R-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.
CLO-1

Wiring diagram (Automatic mode - step 1)

Control panel is powered, on automatic mode, waiting for clock signal to start

1. Electricity goes to the main contacts **C1F** and **C1R** of the magnetic contactors but is stopped there because contacts are normally opened.

2. If the **circuit breaker** is not popped out and if the **emergency stop button** is not pressed down, electricity feeds the **amps sensor**, the **transformer** and the **programmable clock**.

3. The **transformer** can be fed with electricity because **R3-1** is normally closed and its coil **R3** is not fed with electricity.

4. Relay coil **R3** is not fed with electricity because its contact **R3-2** is normally opened and the contact **ECS1-1,** which is controlled by the **amps sensor**, is also normally opened.

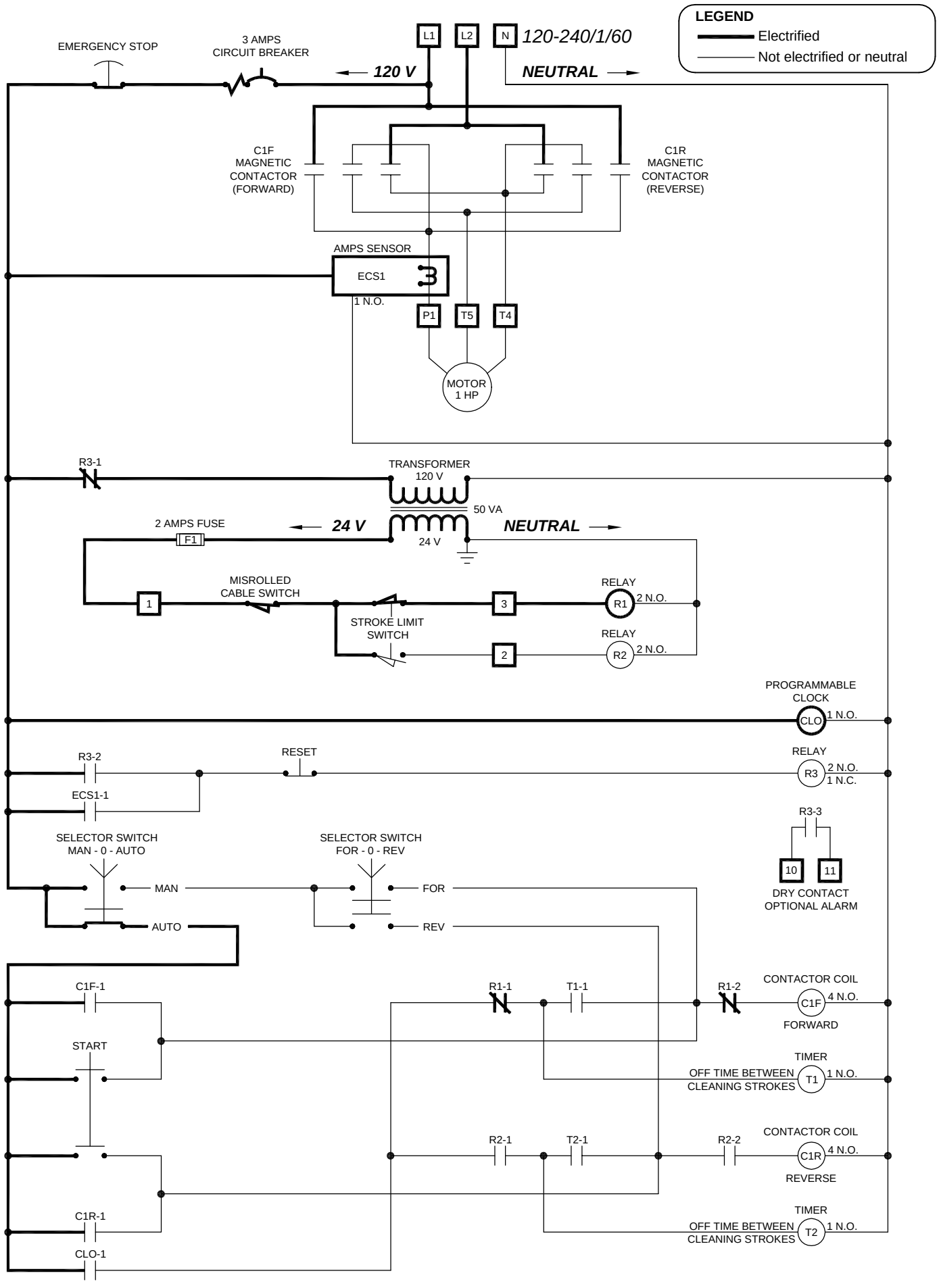
5. Electricity goes through the **MAN - O - AUTO** selector provided it is on **AUTO** position.

6. Electricity does not go through contacts **C1F-1** or **C1R-1** because they are normally opened. It will not go through the **start button** because it is also normally opened.

7. The clock contact **CLO-1** is normally opened, so electricity cannot go through it. This contact will close when the clock enters in program mode.

8. The 120 volts feeding the **transformer** is transformed into 24 volts and goes through the **fuse**, the **misrolled cable switch**, and the **stroke limit switch** to feed the relay coil **R1**.

9. Relay coil **R1** being powered, its corresponding contacts **R1-1** and **R1-2** are closed.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
L1
L2
N
120-240/1/60
120 V
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
3
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
NEUTRAL
24 V
MISROLLED
CABLE SWITCH
1
3
RELAY
R1
2 N.O.
STROKE LIMIT
SWITCH
2
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
ECS1-1
RESET
RELAY
R3
2 N.O.
1 N.C.
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
MAN
AUTO
SELECTOR SWITCH
FOR - 0 - REV
FOR
REV
C1F-1
START
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
C1R-1
CLO-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.

