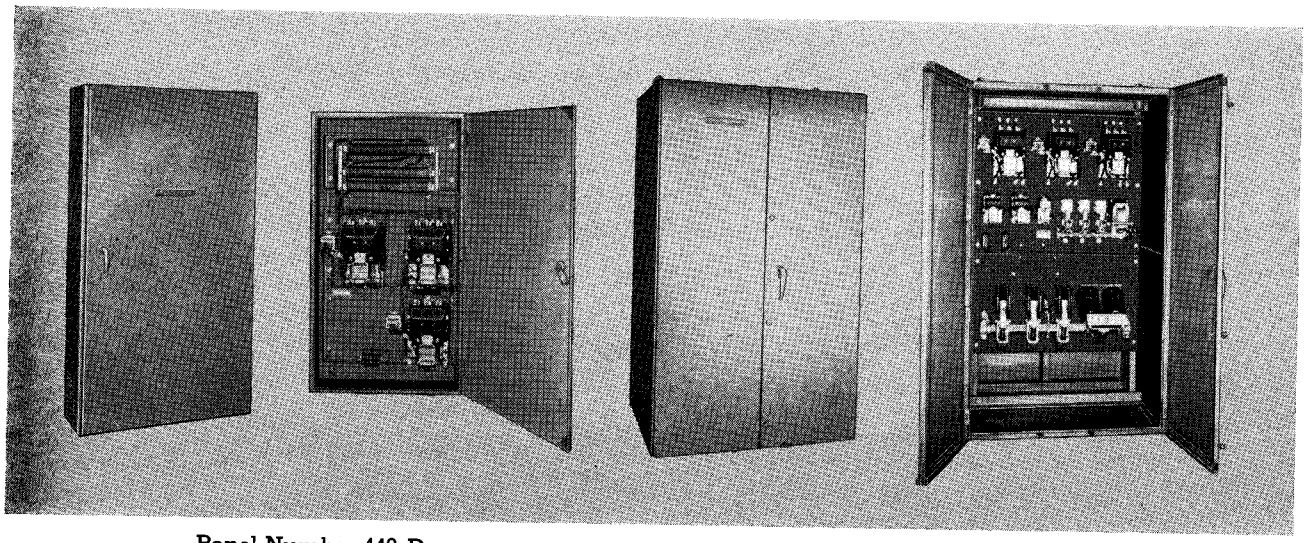
DESCRIPTION • OPERATION • MAINTENANCE

INSTRUCTIONS

A-C GENERAL PURPOSE STARTERS
CLASSES 13-100, 13-500, 13-120 FOR LOW VOLTAGE WOUND-ROTOR INDUCTION MOTORS



Panel Number 443-D
Wall Mounted

Panel Number 655-D
Floor Mounted

FIG. 1. Typical Class 13-100 Non-Reversing Starters

GENERAL DESCRIPTION

This leaflet applies to the following magnetic starters for wound-rotor induction motors:

CL 13-100—Non-reversing, complete primary and secondary control.

CL 13-500—Reversing, complete primary and secondary control.

CL 13-120—Control for motor secondary only.

Although written particularly for standard controllers, these instructions are also applicable to modified controllers of similar design.

The typical Class 13-100 starter consists of the following main components:

A primary contactor to connect the motor primary (stator) winding to the power supply.

A set of overload relays to protect the motor.

A set of starting resistors for connection to the motor slip rings to limit motor currents during starting.

One or more accelerating contactors to short out the resistors in successive steps, and a like number of relays to govern the closing of the accelerating contactors.

A set of wiring details, and instrument transformers as required.

Class 13-500 starters are similar to Class 13-100, except that instead of a single primary contactor, there is supplied a pair of primary contactors, suitably interlocked against simultaneous closing, for reversing the power input to the motor. A Class 13-120 unit is for the control of the rotor, or secondary circuit only, and does not in itself constitute a complete starter. It must be used in conjunction with a suitable primary control and the latter must initiate operation of the accelerating devices on the Class 13-120 control.

