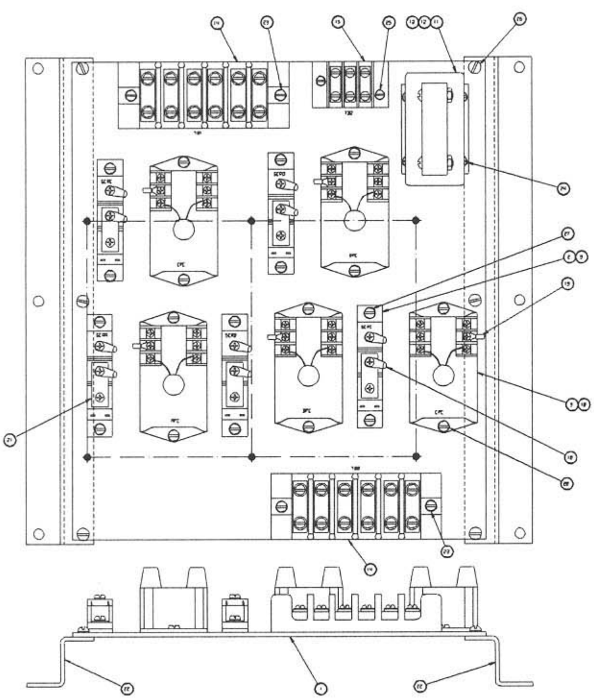
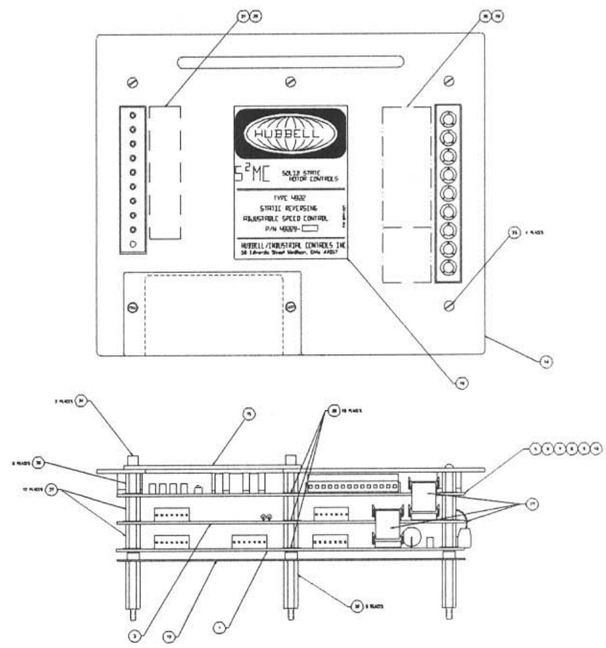
TYPE 4922C INSTRUCTION MANUAL FOR CRANE HOISTS





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Note, drawings and spare parts refered to in this instruction manual are for reference only. Refer to controller nameplate or consult factory for specific drawings.

Serial Number: ______________________________

Reference Drawing Number: ______________________________

1.0 General

The Type 4922C Static Reversing Controller is a solid state adjustable speed motor controller utilizing compact unitized construction and providing speed regulated control of wound rotor motors. The motor speed is controlled by varying the motor primary voltage via primary SCR bridges, and the direction of motor rotation is controlled by selecting the appropriate SCR bridges for the commanded function. The adjustable speed control unit varies the SCR bridge firing signals and the SCR bridge selection in response to a changing motor speed reference signal. The retarding torque during the reduced speed lowering operation is provided by motor counter torque. The retarding torque during full speed lowering can be provided by true motor and system regeneration. Motoring to counter torque transitions and vice versa are automatic and are controlled by the adjustable speed control unit in response to motor loading conditions.

2.0 Circuit Description

2.1.1 POWER CIRCUIT GENERAL

The incoming three phase power, L1, L2, L3 is connected to the main circuit breaker, MCB, and then to the main contactor, M. Power is supplied to the SCR bridges through the overload relays, 1OL, 2OL, and 3OL, when the power contacts of M are closed. Current limit resistors are connected in series with the power inputs of the Lowering SCR bridges. The current limit resistors control SCR fault currents should they occur. The SCR bridge outputs provide adjustable voltage power to the motor primary windings, T1, T2, T3, through the Power Limit Switch, LS. The limit switch transformer, LSXFMR, monitors one of the limit switch power contacts, and removes power from the brake panel should the monitored power contact open. See Fig. 2.1.1. and Fig. 2.1.2.