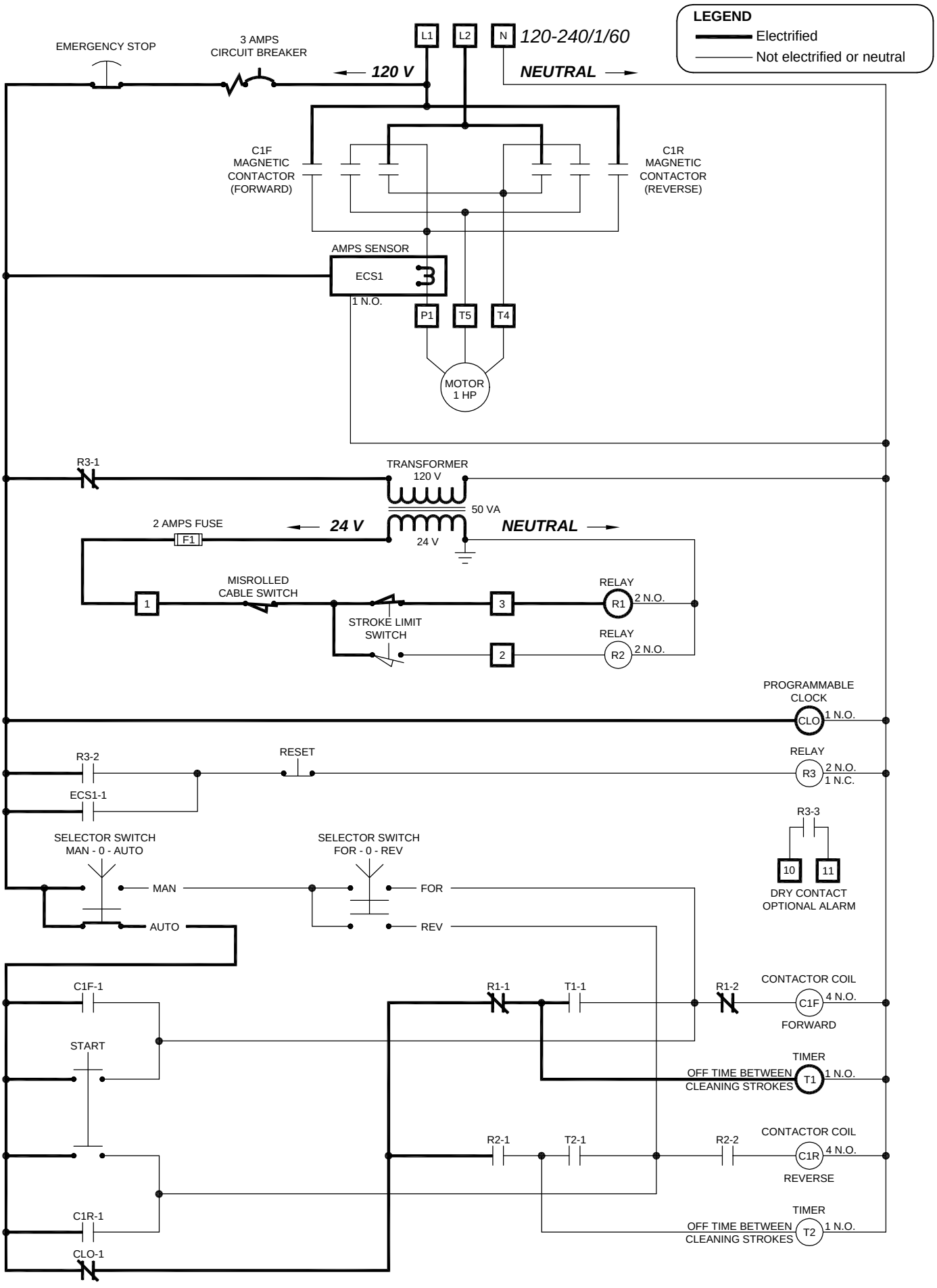
Wiring diagram (Automatic mode - step 2)

Clock ignites a cleaning program

1. The clock closes its contact **CLO-1**.

2. Electricity goes through contacts **CLO-1** and **R1-1** but is stopped at contact **T1-1**.

3. At the same time, it feeds the timer coil **T1** which starts counting.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
L1
L2
N
120-240/1/60
120 V
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
3
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
NEUTRAL
24 V
MISROLLED
CABLE SWITCH
1
3
RELAY
R1
2 N.O.
STROKE LIMIT
SWITCH
2
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
RESET
RELAY
R3
2 N.O.
1 N.C.
ECS1-1
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
SELECTOR SWITCH
FOR - 0 - REV
MAN
FOR
AUTO
REV
C1F-1
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
START
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
C1R-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.
CLO-1