Classes 13-100, 13-500 and 13-120 are intended for starting duty only, and are not intended for plugging.

Panel Nomenclature. Classes 13-100, 13-500 and 13-120 controllers are built in a variety of sizes to suit the requirements of the particular motor with which it is to be used. The number of accelerating points for standard starters, and the size and rating of the primary contactors are selected to conform with recommendations and standards of the National

Table No. 1

SIZE AND RATING OF PRIMARY, OR LINE, CONTACTORS CONFORMING WITH MOTOR RATINGS

PRIMARY CONTACTOR		3 PHASE HORSEPOWER RATING AT		
NEMA Size	8-Hour Open Amp. Rating	110 Volts	208/220 Volts	440 & 550 Volts
1	25	3	7½	10
2	50	7½	15	25
3	100	15	30	50
4	150	25	50	100
5	300		100	200
6	600		200	400
7	900		300	600
8	1350		450	900
9	2500		800	1600

Electric Manufacturers' Association. See Tables 1 and 2.

Since the terms "Points" and "Steps" are often confused, it should be noted that "Steps" should conform with the number of resistor steps and accelerating contactors and hence, is one less than the number of starting points. Controllers are catalogued and listed according to number of points and Westinghouse uses a simple panel numbering system. The first digit of a three-digit panel number indicates the NEMA size of the primary contactor, the second digit indicates the NEMA size of the final accelerating contactor and the final digit indicates the number of points. For instance, in Fig. 1, panel ✳443-D indicates that the primary contactor is size 4, the final accelerating contactor is size 4, and the number of points is 3. The "D" indicates that the final accelerating contactor is 3-pole, connected in delta across the motor slip rings.

The final accelerating contactor must be applied on a continuous rating basis, but intermediate accelerating contactors are usually selected on an intermittent basis, since they are loaded only during the starting period.

Although definite panel numbers are catalogued for various motor ratings, secondary contactor sizes are always selected to suit the actual secondary current of the motors which often varies between similarly rated motors of different manufacture.

Resistors. Standard controllers of 3 points and below and for 75 hp and below include type M edgewound resistors, mounted and wired within the controller cabinet. Above 75 hp and up to 400 hp, the resistors are usually grid type and may be either separately mounted, or mounted in a ventilated enclosure on top of the main cabinet. Above 400 hp, the resistors are grid type and separately mounted.

Standard starting resistors are usually Class 135 or 136, but resistors for heavier duty are often supplied to meet special requirements.

Non-Standard Starters. This leaflet is applicable both to standard and to special, or non-standard starters, since most popular modifications do not affect the basic principles of design and operation. A few common modifications are:

Special enclosures and finishes.
Special resistors to meet unusual requirements.
Addition of circuit breakers, knife switches, control transformers, extra relays, instruments, etc.
Special master switches.
Extra accelerating points.

Accelerating Relays. Standard starters use magnet operated, pneumatically delayed, type AM relays where the main contactors are sizes 5 and larger. With size 4, or smaller, contactors, similar timing devices, minus operating magnets, are mechanically linked to and operated by the main contactors. In this case, we designate the device as type AMB. We could also use any other conventional type of timing relay, and special conditions sometimes necessitate the use of current limiting devices.

Limitations. The controller will operate satisfactorily with a motor of corresponding rating and duty cycle. Starting resistors, Classes 135 and 136 are rated for 10 seconds on out of each 80 seconds and heavier duty may cause them to overheat. Overload relay heaters are selected for the average motor of the particular rating.

These starters have no protection against and are not to be used for, plugging duty.

INSTALLATION

Disconnect Switch. It is good practice to install ahead of the starter, a fused switch or circuit breaker, for short circuit protection and as a means of disconnecting the starter and motor from the line. During periods of shut down, whether through idleness or for purposes of inspection and repair, this switch should be open.