2.1.2 CONTROL CIRCUIT GENERAL

The three phase power from the main circuit breaker, MCB, is also connected to the control circuit breaker, CCB. The control circuit breaker supplies power to the synchronizing transformer, XFMR2, and the control power transformer, XFMR1. See Fig. 2.1.1. and Fig 2.1.2. Transformer XFMR2 supplies power and SCR synchronizing information to the Static Control Assembly, SCA, and the control power transformer XFMR1 supplies 120 volt power to the remaining control circuit.

The 120 volt control circuit power from the control transformer is controlled by the UV relay located on the tachometer continuity assembly, TCA. The function of the TCA is to verify continuity in the Tachometer / Overspeed Switch circuit. The UV relay will pickup when continuity is established through the tachometer circuit and the control circuit continuity loop composed of the normally closed overload contacts, 1OL, 2OL, and 3OL. The SCR bridge over temperature switch, mounted on the central common SCR bridge, is also included in the control circuit continuity loop along with 1CR and 2CR contacts which are present when the Float option is supplied.

The master switch or pendant station controls the Hoist and Lower Relays, HR and LR, the Off-Point Timing Relay, TR, and the Full Speed Contactor, FS. The brake relay, BR, supplies power to the brake panel and is controlled by HR, LR and the Limit Switch Transformer. HR and LR also operate the Main Contactor, M, through the controlling Master Switch or Pendant contacts. The M Contactor and the initiating directional relay will remain energized when the Master Switch or Pendant is returned to Off-Point to allow the motor to slow the load before removing power and setting the holding brake. The Off-Point Timing Relay, TR, and the Low Speed Relay, LSR, perform this function. Normally, LSR will open at minimum speed to set the brake and remove power. However, should a system problem prevent normal slowdown, the TR contact acts as a backup and removes power and sets the brake after a preset minimum time. See Figure 2.1.1.

The Master Switch or Pendant also provides a bipolar adjustable voltage DC speed reference signal from an internal potentiometer. A positive signal represents the hoisting direction, and a negative signal represents the lowering direction. In this way, the Master Switch handle or Pendant button determines the direction of motion and establishes a voltage reference level by which motor speed will be controlled.

Figure 2.1.2 shows the addition of the SC contactor which is used when the extended slow speed option is required. During normal speed hoisting operations, the Low Speed Relay, LSR, will be picked up, and the Counter-torque Relay, CTR, will remain de-energized. This causes the SC contactor to close and supply normal .1 E/I motor secondary impedance in the rotor circuit. During slow, minimum speed operations, when LSR is dropped out, or during counter-torque operations, when CTR is picked up, the SC contactor will remain open, and the extended .3 E/I secondary impedance will be in the rotor circuit to reduce slow speed and counter-torque motor currents.

Figure 2.1.2 also shows the addition of the Float option components which are, 1FR, 1CR, 2CR, FTR, and the Float Relay Assembly. The Float option is used when very slow or zero speed load position control is required. The Float mode is entered by depressing and holding the Master Switch thumb button while the Master Switch is in the Off position. This mode limits the full travel Master Switch speed value to +/- 10% with smooth load control through zero speed.

2.2.1 PRIMARY SCR BRIDGE

The primary SCR bridge is an SCR/Heat Sink assembly with the power SCRs connected in inverse parallel, See Fig.2.1.3.

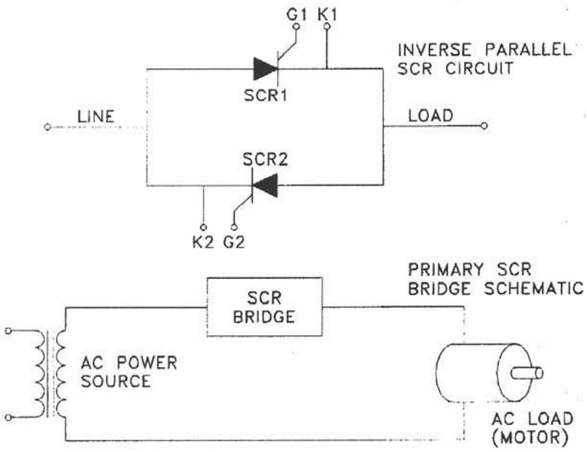


FIGURE 2.1.3

The function of the SCR bridge is to control the amount of voltage applied to the motor. The SCR, silicon controlled rectifier, is similar to standard rectifiers in that it will allow current to flow in one direction while blocking current in the reverse direction. However, SCRs will conduct current only when turned ON, or GATED ON. When two SCRs are connected as shown in Fig. 2.1.3, a controllable AC switch or contact is formed that will carry current in either direction but only when GATED ON. SCRs can react very quickly to gating signals, quickly enough to be able to control portions of half cycles of standard AC power. When the gating or firing signal is presented to the SCR very late in the half cycle, the SCR will block all of the cycle up to the time of firing. At the time the gating signal is applied, the SCR will turn ON and conduct the remaining portions of the half cycle to the load. See Fig. 2.1.4.