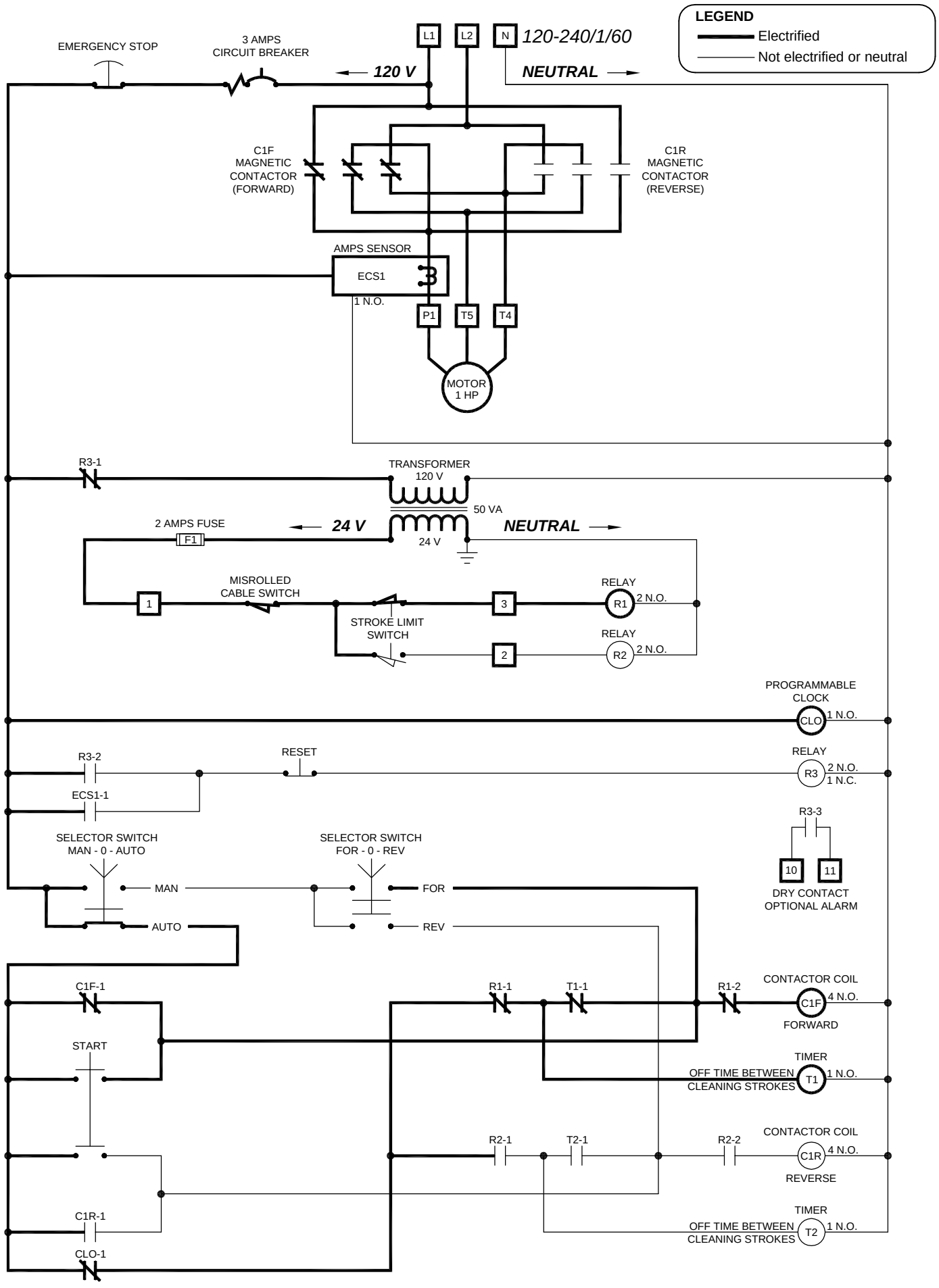
Wiring diagram (Automatic mode - step 3)

Forward stroke engaged once time set at the timer dial has elapsed

1. When the time set at the dial of timer **T1** has elapsed, the contact **T1-1** closes and electricity goes through contact **R1-2** to feed the contactor coil **C1F**.

2. Contactor coil **C1F** being powered, its main contacts close to feed the **motor**.

3. At the same time, the contact **C1F-1** closes to keep feeding the contactor coil **C1F** even if the clock contact **CLO-1** would open.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
L1
L2
N
120-240/1/60
120 V
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
NEUTRAL
24 V
MISROLLED
CABLE SWITCH
1
3
RELAY
R1
2 N.O.
STROKE LIMIT
SWITCH
2
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
RESET
RELAY
R3
2 N.O.
1 N.C.
ECS1-1
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
SELECTOR SWITCH
FOR - 0 - REV
MAN
AUTO
FOR
REV
C1F-1
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
START
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
C1R-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.
CLO-1

Forward stroke is finished, clock still ingnites a cleaning program

1. When the **stroke limit switch** hits the washer (on the cable drive unit) at the end of a stroke, it changes the state of its contacts and feeds relay coil **R2** instead of relay coil **R1**.

