STUDENT HANDOUT

TROUBLE SHOOTING GUIDE FOR SPECIAL PURPOSE HYDRAULIC ELEVATOR AND AUTOMATICALLY OPERATED DOORS

NIKE (357.1)

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FOREWORD

THIS CHART WAS FORMULATED ON THE ASSUMPTION THAT THE SYSTEM HAS BEEN WIRED IN ACCORDANCE WITH THE WIRING DIAGRAM AND ALL MODIFICATIONS TO THE SYSTEM HAVE BEEN MADE TO DATE.

IT HAS ALSO BEEN ASSUMED THAT THE 110 VOLT AND THE 416 VOLT POWER SUPPLY HAVE BEEN TESTED AND DETERMINED SATISFACTORY.

ALL INSULATION RESISTANCE TESTS ARE MADE FROM ONE CONDUCTOR OF THE DEVICE UNDER TEST TO GROUND. THE DEVICE UNDER TEST MUST BE DISCONNECTED FROM THE CIRCUIT AND EQUIPMENT DE-ENERGIZED AT THE SERVICE SWITCH. INSULATION RESISTANCE SHALL BE A MINIMUM OF 100,000 OHMS (.1 MEG-OHM). IF INSULATION TESTS 100,000 OHMS OR LESS A THOROUGH INVESTIGATION SHOULD BE MADE TO DETERMINE AND ELIMINATE THE GROUNDED CONDITION.

ALL CONTINUITY TESTS ARE MADE WITH THE EQUIPMENT DE-ENERGIZED AT THE MAIN SERVICE SWITCH.

WHEN CHECKING CONTINUITY THROUGH A COIL ONE SIDE OF THE COIL MUST BE DISCONNECTED FROM THE CIRCUIT TO ELIMINATE THE POSSIBILITY OF READING THROUGH OTHER COILS IN THE CONTROL SYSTEM.

WHEN THIS CHART WAS WRITTEN IT WAS ASSUMED THAT LINE 3L1 WAS GROUNDED. THIS MAY NOT BE TRUE IN ALL CASES. IF IT IS NOT GROUNDED, THE MALFUNCTION CAUSED BY GROUNDING OTHER COMPONENTS WOULD BE EXTREMELY RARE.

IT IS POSSIBLE TO BY-PASS THE TOTAL OUTPUT FROM THE PUMP WITHOUT THE RELIEF VALVE CHATTERING. CHECK THE MOTOR OUTPUT WITH AN AMMETER.

TABLE OF CONTENTS

	PAGE NO.
DOORS OPEN CIRCUIT	1 - 6
DOORS CLOSE CIRCUIT	7 - 10
COMMON TO BOTH DOORS OPEN AND DOORS CLOSE CIRCUITS	11
ELEVATOR "UP" CIRCUIT	12 - 23
ELEVATOR "DOWN" CIRCUIT	24 - 30
CONSOLE "UP" OPERATION	31 - 33
CONSOLE "DOWN" OPERATION	34 - 35
CIRCUIT RELAYS	36
TIMING RELAYS	37
LIMIT SWITCHES	38
TWO-WAY SOLENOID VALVES	39 - 40
FOUR-WAY SOLENOID VALVES	41

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN THE "DOORS OPEN" CIRCUIT

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	No response when "Doors Open" button is depressed. (ICR & ITR relays do not pick up)	1. Selector switch on associated wiring faulty.	1. Check continuity thru the switch and wiring. (Selector switch in "Master" position.) Terminals 11 to 15 in control relay cabinet.
		2. Circuit thru push buttons is faulty.	2. Check continuity as follows: Terminals 15 to 17 ("OPEN" Button) (Button must be depressed for this test.) Terminals 7 to 10 ("CLOSE" Button) Terminals 3L2 to 14 (Master "STOP") Terminals 14 to 29 (Elevator "STOP")
		3. 5LS1 & 6LS1 contacts open or wiring faulty in these limit switches.	3. Check continuity thru 5LS1 and 6LS1. Terminals 10 to 38.
		4. Coil on 1CR burned out or has broken leads.	4. Check continuity thru 1CR coil. Terminals 38 to 29. (Disconnect coil at terminal 38 for this test.)
II	1CR & 1TR relays pick up, but motor does not start. Warning bell rings.	1. Circuit thru 17LS open.	1. Check continuity terminals 53 to 63.
		2. Auxiliary relay contacts open.	2. Check for continuity thru "Normally Closed" contacts of auxiliary relay.
		3. Open circuit thru 1CR1.	3. Check movable contact assembly of 1CR relay. Check continuity thru 1CR1 (terminals 11 to 86) with circuit de-energized, relay held in manually.
		4. Open circuit thru 6CR1 or 8CR6.	4. Check for continuity as follows: Terminals 86 to 63 (6CR1) Terminals 53 to 62 (8CR6)