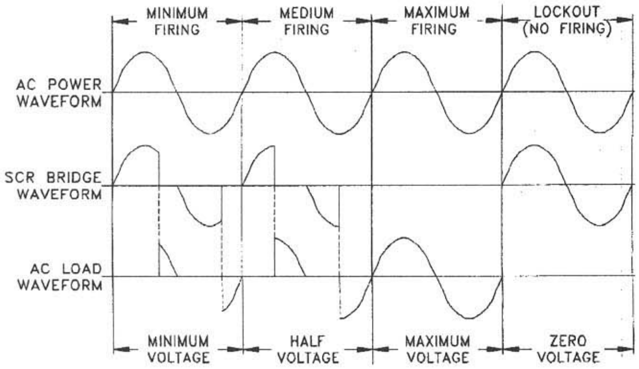


FIGURE 2.1.4

As the firing signal is presented earlier in the half cycle, the SCR will conduct more and more of the cycle on to the load. The extremes will be maximum firing when the SCR bridge passes all of the AC power on to the motor, and lock-out, zero firing, when the SCR bridge blocks all of the AC power.

In static reversing controllers, the SCR bridges also perform a directional control function as well. As can be seen in Figures 2.1.1 and 2.1.2, there are five SCR bridges, 2 Hoist bridges, 2 Lower bridges, and 1 Common bridge. When a Hoist operation is required, adjustable voltage three phase power is supplied to the motor via the two Hoist bridges and the Common bridge. The three phase relationship of the applied motor power determines the direction of developed motor torque and rotation.

A Lower operation will be performed in one of two ways depending upon mechanical losses and the weight of the suspended load. First, adjustable voltage power is supplied to the motor via the two Lower bridges and the Common bridge to produce a driving lower operation. If the loading is such as to continue to require a driving lower torque, the system will supply lowering adjustable voltage power to meet the commanded speed condition. If an overhauling condition exists, a counter-torque lowering operation will occur where the Hoist SCR bridges and the Common bridge provide motor power. True motor and power system regeneration can be used, if desired, to lower overhauling loads at full speed. For this condition, the system turns the Lower SCR bridges and the Common SCR bridge fully on to supply full lowering voltage to the motor.

The transition from driving lower to counter-torque lower is automatic and is determined by the mechanical loading presented to the motor. Full voltage regenerative lowering will produce lowering speeds 10% to 15% greater than full load hoisting speeds.

2.2.2 CONTROL CIRCUIT, STATIC CONTROL ASSEMBLY

The Static Control Assembly, SCA, contains all of the control system responsible for the speed regulation function of the Static Reversing Controller. The system also determines the motor's operating mode by controlling which set of SCR bridges is supplying the power. The Static Control Assembly receives its three phase power from the synchronizing transformer, XFMR2. See Figures. 2.1.1. and 2.1.2. This transformer provides low voltage AC power for the electronic power supply section and synchronizing information for the firing circuits. See Fig. 2.2.1.

The permissive circuit monitors the Permissive command input from the M contactor coil at the 120V AC control power level and converts this signal to an isolated low level signal compatible with the electronic system. The permissive circuit also monitors a tachometer continuity signal originating on the Tachometer Continuity Assembly. In order for the Static Control Assembly system to operate, the tachometer continuity signal must be present along with the control permissive signal from the M contactor circuit. The permissive circuit also monitors the Full Speed command input. This input will enable full speed regenerative lower operation.