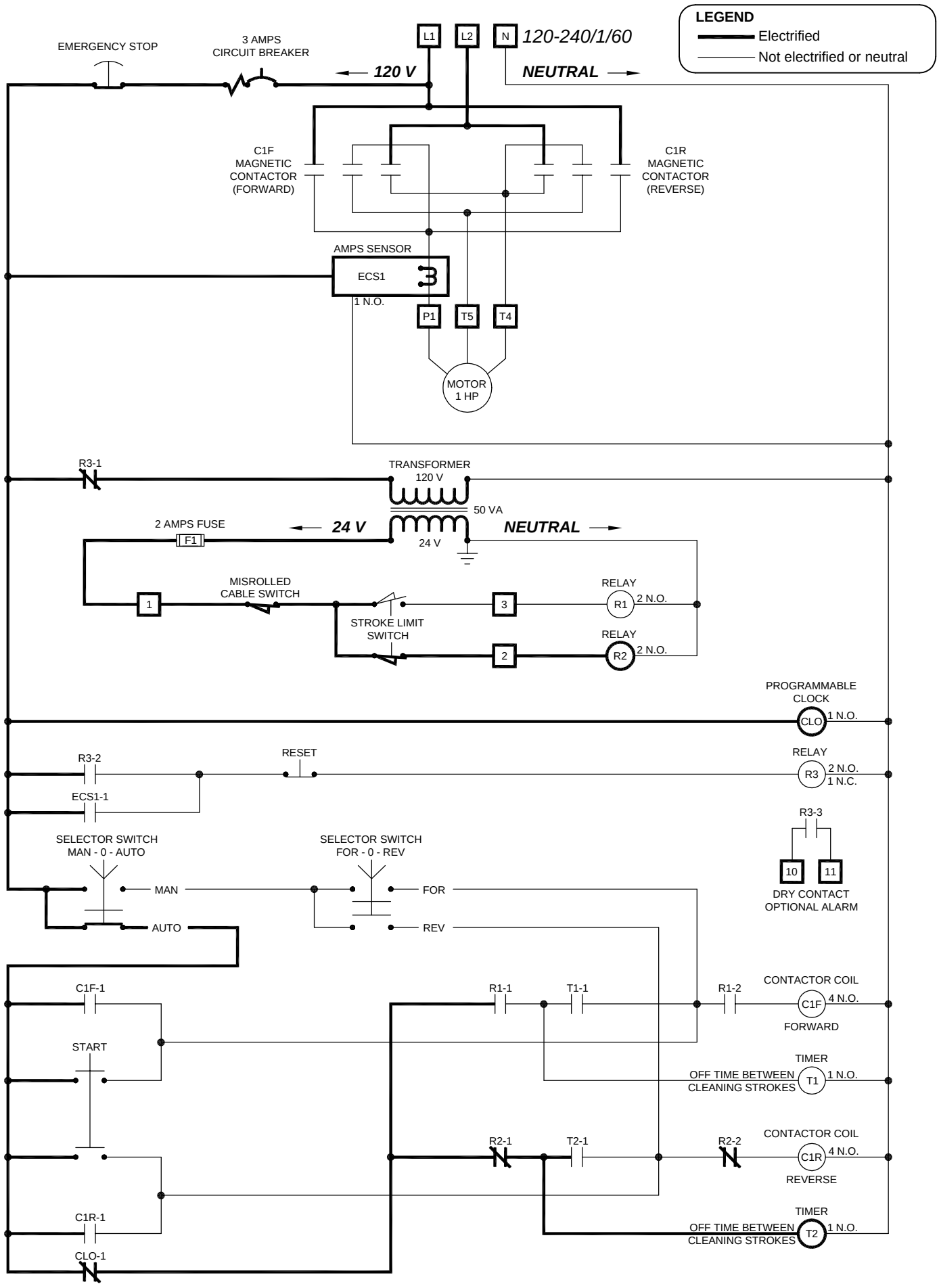
2. Relay coil **R1** not being fed anymore, its corresponding contacts **R1-1** and **R1-2** open.

3. The contactor coil **C1F** is no longer powered, so all its corresponding contacts open, stopping the **motor**.

4. Relay coil **R2** being powered, its corresponding contacts **R2-1** and **R2-2** close.

5. The clock contact **CLO-1** is still closed, electricity goes through contact **R2-1** but is stopped at contact **T2-1**.

6. At the same time, electricity feeds the timer coil **T2** which starts counting.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
L1
L2
N
120-240/1/60
120 V
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
24 V
NEUTRAL
MISROLLED
CABLE SWITCH
1
STROKE LIMIT
SWITCH
3
2
RELAY
R1
2 N.O.
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
ECS1-1
RESET
RELAY
R3
2 N.O.
1 N.C.
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
MAN
AUTO
SELECTOR SWITCH
FOR - 0 - REV
FOR
REV
C1F-1
START
C1R-1
CLO-1
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.

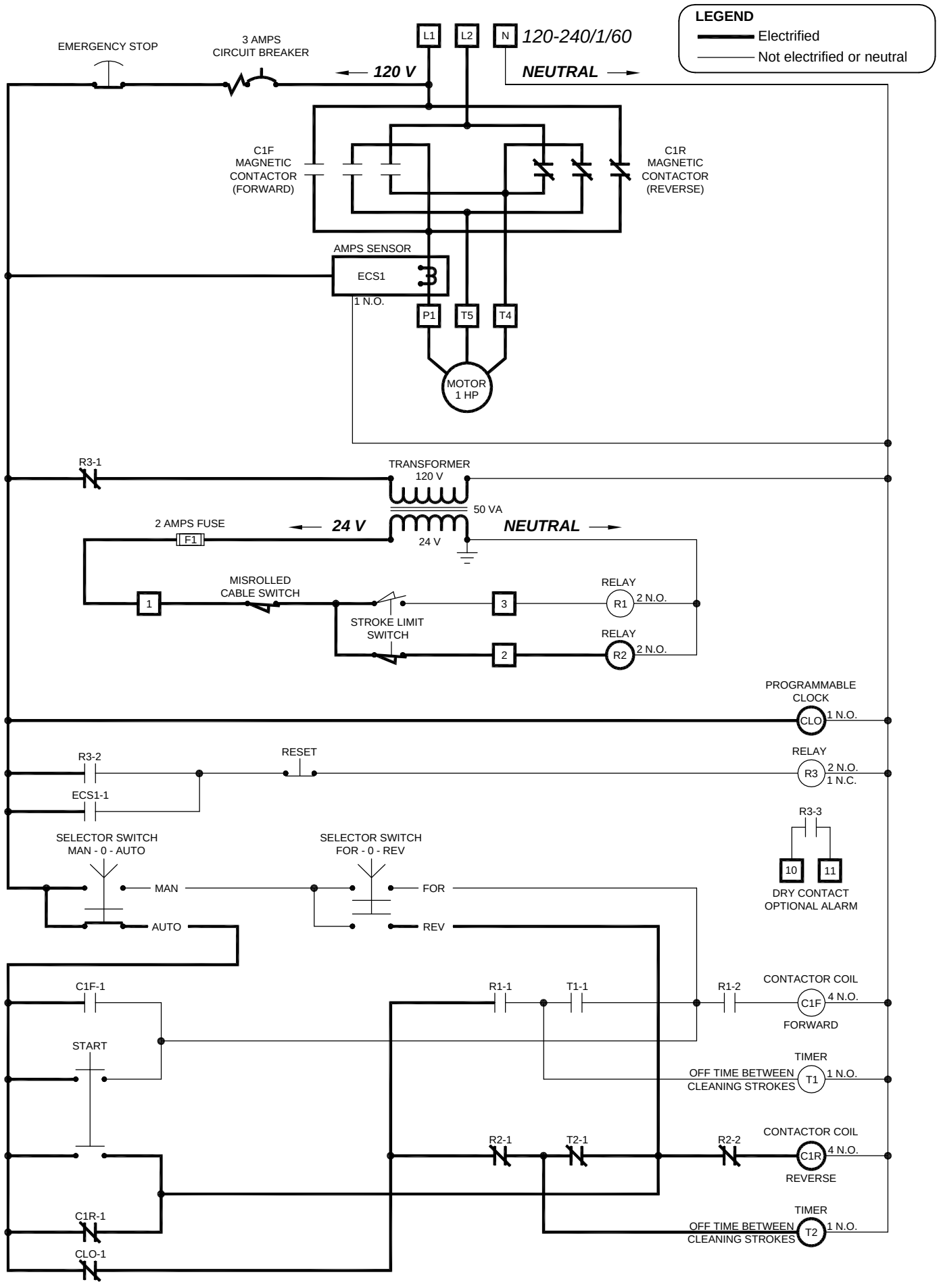
Reverse stroke is engaged once time set at the timer dial has elapsed