Table No. 2

NUMBER OF ACCELERATING CONTACTORS CONFORMING WITH MOTOR HORSEPOWER

HP RATING	MINIMUM REQUIRED			
	Number of Steps in Stg. Resistor	Number of Accel. Contactors	Number of Controller Points	
15	1	1	2	This column is included because controllers are usually described per number of points, which is one more than the number of accelerating, or secondary, contactors.
75	2	2	3	
150	3	3	4	
300	4	4	5	
600	5	5	6	
1200	6	6	7	

Before attempting to start the motor, be sure that the equipment is ready. Particularly check the following:

Mechanical. See that the motor and driven equipment are properly lined up, bolted down, coupled, lubricated, and free of obstructions.

Electrical. Check Control NP marking against motor NP marking. See that correct power supply is available. Check wiring with diagrams of connections. See that all control devices are in good mechanical condition and free to operate. See that arc boxes are in place, connections are tight, installation debris has been removed and equipment is free of excessive dirt.

Sequence. Before starting the motor, it is a good idea to check the starter sequence. This can be done by opening the line leads and temporarily connecting the device operating circuit ahead of the "open".

Low Voltage Protection Master Switch. The most usual type of master switch is the three-wire, start-stop, low voltage protection pushbutton shown in full lines in Fig. 2. "Low Voltage Protection" applies to a scheme whose start button, or contact, closes momentarily and spring returns to its open position when manual pressure is removed. The contactor or control relay, closed in response to the momentary "start" contact, sets up its own holding circuit around the "start" contact. In case the holding device opens due to operation of the stop button, tripping of the overload relay or loss of voltage, it will not reclose until the operator again manually closes the "start" switch.

Low Voltage Release Master Switch. The two-wire, maintained contact pushbutton shown in dotted lines, constitutes what is known as a low voltage release type of master switch. The "start" contact, when once closed, remains closed until the "stop" button is manually operated. Upon loss of voltage, the contactors open, but they will reclose automatically when voltage is restored. Low voltage release master switches may be pushbuttons, pressure switches, thermostats, float switches, etc. They are usually applied to sump pumps, refrigerators and other drives that must maintain certain conditions in the absence of an operator. They should never be applied to machines where automatic restarting might be hazardous to equipment or personnel.

Overload Relay Reset. When a low voltage release master switch is used, the overload relay must be arranged for "hand reset", that is, it must latch in its tripped position and remain tripped until manually reset. Otherwise, the motor would stop-start-stop-start and so on, in a destructive cycle.

Where a low voltage protection master switch is used, the overload relay can be arranged to reset automatically, because the motor cannot restart except by manually operating the "start" master switch.

Overload relays are usually Type MW, though they can be of any conventional type.

OPERATION

Refer to Fig. 2. Depress the start button. Contactor M closes, sets up its own holding circuit

designed for plugging duty and they must not be reversed until the motor has decelerated to a very low speed. For plugging duty the motor design must be checked and additional devices must be added to the control, in which case it is no longer Class 13-100 or 13-500.

Class 13-120 is similar to Classes 13-100 and 13-500 except that it includes only those devices necessary for control of the rotor, or motor secondary, and therefore can be used with either a reversing or non-reversing primary controller of proper design.

Although all coils in Figs. 2 and 3 are shown operated across one phase of the AC power supply, large contactors, NEMA sizes 6 and above, are usually equipped with DC operating magnets and are energized through rectifiers. Occasionally service conditions require that all contactors and auxiliary relays operate from a separate DC source of power, in which case the control devices will be selected accordingly.

Adjustments. For detailed instructions pertaining to individual devices, refer to the leaflets listed in literature table.

Possible Sources of Trouble. If apparatus fails to operate properly, check the following:

1. Power supply, voltage failure, open disconnect switch, blown fuses.

2. Overload relay. Are its contacts closed?

3. Loose or wrong connections.

4. Poor contacts, due to wear, dirt, poor mechanical condition or low spring pressure.

5. Burned out operating coils.

6. Is starter being used as intended and within rated capacity?

There can be other causes of trouble, but the above are the most common. Experience will teach what to look for and to expect. Some of the most difficult sources of trouble to locate, are caused by incorrect or loose connections. Contact between two points that should be insulated from each other may cause a short circuit or result in sneak circuits that may be baffling. Connections should be kept tight and wiring should be neat and as straight as possible. Do not allow starter cabinets to become cluttered with dirt and other foreign objects.