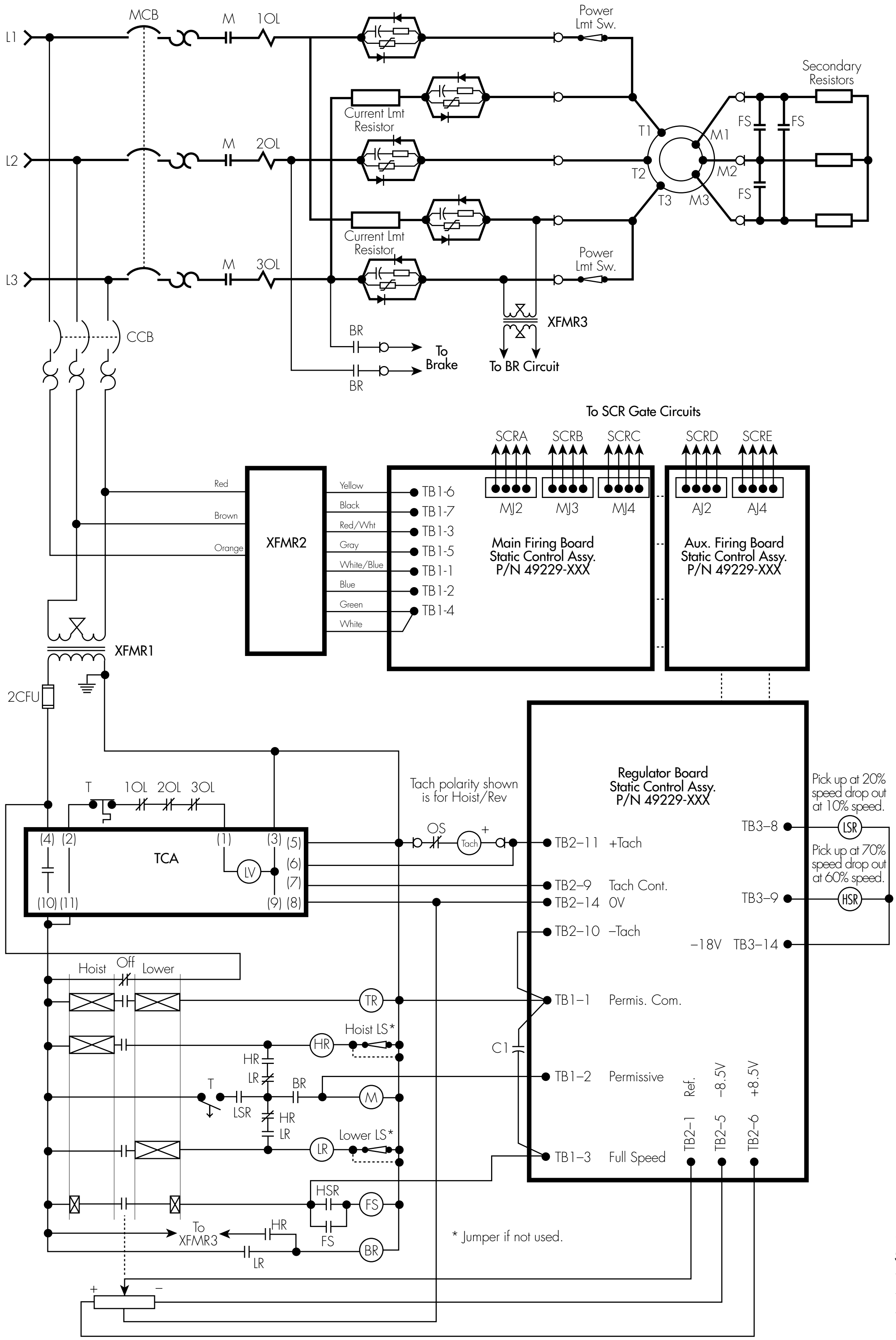


Figure 4 — Schematic Diagram of Compact Primary Static Reversing Hoist Control Speed Regulated with Full Speed Contactor and Off-Point Counter Torque