TROUBLE	POSSIBLE CAUSES	REMEDIES
III Motor starts, bell rings but doors do not open after 5 second delay. #1 motor did not shift to 100% line voltage (run). Pump continued to by-pass and pressure relief valve did not open.	1. Micro switch on motor timing relay did not operate.	1. With equipment energized, check countinuity on micro switch terminals on timing relay in #1 motor control cabinet with a voltmeter. There should be no voltage across "Common" and "Normally Open" terminals. Voltage here indicates open contacts.
	2. Faulty micro switch.	2. Disconnect wires from micro switch and operate manually. Check for continuity between "Common" and "Normally Open"; also "Common" and "Normally Closed".
	3. Operating Linkage out of adjustment.	3. Adjust operating linkage, after checking that micro switch is operating properly, to operate switch near the end of its stroke.
	4. Timing relay out of adjustment (in #1 motor control cabinet.)	4. Adjust timer to allow motor to shift to 100% line voltage at two (2) seconds after motor starts.
IV #1 Motor starts and shifts to "RUN" But #1 pump continues to by-pass. Pressure relief valve does not open.	1. Open circuit to SB valve.	1. Check for voltage across SB coil. Terminals 44 to 29. If no voltage is indicated here check voltage across the following contacts: Terminals 11 to 69 (1TR2) Terminals 44 to 44A (Launcher interlock) Terminals 69 to 44A (1MR2 contacts) Voltage at one of these points indicates open contacts. (Tests to be made with circuit emergized).
	2. SB coil burned out.	2. Check continuity through SB coil. Terminals 29 to 44. (Disconnect coil at terminal 44 for this test.)

TROUBLE	POSSIBLE CAUSES	REMEDIES
IV (Cont'd)	3. SB Valve not closkng because of adjustment.	3. Adjust SB according to recommended procedure.
	4. SB not operating properly.	4. Disassemble SB valve, clean, replace any worn, bent or broken components, reassemble, adjust & test.
	5. S6 valve does not hold pressure on fails to remain closed. (Test: Close hand valve between SA1 and tank.)	5. Disassemble S6 valve, clean, replace any worn, bent or broken components, reassemble, adjust and test.
V When #1 motor shifts to "RUN" the pressure releif valve opens and continues to chatter.	1. S1A coil not energizing to shift 4-way valve.	1. Check for voltage across the coil, terminals 38A to 29. If no voltage is present make continuity checks across 2CR5, terminals 44 to 39A. (Equipment de-energized and 2CR relays operated manually.)
	2. S1A coil burned out.	2. Check for continuity thru coil, termining 38A to 29. (Disconnect coil at terminal 38A for this test.)
	3. 4-Way valve not shifting because of dirt in pilot assembly. "O" ring seal on pilot spool may be displaced and binding the spool.	3. Remove S1A pilot valve assembly, disassemble, clean and flush. Replace "O" ring seal if imperfect. Reassemble and test.
	4. Low control voltage. S1A coil will not overcome spring tension. (This is evidenced by vibrating pilot plunger. Coil will hold if assisted manually & doors will operate.)	4. Check that control voltage is a minimum of 110 volts at terminals 3L1 and 3L2. If control voltage is 110 volts or higher and all other causes have been eliminated time spring above the pilot spool may be shortened but <u>not more than one spiral</u>.
	5. Coil grounded.	5. Disconnect coil at terminal 38A. Make insulation resistance test from wire 38A to ground.
	6. S5 valve is not opening wide enough, restricting flow to doors.	6. Adjust S5 according to recommended procedure.