MAINTENANCE

In operating, servicing and adjusting the equipment, the attendant should consult the diagram and instruction leaflets, and particularly remember the following points:

1. Warning. *All circuits should be de-energized and disconnecting devices locked open when working on equipment.*

2. The equipment should be kept clean at all times.

3. Periodic inspection of all equipment should be made to insure that apparatus is kept in good condition.

4. Contacts becoming badly worn should be replaced before they cause failure. Proper spring pressure should be maintained at all times.

5. Do not oil contactor bearings.

6. Do not use emery paper around electrical apparatus. Sandpaper or file only when necessary, and use care to avoid damaging insulation by metal particles.

7. Keep all connections tight; particular attention should be given overload relay heater connections, to keep them clean and tight.

For more detailed instructions for Inspection and Maintenance, see I.L. 7000-1.

Table of printed leaflets applying to individual components commonly used on classes 13-100, 13-500, and 13-120 controllers.

DEVICE TYPE	DESCRIPTION	INSTRUCTION LITERATURE
General	Storage and Handling	I.L.-4330
General	Unpacking	I.L.-4332
General	Installation	I.L.-7000-2
General	Inspection and Maintenance	I.L.-7000-1
NH	Aux. Relay	I.L.-11192
N	Aux. Relay or Small Contactor	I.L.-10449
AM	Timing Relay	I.L.-10234
AMB	Timing Relay	I.L.-15827-15
AQ	Timetactor and Relay	I.L.-15827-2-AQ
MW-31,41	Thermal OL Relay	I.L.-10707
MW-52	Thermal OL Relay	I.L.-15827-10
N-	NEMA Size 2 Contactors	I.L.-4842
NR	NEMA Sizes 3 and 4 Contactors	I.L.-10711
NF	NEMA Size 5 Contactors	I.L.-15825-5A
NF	NEMA Sizes 6-7-8 Contactors	I.L.-15825-7
NFD	NEMA Sizes 6-7-8 (DC Operated) Contactors	I.L.-15825-8