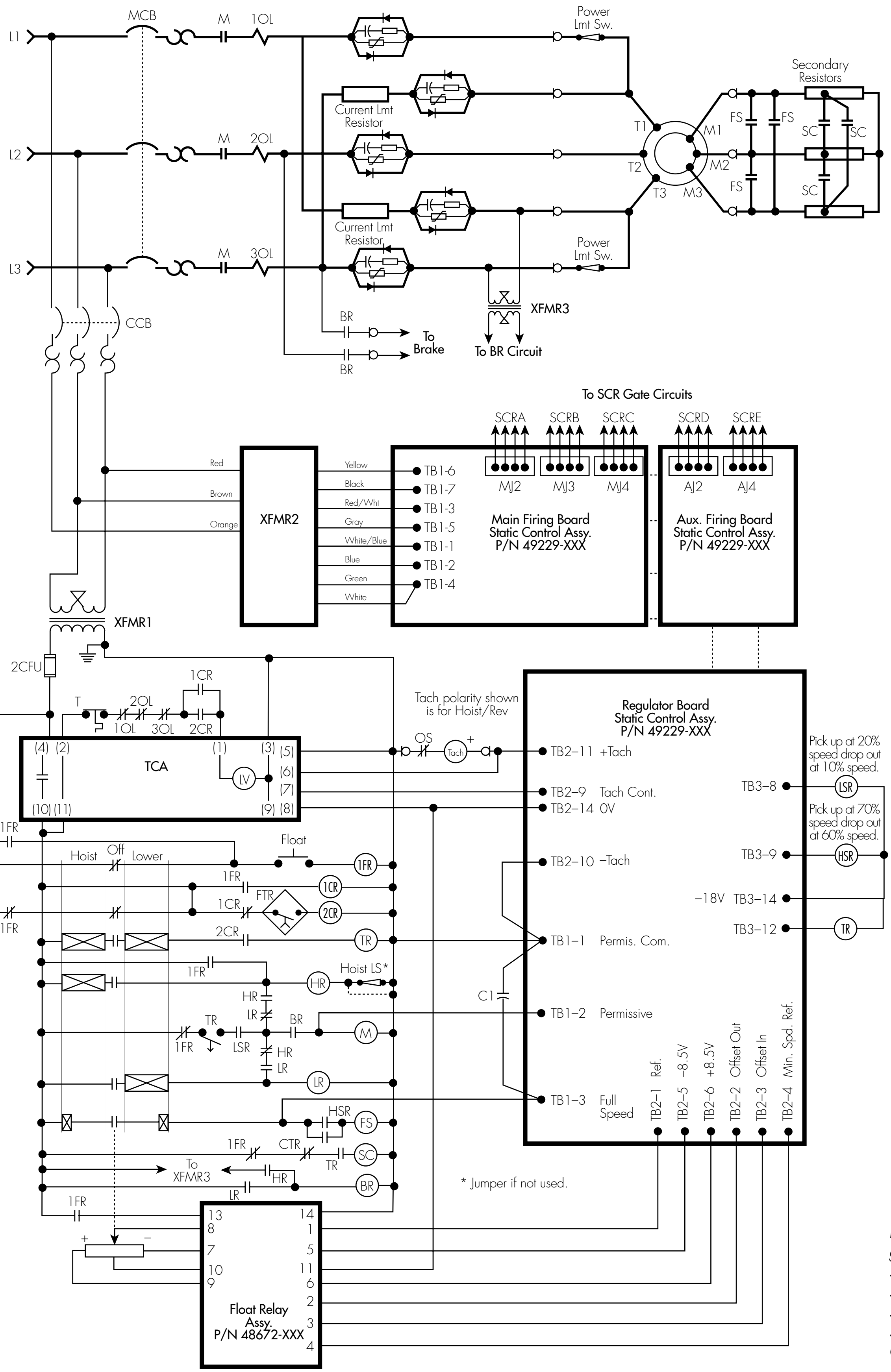


Figure 5 — Schematic Diagram of Compact Primary Static Reversing Hoist Control Speed Regulated with Full Speed Contactor, Extended Slow Speed, and Off-Point Counter Torque and Float

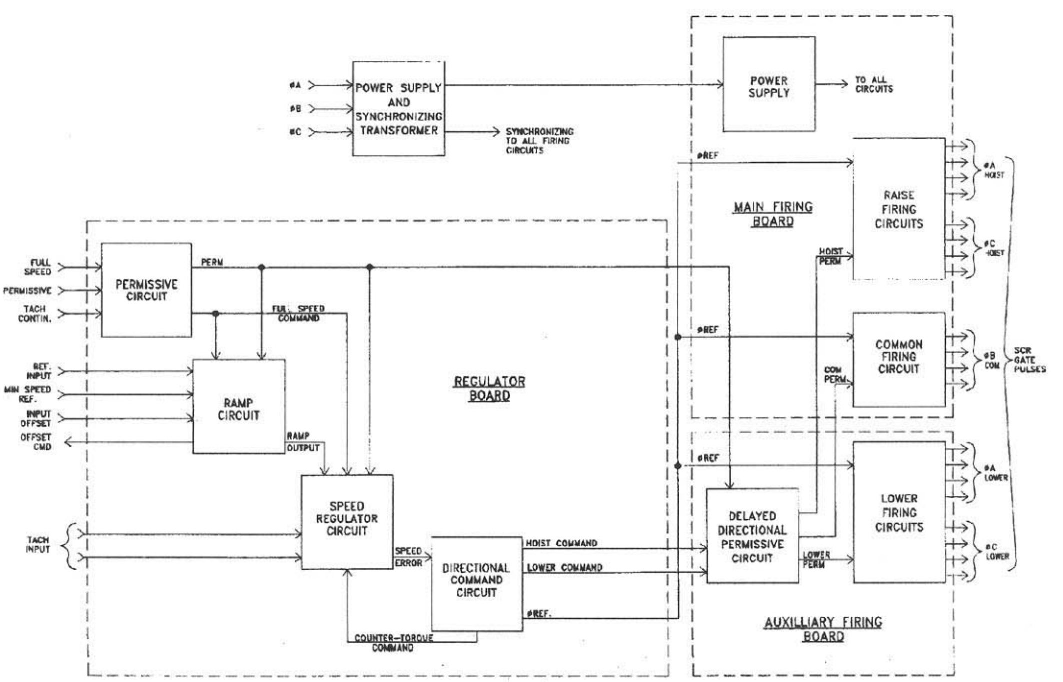
The ramp circuit receives the speed reference signal from the Master Switch or Pendant potentiometer and conditions the signal such that it is allowed to change only at a preset rate. This function provides for controlled acceleration and deceleration.