1. When the time set at the dial of timer **T2** has elapsed, the contact **T2-1** closes and electricity goes through contact **R2-2** to feed the contactor coil **C1R**.

2. Contactor coil **C1R** being powered, its main contacts close to feed the **motor**.

3. At the same time, the contact **C1R-1** closes to keep feeding the contactor coil **C1R** even if the clock contact **CLO-1** would open.

Wiring diagram (Automatic mode - step 5)



Wiring diagram (Automatic mode - step 6)

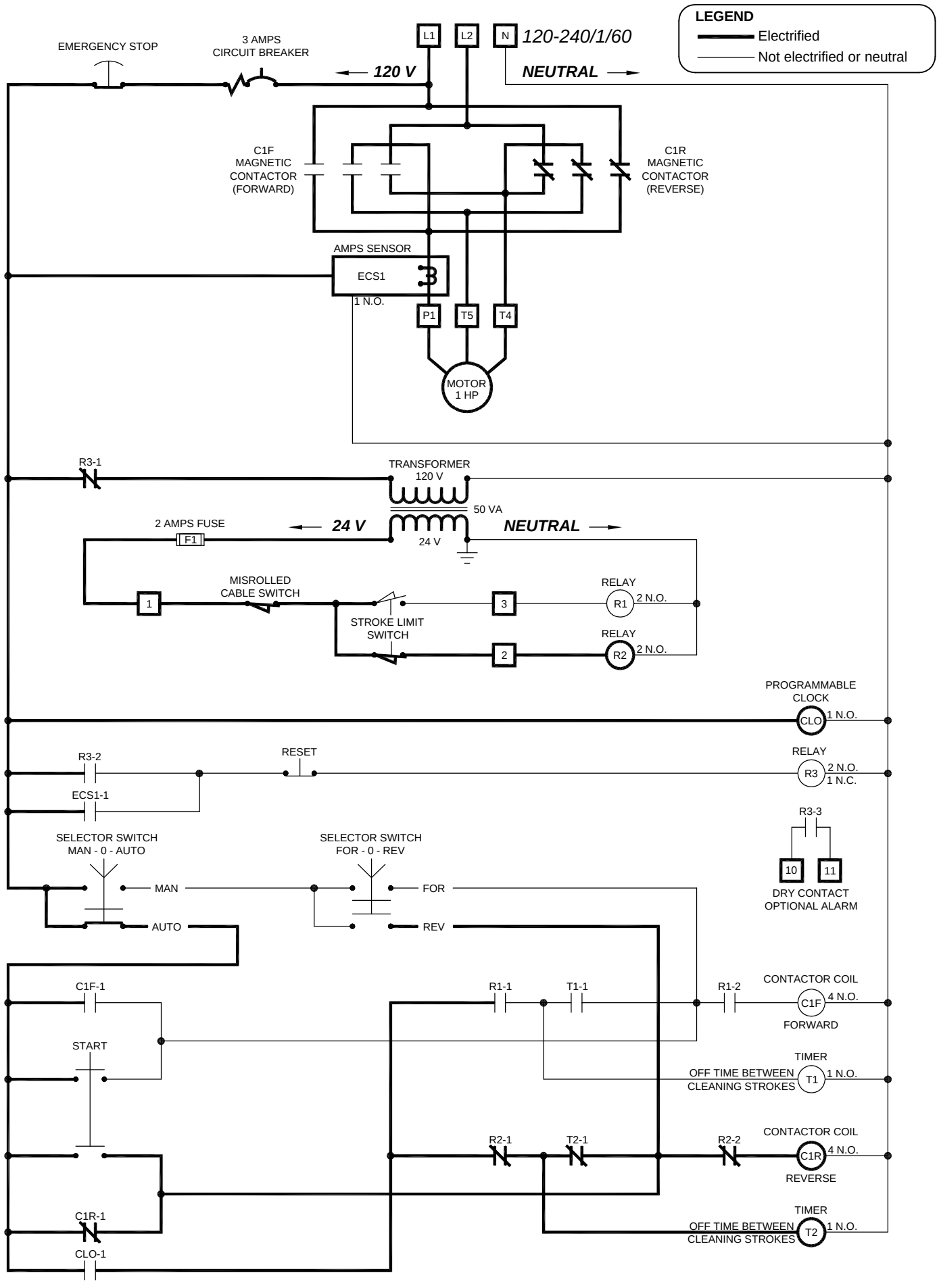
Clock cleaning program is over and reverse stroke is about to finish

1. When the cleaning program time in the clock has elapsed, its contact **CLO-1** opens.

2. Contactor coil **C1R** being powered, its corresponding contact **C1R-1** keeps feeding the contactor coil **C1R** even if the clock contact **CLO-1** is opened.