TROUBLE	POSSIBLE CAUSES	REMEDIES
V (Cont'd)	7. S5 not opening - mechanical failure.	7. Disassemble S5 valve; clean; replace any worn, bent or broken components; reassemble, adjust and test.
	8. Drain lines clogged or closed off, not allowing 4 way valve to shift.	8. Make sure valves on drain lines are wide open and lines are free of any restriction.
	9. Hand valves turned off.	9. Check that the hand shut off valves in the hydraulic lines are wide open.
VI Doors begin opening but one linkage does not break over center.	1. Flow control valves out of adjustment.	1. Check that both flow control valves on the same door are set the same.
	2. Cup packing in cylinder faulty and by-passing pressure.	2. Break the linkage over center manually to enable the doors to open. Stop the doors half way open and observe that <u>both</u> doors do not drift open. (Indicates a ruptured or leaking cup). Doors may "Float" (One opens while one closes) but both doors must move.
	3. Air in cylinders	3. Air bleed all cylinders to remove any trapped air, both head and rod ends.
	4. Pressure relief valve not properly adjusted.	4. If all above causes have been eliminated adjust pressure relief valve according to recommended procedure.
	5. #1 pump failing.	5. Test pump according to recommended procedure.
VII Doors open but #1 motor continues to run when doors reach stops.	1. 5LS or 6LS did not operate.	1. Check for continuity between terminals 10 and 38. Continuity indicates 5 or 6LS has not operated.
	2. Line 38 grounded.	2. Disconnect wire #38 and make insulation resistance test from this wire to ground.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
VII	(Cont'd)	NOTE: - If line 3L1 was not installed as a "Neutral" (Grounded) conductor, cause - 2 does not apply.	
VIII	Doors open but stop before they reach stops.	1. 5LS and 6LS operated too soon.	1. Reset limit switches 5 and 6LS so they operate when doors reach their fully open position.
IX	Doors open as soon as #1 motor shifts to "RUN" without the 5 second warning delay period.	1. 1TR out of adjustment.	1. Adjust 1TR to give 5 second delay before doors start opening.
		2. Micro switch 1TR2 faulty.	2. Disconnect micro switch and operate manually while checking with an ohmeter for proper operation.
		3. 2TR1 contacts not opening.	3. Shift selector switch to "CONSOLE" position. If #1 motor starts 2TR1 is not opening. (Micro switch on 2TR relay.) Adjust operating linkage to insure that 2TR1 opens when 2TR is de-energized.
		4. Diaphram ruptured.	4. Remove timing relay, disassemble, replace faulty diaphram, assemble, adjust and test.
X	Warning bell does not ring before or while doors are opening.	1. Clapper on bell binding.	1. Check that calpper is free to move with no bind.
		2. 1TR1 contacts not closing.	2. Disconnect lines #48 and #49 at 1TR and check continuity through the switch with relay energized.
		3. Wiring on primary of transformer open.	3. Check continuity through the primary at leads marked "H".
		4. Wiring on secondary of transformer open.	4. Check continuity through the secondary at leads marked "X".

	TROUBLE	POSSIBLE CAUSES	REMEDIES
X	(Cont'd)	5. Transformer grounded at primary or secondary.	5. With transformer disconnected check insulation resistance from leads to ground.
XI	Warning bell starts ringing after doors begin opening.	1. Clapper on bell hanging up.	1. Check that the clapper is free to move and free from any bind.
		2. Operating linkage on 1TR1 out of adjustment.	2. Adjust 1TR1 operation linkage to operate Micro switch at the beginning of the timing stroke.
XII	Warning bell continues ringing after doors are fully open and #1 motor stops.	1. 1TR1 contacts did not open when 1TR was de-energized.	1. Adjust 1TR1 operating linkage to open 1TR1 contacts when 1TR is de-energized.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN THE "DOORS CLOSE" CIRCUIT