The speed regulator circuit receives the tachometer signal and compares it to the system speed reference signal from the ramp circuit. If the system speed is below the speed reference level, the output of the speed regulator circuit increases to provide more phase reference signal via the directional command circuit. This increased signal provides more voltage to the motor via the firing circuits and consequently more motor torque to increase system speed. If the system speed is above the speed reference level, the speed regulator output reverses polarity. This action causes the directional command circuit to issue a counter torque command to slow the motor. The resulting counter torque command signal causes the speed regulator circuit to provide a clamped or limited phase reference voltage to the firing circuits to control motor current and torque during the slow down interval.

The directional command circuit receives the bipolar speed error signal and a bipolar tachometer signal from the speed regulator circuit and compares these signals to determine the operational mode of the system motor. The directional command circuit issues a Hoist command signal to activate the Hoist and Common SCR bridges via the delayed directional permissive circuit, or a Lower command signal to activate the Lower and Common SCR bridges in a similar fashion.

The delayed directional permissive circuit receives the directional command signals from the directional command circuit and generates firing circuit permissive signals that are delayed by 4 1/2 cycles of the 60 Hz line. The delay is inserted in the permissive signals to prevent firing circuits that control the previously OFF SCR bridges from turning ON before the SCR bridges which are currently ON have stopped conducting. Shoot through faults are prevented by this delay.

The firing circuits receive the phase reference signal and, along with the synchronizing signals from the three phase synchronizing transformer and the delayed permissive signals from the delayed directional permissive circuit, produce the firing or gating signals required by the SCR bridges.



STATIC CONTROL ASSEMBLY
SYSTEM DIAGRAM
FIG. 2.2.1

3.0 Specifications

I	**Input Power**	230V or 460V, 3 phase, 60 hz.,
II	**Horsepower Range (at 460V)**	5 - 40HP Compact Construction. 50 - 250 HP with external SCR's.
III	**Speed Range**	Typical 10 to 1 with full speed = 80% sync.
IV	**Speed Regulation**	Better than 1%.
V	**Control Configuration**	Static Reversing
VI	**Temperature Range**	- 40 C to + 55 degree C (typical) - 40 to + 70 degree C (electronics)

3.1 INITIAL SET-UP STATIC CONTROL ASSEMBLY.

The start-up adjustments of the Static Control Assembly involve the setting of the control potentiometers and jumper plugs. Following is a description of these adjustments and their functions. Refer to figure 3.1 for their respective locations.

Permissive Jumper

This jumper has two positions. The left position is the "Set-up" position and allows the ramp circuit adjustments to be made without operating the firing circuits. The right position is the normal "Run" position. In this position the firing circuit permissive signal is active and the firing circuits will operate. Note...with the jumper in the "Set-up" position, the remaining control circuit will be active and holding brakes may be released when direction control commands are issued. To prevent unintended motion, disable the brake control circuit by removing the brake circuit fuses.

Ramp Select Jumper

This jumper has two positions. The upper position, "Internal", is the most common position, and connects the internal ramp signal to the speed regulator circuit. The lower position, "External", is used when the speed regulator circuit is to operate with an outside reference signal such as when two or more drives are to be speed matched from a common ramp signal. Unless the application involves a speed matching function with two or more drives operating in a "Master / Slave" arrangement, place the Ramp Select jumper in the "Internal" position.

RPM Select Jumper

This jumper has five positions, and provides the correct scaling factor for the system tachometer based on the synchronous speed of the driven motor.