3. The system will stop when the stroke limit switch hits the washer (on the cable drive unit) at the end of the stroke.

4. The system will then return in stanby state. See wiring diagram on pages 16 and 17.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
L1
L2
N
120-240/1/60
120 V
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
NEUTRAL
24 V
MISROLLED
CABLE SWITCH
1
3
RELAY
R1
2 N.O.
STROKE LIMIT
SWITCH
2
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
RESET
RELAY
R3
2 N.O.
1 N.C.
ECS1-1
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
SELECTOR SWITCH
FOR - 0 - REV
MAN
FOR
AUTO
REV
C1F-1
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
START
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
C1R-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.
CLO-1

Wiring diagram (Manual mode - step 1)

Control panel is powered, on manual mode, forward stroke is engaged

1. If the **circuit breaker** is not popped out and if the **emergency stop button** is not pressed down, electricity feeds the **amps sensor**, the **transformer** and the **programmable clock**.

2. The **transformer** can be fed with electricity because **R3-1** is normally closed and its coil **R3** is not fed with electricity.

3. Relay coil **R3** is not fed with electricity because its contact **R3-2** is normally opened and the contact **ECS1-1,** which is controlled by the **amps sensor**, is also normally opened.

4. Electricity goes through the **MAN - O - AUTO** selector provided it is on **MAN** position.

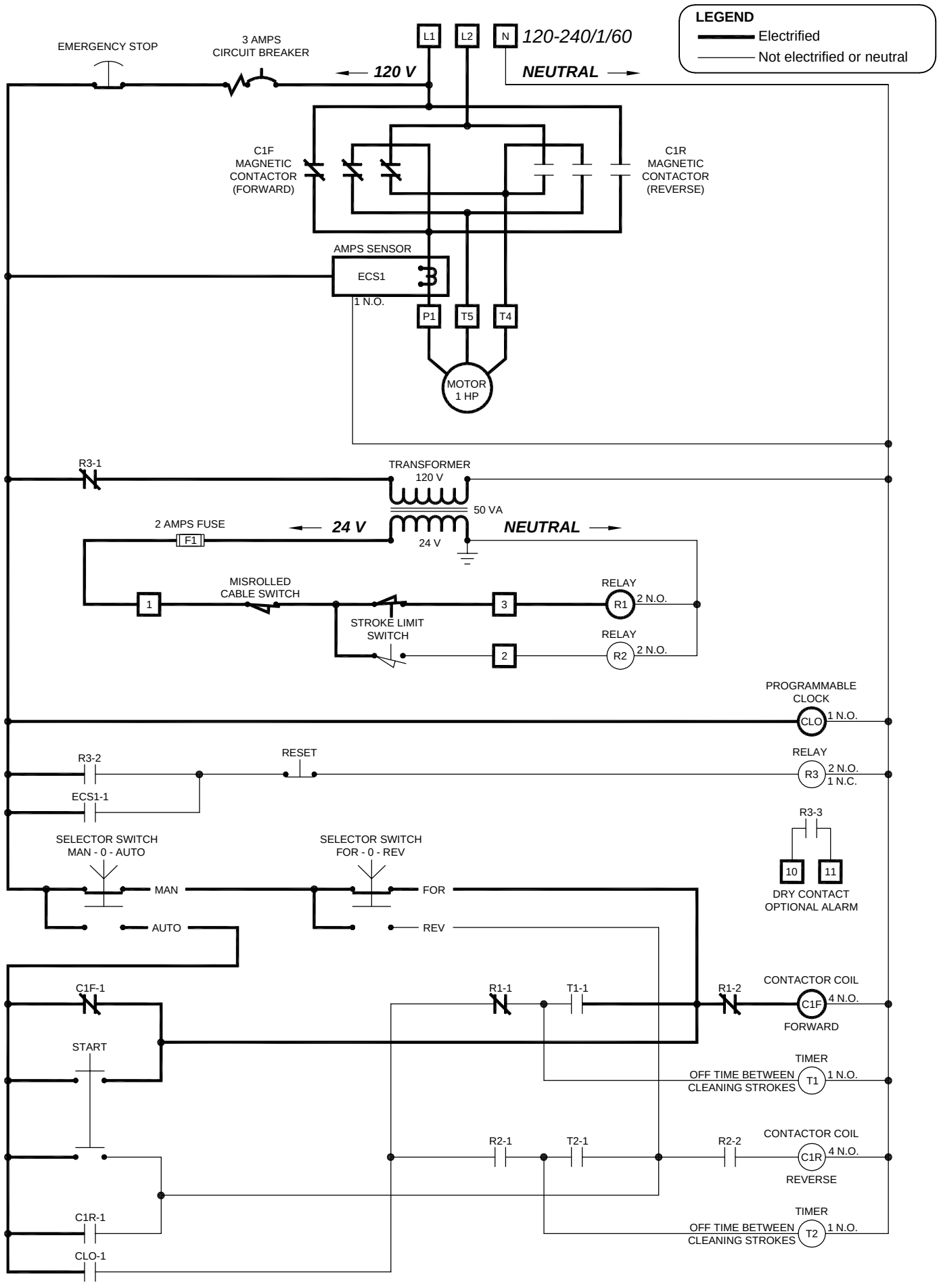
5. Electricity goes through the **FOR - O - REV** selector provided it is on **FOR or REV** position.

6. The 120 volts feeding the **transformer** is transformed into 24 volts and goes through the **fuse**, the **misrolled cable switch**, and the **stroke limit switch** to feed the relay coil **R1**.