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	No response when "DOORS CLOSE" button is depressed.	1. Selector switch faulty.	1. Check continuity thru selector switch terminals 11 to 15 in control relay cabinet. (Selector switch in Master Position)
		2. Circuit thru push buttons is faulty.	2. Check continuity thru "DOORS CLOSE" button terminals 11 to 8 (with "DOORS CLOSE) button depressed) and the normally closed contacts of the "DOORS OPEN" button, terminals 8 and 9.
		3. Circuit thru "STOP" buttons is open.	3. Push "STOP" button and listen for relays 4CR and 10CR to pick up when button is released. If relays do not pick up check for continuity. thru "ELEVATOR STOP" button, terminals 14 to 29 and continuity thru Master Station "STOP" button, terminals 3L2 to 29.
		4. 1LS and 2LS in operated position or circuit faulty thru these limit switches.	4. Check continuity thru 1LS and 2LS, terminals 23 to 39.
		5. Coil on 2CR burned out or has broken leads.	5. Check continuity thru 2CR coil. Terminals 39 to 29 (Disconnect coil at terminal 39 for this test.)
		6. Circuit not complete thru 22LS1.	6. Check continuity thru 22LS1. Terminals 9 to 23.
II	Motor starts but does not shift to "RUN" when "DOORS CLOSE" button is depressed.	1. Micro switch on motor timing relay did not operate. (In #1 motor control cabinet.)	1. With equipment energized, check continuity on Micro switch terminals on timing relay in #1 motor control cabinet with a voltmeter. There should be no voltage across "Common" and "Normally Open" terminals. Voltage here indicates open contacts.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
II	(Cond't)	2. Faulty micro switch.	2. Disconnect wires from micro switch and operate manually. Check for continuity between "Common" and "Normally Open"; also "Common" and "Normally Closed".
		3. Operating linkage out of adjustment.	3. Adjust operating linkage, after checking that micro switch is operating properly, to operate switch near the end of its stroke.
		4. Timing relay out of adjustment (in #1 motor control cabinet).	4. Adjust timer to allow motor to shift to 100% line voltage at two (2) seconds after motor starts.
III	Motor starts and shifts to "RUN" but #1 pump continues to by-pass. Pressure relief valve does not open.	1. Open circuit to SB valve.	1. Check for voltage across SB coil. Terminals 44 to 29. If no voltage is indicated here check voltage across the following contacts: Terminals 11 to 69 2CR3 Terminals 44 to 44A Launcher Interlock Terminals 69 to 44A 1MR2 Voltage at one of these points indicates open contacts. (Tests to be made with circuit energized).
		2. SB coil burned out.	2. Check continuity thru SB coil. Terminals 29 to 44. (Disconnect coil at terminal 44 for this test.)
		3. SB valve not closing because of adjustment.	3. Adjust SB according to recommended procedure.
		4. SB not operating properly.	4. Disassemble SB valve, clean, replace any worn, bent or broken components, reassemble, adjust and test.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
		5. S6 valve does not hold pressure or fails to remain closed. (Test: Close hand valve between SA1 and tank.)	5. Disassemble S6 valve, clean, replace any worn, bent or broken components, reassemble, adjust and test.
IV	Motor starts, shifts to "RUN", pressure relief valve opens and continues to chatter.	1. S1B coil not energizing to shift the 4-way valve.	1. Check for voltage across the coil, terminals 39A to 29. If no voltage is present make continuity checks across 2CR5 contacts, terminals 44 to 39A (2CR relay operated manually and equipment de-energized.)
		2. S1B coil open.	2. Check for continuity thru coil. Terminals 39A to 29.
		3. 4-way valve not shifting because of dirt in pilot assembly; "O" ring on pilot spool may be displaced, binding the spool.	3. Remove S1B pilot assembly, disassemble, clean and flush. Replace "O" ring seal if imperfect, reassemble and test.
		4. Low control voltage. S1B coil will not overcome spring tension. (This is evidenced by vibrating plunger. Coil will hold if assisted manually and doors will work properly.)	4. Check that control voltage is a minimum of 110 volts at terminals 3L1 and 3L2. If control voltage is 110 volts or higher and all other causes have been eliminated, the spring above the pilot spool may be shortened; but not more than one spiral.
		5. S1B coil grounded.	5. Disconnect coil at terminal 39A. Check insulation resistance from wire #39A to ground.
		6. S5 valve is not opening wide enough, restricting flow to doors.	6. Adjust S5 according to recommended procedure.
		7. S5 not opening - mechanical failure.	7. Disassemble S5 valve; clean, replace any worn, bent or broken components; reassemble, adjust and test.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
IV	(Cont'd)	8. Drain lines clogged or closed off, not allowing 4-way valve to shift.	8. Make sure valves on drain lines are wide open and lines are free of any restriction.
V	Doors close, #1 motor stops, but one linkage did not lock over center.	1. Seal between the doors not fastened down tight, causing bind upon closing. 2. Doors do not close evenly because of flow control valve adjustment. 3. Air in cylinders. 4. Limit switches 1LS and 2LS set out too far. 5. Cylinder rod length out of adjustment causing piston to "bottom" on head end of cylinder before linkage locks over center.	1. Tighten down seal, replace any bolts that cannot be tightened and replace missing bolts. 2. Check that both flow control valves on the same door are set the same. 3. Air bleed all cylinders to remove any trapped air, both head and rod ends. 4. Reset 1LS and 2LS to stop #1 motor after linkage have locked over center. 5. Adjust rod length according to recommended procedure.
VI	Doors close but #1 motor continues to run after operating linkages are locked over center.	1. 1LS or 2LS did not operate. 2. Lines 9 or 23 grounded. NOTE: If line 3L1 was not installed as a "neutral" (Grounded) conductor, cause 2 does not apply	1. Check for continuity between terminals 23 and 39. Continuity indicates 1 or 2 LS has not operated. 2. Disconnect wires 9 and 23. Make insulation resistance test from these wires to ground.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE COMMON TO BOTH "DOORS OPEN" AND "DOORS CLOSE" CIRCUIT