The jumper positions available are:

1800 RPM

1200 RPM

900 RPM

720 RPM

600 RPM

For systems not using a Tachometer / Overspeed Switch assembly, place the RPM Select jumper in the corresponding synchronous speed position for the motor used. If a Tachometer / Overspeed Switch assembly is used, place the RPM Select jumper in the 1200 RPM position. This is necessary because the incorporated tachometer is geared for 1200 RPM operation at motor synchronous speed.

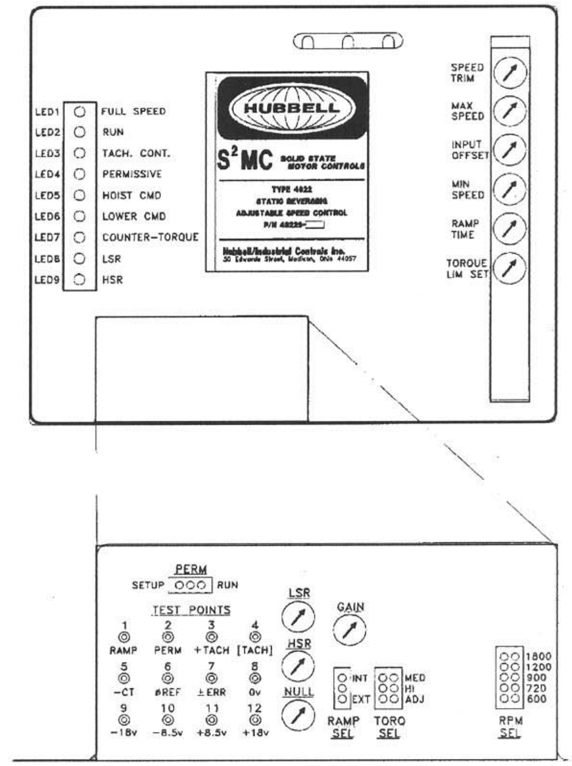


FIG. 3.1

Torque Select Jumper

This jumper is used to select the limited torque value supplied by the motor during counter-torque and plugging operations. The "HI" position, recommended for hoisting applications, limits motor torque to 200% to 250% during counter-torque. The "MED" position limits torque to 150% torque, and the "ADJ" position provides an adjustable range of 50% to 150%. Initially place this jumper in the "HI" position.

Speed Trim Potentiometer

The Speed Trim Potentiometer is used to make fine adjustments in system speed. In typical single motor applications or in multi-motor applications where the motors operate independently, this adjustment should be set to the "50" position. In "Master / Slave" speed matching applications with the Master drive set to the "50" position, this adjustment allows the "Slave" drive to be trimmed to match the speed of the "Master" drive. Initially, set this pot to the "50" position.

Minimum Speed Potentiometer

The Minimum Speed Potentiometer sets the minimum speed signal level out of the ramp circuit. Initially, this potentiometer is set fully counterclockwise to the "0" position.

Maximum Speed Potentiometer

The Maximum Speed Potentiometer determines the amount of scaling that is applied to the input speed reference signal. After the minimum speed signal level has been set, this adjustment will set the full speed level of the input speed reference signal. Initially, this potentiometer is set fully clockwise to the "100" position.

Input Offset Potentiometer

This potentiometer is used to remove residual first point master switch or pendant speed reference signal arising from a speed reference potentiometer without an off-point shorting band. Set this potentiometer fully counterclockwise to the "0" position.

Ramp Time Potentiometer

The Ramp Time potentiometer sets the slope of the output ramp signal to the speed regulator circuit. The adjustment range is from 0.5 seconds at the full counterclockwise position to 10.0 seconds at the full clockwise "100" position. This adjustment determines how quickly the ramp output signal is allowed to increase or decrease. Initially, this potentiometer is set fully counterclockwise to the "0" position.

Torque Limit Set

This potentiometer sets the value of limited motor torque during counter-torque or plugging operations when the torque select jumper, described above, is placed in the "ADJ" position. The adjustment range is from 50% to 150%. Initially, set this potentiometer fully clockwise to the "100" position.

LSR Trim Potentiometer

This adjustment is located directly on the main regulator board and sets the motor speed value above which the "LSR" LED will light, and the LSR relay will pick up. The adjustment range is 5% at full counterclockwise to 25% when fully clockwise. Set this potentiometer mid range.

HSR Trim Potentiometer

This adjustment is located directly on the main regulator board and sets the motor speed value above which the "HSR" LED will light, and the HSR relay will pick up. The adjustment range is 75% at full counterclockwise to 95% when fully clockwise. Set this potentiometer fully counterclockwise.

Gain Potentiometer

This potentiometer is located on the main regulator board and is used to adjust system stability. Initially, set this potentiometer mid range.