7. Relay coil **R1** being powered, its corresponding contacts **R1-1** and **R1-2** are closed.

8. Electricity from the **FOR - O - REV** switch goes through **R1-2** to feed the contactor coil **C1F**.

9. Contactor coil **C1F** being powered, its corresponding contacts close to feed the motor.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
120 V
L1
L2
N
120-240/1/60
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
24 V
NEUTRAL
MISROLLED
CABLE SWITCH
1
3
RELAY
R1
2 N.O.
STROKE LIMIT
SWITCH
2
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
RESET
RELAY
R3
2 N.O.
1 N.C.
ECS1-1
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
SELECTOR SWITCH
FOR - 0 - REV
MAN
FOR
AUTO
REV
C1F-1
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
START
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
C1R-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.
CLO-1

Forward stroke is finished and system is ready to start on reverse

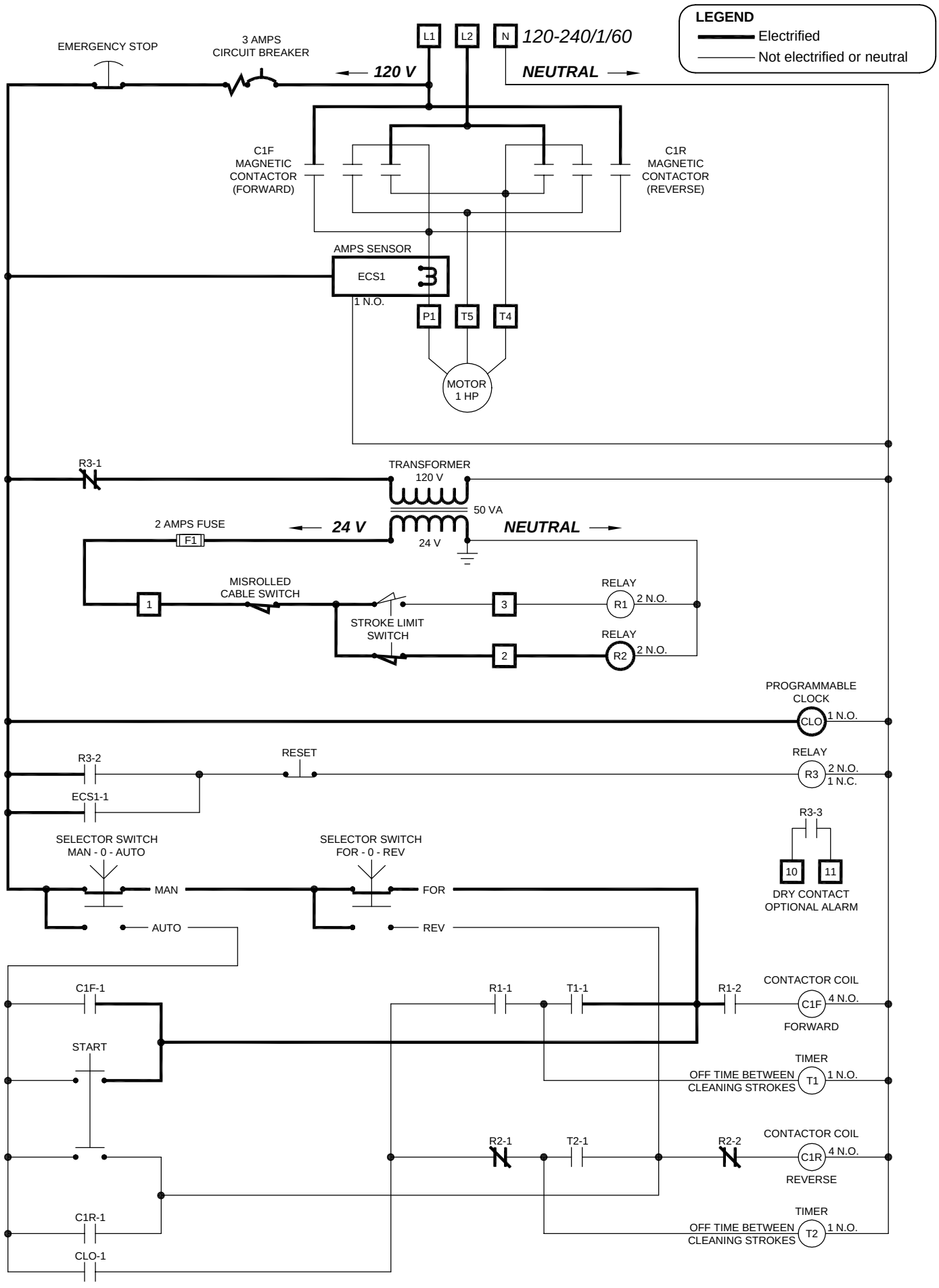
1. When the **stroke limit switch** hits the washer (on the cable drive unit) at the end of a stroke, it changes the state of its contacts and feeds relay coil **R2** instead of relay coil **R1**.

2. Relay coil **R1** not being fed anymore, its corresponding contacts **R1-1** and **R1-2** open.

3. The contactor coil **C1F** is no longer powered, so all its corresponding contacts open, stopping the **motor**.

4. Relay coil **R2** being powered, its corresponding contacts **R2-1** and **R2-2** close.

5. At this point, to run the system in reverse direction, the **FOR - O - REV** selector must be set to **REV**.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
120 V
L1
L2
N
120-240/1/60
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
24 V
NEUTRAL
MISROLLED
CABLE SWITCH
1
STROKE LIMIT
SWITCH
3
2
RELAY
R1
2 N.O.
RELAY
R2
2 N.O.
PROGRAMMABLE
CLOCK
CLO
1 N.O.
R3-2
ECS1-1
RESET
RELAY
R3
2 N.O.
1 N.C.
R3-3
10
11
DRY CONTACT
OPTIONAL ALARM
SELECTOR SWITCH
MAN - 0 - AUTO
MAN
AUTO
SELECTOR SWITCH
FOR - 0 - REV
FOR
REV
C1F-1
START
R1-1
T1-1
R1-2
CONTACTOR COIL
C1F
4 N.O.
FORWARD
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T1
1 N.O.
R2-1
T2-1
R2-2
CONTACTOR COIL
C1R
4 N.O.
REVERSE
C1R-1
CLO-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.