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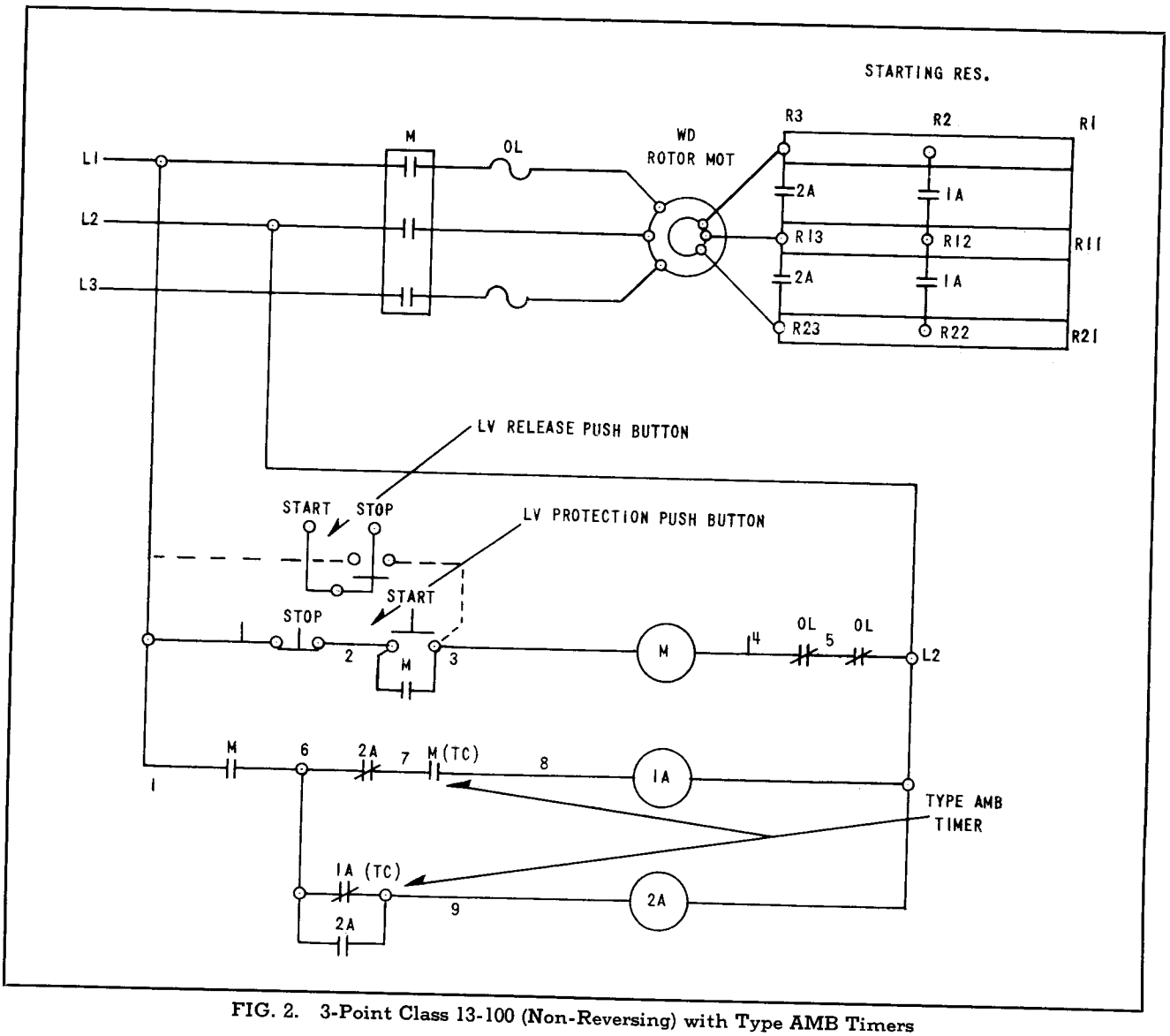

FIG. 2. 3-Point Class 13-100 (Non-Reversing) with Type AMB Timers

around the start button 2 to 3, and closes its main contacts between the power supply and the motor primary winding. When M closes, its auxiliary contact 1 to 6 closes in the circuit to coils 1A and 2A and the type AMB mechanically initiated (but pneumatically retarded) device starts its timing cycle. When M (TC) closes, it energizes coil 1A, and 1A closes and shorts out the first step of starting resistance. In similar fashion, when 1A closes, 1A (TC) starts its timing cycle and eventually energizes coil 2A. When 2A closes, it shorts the final step of starting resistance. 2A also sets up a holding circuit 6 to 9 and opens the circuit to coil 1A, so that contactor 1A opens. This prevents continuous energization of intermediate accelerating contactor 1A, with saving in power and adding to the life of 1A. This is more important where there are a number of intermediate contactors.

Fig. 3 for a Class 13-500 starter differs from Fig. 2 as follows:

1. A reversing contactor has been added for the primary circuit.

2. The main contactors are too large to permit their operation directly from pushbutton contacts, so that interposing relays FX, RX, 1AX, 2AX and 3AX have been added.

3. Since AMB timers cannot be used with contactors above size 4, magnet operated AM relays have been substituted. These are 1TR, 2TR and 3TR.

4. Another accelerating point has been added.

The scheme is essentially the same as in Fig. 2 except for the interposing relays. It will be noted that the main reversing contactors FWD and REV are both mechanically and electrically interlocked, so that neither can close unless the other is open.