Null Potentiometer

This potentiometer is located on the main regulator board and is used to adjust the speed regulator offset. This is a factory adjustment and needs no further attention. Should the setting of this potentiometer be disturbed, return the setting to a mid range position.

3.2 SETUP ADJUSTMENTS

Section 3.1 above described the system adjustments and the initial settings of these adjustments. This section describes the procedure by which the system can be setup. Refer to Figure 3.1 for control adjustment locations.

1. Using a digital voltmeter set to read 20 volts DC, place the black common meter probe tip into test point 8, 0V. The black common lead will remain in this test point for the remainder of the set up procedure.

Place the red meter probe tip into test point 1, Ramp output. For Hoist commands from the master switch or pendant, the output voltage should be positive. For Lower commands, the output should be negative. The following setup will use Lower commands, therefore, a negative voltage on the digital voltmeter is expected.

2. Move the Permissive Jumper from the "Run" position to the "Setup" position. The firing circuits are now disabled. Note.. holding brakes may be released during the remaining setup procedure. To prevent unintended movement, disable the brake control circuit by removing the brake circuit fuses.

3. Close the Control circuit breaker and apply 3 phase system power. The "Tach Continuity" LED should light on the SCA, and the LED on the tach continuity module, if present, should be lit.

4. A typical speed range is 10 to 1 with maximum stepless speed equal to 5.O volts, and minimum speed equal to 0.5 volts. Assuming a typical speed range, proceed as follows:

a. Move the master switch or depress the pendant button until first point lower is obtained. The "Run", "Perm", and "Lower" LEDs should light.

b. Rotate the Input Offset potentiometer clockwise until the digital voltmeter reads 0V.

c. Move the master switch in the Lower direction or depress the Lower pendant button until the Full Speed LED lights. Back up from this position until the Full Speed LED just goes out and hold at this point. Adjust the Max Speed potentiometer counterclockwise until a reading of -4.5 volts is obtained on the digital voltmeter. Repeat steps b. and c. until no further adjustments are necessary. Typically, three iterations are required to obtain a 0V reading at first point, and a -4.5V setting at the maximum stepless position.

d. Move the master switch or depress the Lower pendant button until first point Lower is obtained. Rotate the Min Speed potentiometer clockwise until a -0.5V reading is obtained on the digital voltmeter.

e. Move the master switch or depress the Lower pendant button to the last stepless position. The digital voltmeter should read -5.0V.

f. Check the minimum speed and maximum stepless speed points in the Hoist direction. The "Lower" LED should go off and the "Hoist" LED should come on. The digital voltmeter should read +0.5V and +5.0V respectively.

g. Return the master switch or the pendant button to the Off position. The digital voltmeter should indicate 0.0 volts. Determine the required system speed ramp time. The Ramp can provide times to full output from 0.5 seconds to 10 seconds. Rotate the Ramp Time adjustment potentiometer clockwise to the desired time setting. Hoist applications typically use short acceleration times of 0.5 to 2.0 seconds for good response.

5. Determine the relative synchronous speed of the system tachometer. Move the RPM Select jumper to the RPM position corresponding to the tachometer synchronous speed value.

NOTE: When a Hubbell Tachometer/Overspeed Switch Assembly is used, the 1200 RPM range must be selected.

6. Open the Main and Control circuit breakers and remove system power. Move the Permissive Jumper on the regulator board from the "Setup" position to the "Run" position. Restore operation to the holding brake circuit by reinstalling the brake circuit fuses. Close the main and control circuit breakers. The motor control system will now be able to operate the motor.

7. Assuming that the hook is in the UP position, attempt to operate the motor at first point Lower by moving the master switch or by depressing the pendant Lower button. The hook should descend at minimum speed. If the motor appears to be running at full speed, stop the control and reverse the tachometer leads.

8. Observe the operation of the motor to changes in speed reference. This can be accomplished by moving the master switch or pendant button between minimum and mid speed positions. This causes the Ramp output to increase and then decrease. Watch the directional "Lower" and "Hoist" command LEDs for direction command changes and the incandescent lights on the Firing Circuit boards for relative performance and stability. One change in the directional command LEDs is normal indicating the slow down operation. If "back and forth" oscillation of the direction LEDs or repetitive flickering of the Firing Circuit Lights occurs, adjustment of the "Gain" potentiometer on the regulator board will be required. The best performance will be obtained when the Gain potentiometer is adjusted to provide smooth steady response to speed reference changes without repetitive flickering of the firing circuit lights or continued oscillation of the direction command LEDs.

9. Open the Control and Main circuit breakers. This completes the set up of the motor control system.

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