Amps sensor is detecting an amperage overdraw

1. When the amps sensor **ECS1** detects an amperage overdraw, its corresponding contact **ECS1-1** closes and opens very quickly.

2. When **ECS1-1** closes, electricity feeds the relay coil **R3**.

3. Relay coil **R3** being powered, contact **R3-2** closes to keep feeding the coil **R3** after the contact **ECS1-1** has re-opened.

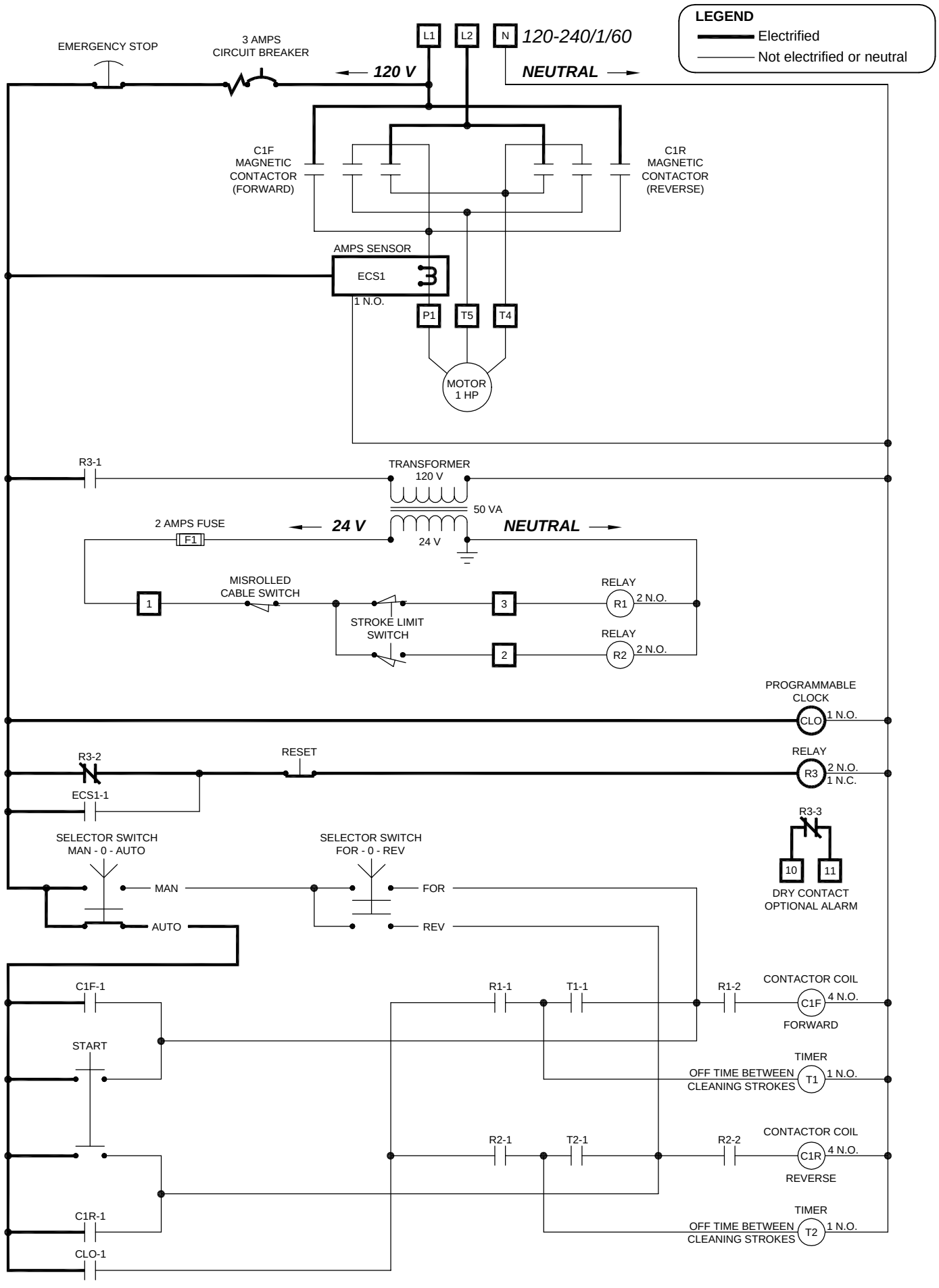
4. At the same time, contact **R3-1** opens, so the **transformer** is not fed anymore.

5. Also, contact **R3-3** closes to feed an optional equipment such as a light or a horn to give an alarm signal.

6. The **transformer** being no longer powered, both relay coils **R1** and **R2** are no longer powered also.

7. Relay coils **R1** and **R2** being no longer powered, their corresponding contacts open and electricity does not feed the contactor coils **C1F** or **C1R** anymore, so the **motor** is stopped.

8. (Not shown) By pressing the **reset button**, electricity will quit feeding the relay **R3**. So the transformer will be fed again and so the relay coil **R1** or **R2**. The system will then start again, or be able to start again.


LEGEND
Electrified
Not electrified or neutral
EMERGENCY STOP
3 AMPS
CIRCUIT BREAKER
L1
L2
N
120-240/1/60
120 V
NEUTRAL
C1F
MAGNETIC
CONTACTOR
(FORWARD)
C1R
MAGNETIC
CONTACTOR
(REVERSE)
AMPS SENSOR
ECS1
3
1 N.O.
P1
T5
T4
MOTOR
1 HP
R3-1
TRANSFORMER
120 V
50 VA
2 AMPS FUSE
F1
24 V
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MISROLLED
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1 N.O.
R3-2
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OPTIONAL ALARM
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CONTACTOR COIL
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4 N.O.
FORWARD
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OFF TIME BETWEEN
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T2-1
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CONTACTOR COIL
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4 N.O.
REVERSE
C1R-1
TIMER
OFF TIME BETWEEN
CLEANING STROKES
T2
1 N.O.
CLO-1

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