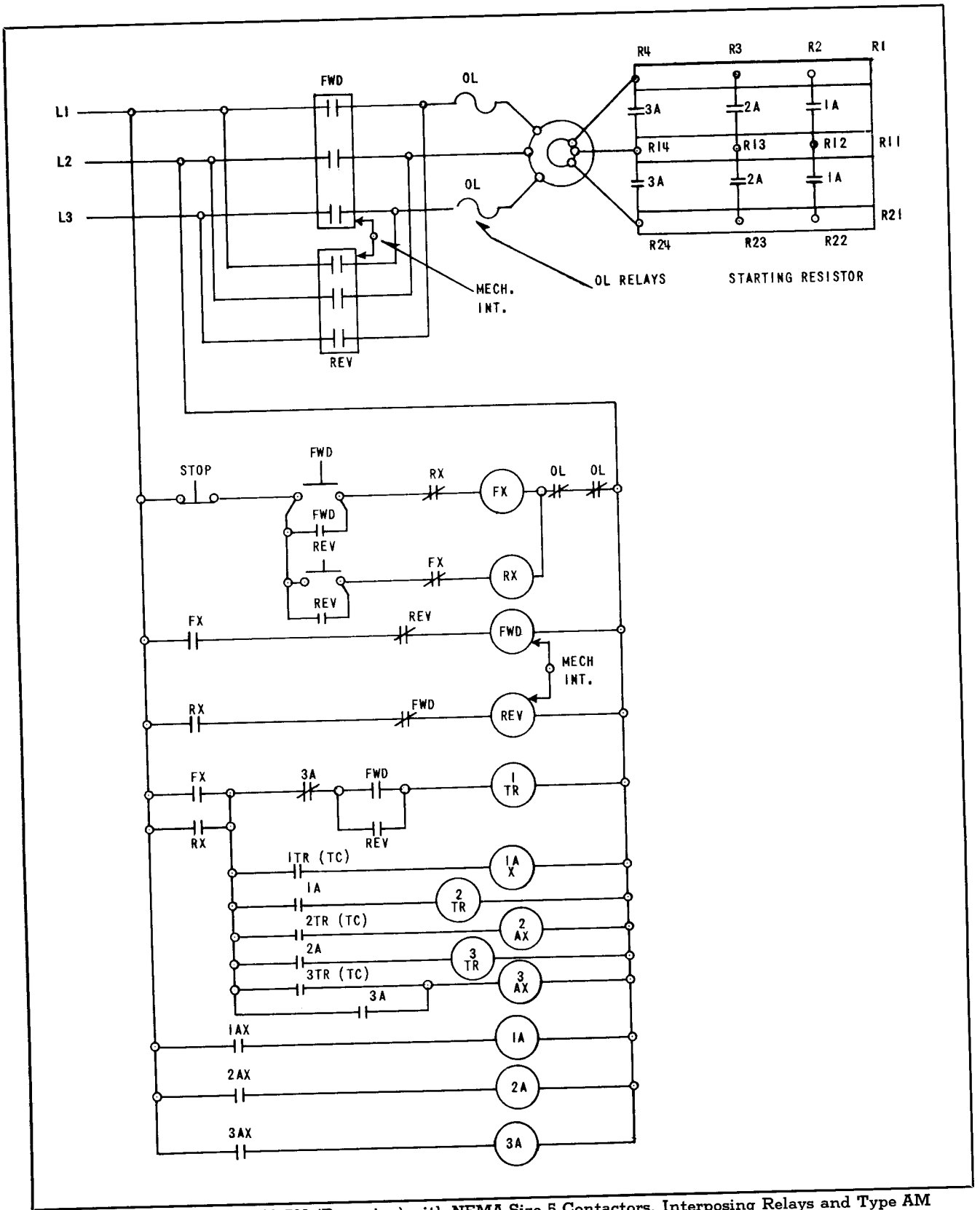

FIG. 3. 4-Point Class 13-500 (Reversing) with NEMA Size 5 Contactors, Interposing Relays and Type AM Timing Relays

However, there is no protection against an operator reversing the power input to the motor while it is still rotating at high speed in the opposite direction, except his own good sense. These starters are not