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	When "Doors Open" or "Doors Close" button is depressed, elevator begins rising.	1. S6 valve fails to close tightly at the same time SA1 fails to open.	1. Adjust S6 and SA1 valves according to recommended procedure. Try door operation after S6 has been adjusted, with hand valve between SA1 and tank closed. If elevator still rises S6 willhave to be disassembled, cleaned and repaired.
II	Doors are slow opening or closing and #1 pump loads up on starting.	1. S5 valve is restricting flow thru the valve body because of faulty seat screw. (Brass seat screws have a tendency to peen, closing orfice thru them.)	1. Disassemble S5 valve; clean; replace any faulty, worn, bent, or broken parts. Reassemble, adjust and test. (All normally open type Atkomatic valves should have stainless steel seat screws to obtain optimum results in operation and dependability.
III	4-Way pilot assembly chatters when energized but valve shifts and operates satisfactorily.	1. Dirt, rust or corrosion in air gap of solenoid assembly. 2. Cracked or broken shading pole.	1. Remove pilot valve assembly; disassemble and clean. Remove any dirt, rust or foreign material from air gap. Reassemble and test. 2. Remove pilot valve assembly and disassembly. Remove broken shading pole and replace. (oblong copper ring imbedded in the pole face.)
IV	Circuit relay chatters or hums loudly when energized.	1. Dirt, rust or corrosion in air gap of solenoid assembly. 2. Cracked or broken shading pole.	1. Remove movable contact assemblies; then remove armature (part attracted by the coil). Remove any dirt, rust, or foreign material from mating surfaces. 2. Remove armature to gain access to pole face. Remove broken shading pole and replace. (Shading pole is a continuous copper ring imbedded in pole face.)

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN "ELEVATOR UP" CIRCUIT.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	No response when "UP" button is depressed at the Master Station. (3CR does not pick up). Doors are open and elevator is on pedestals.	1. Selector switch or associated wiring is faulty.	1. Check continuity trhough the switch and wiring. (Selector switch in "Master" position.) Terminals 29 to 22 in control relay cabinet.
		2. Circuit through push buttons is faulty.	2. Check continuity as follows: Terminals 2 to 22 Up button - Master Station (Up button is depressed for test) Terminals 2 to 13 Down - Elevator Terminals 13 to 6 Down - Master
		3. 4CR coil burned out or leads broken.	3. Check continuity through 4CR coil, terminals 47 to 29. (Disconnect one side of 4CR coil for test).
		4. 4CR not picked up because locking bars are not retracted.	4. Retract locking bars by closing 5CR relay manually with power on.
		5. 4CR2 contacts not closed.	5. Check continuity through 4CR2 contacts. Terminals 6 to 84 (Equipment de-energized, 4CR Operated Manually).
		6. 3CR coil burned out or leads broken.	6. Check continuity through 3CR coil, terminals 84 to 29. (Disconnect one side of coil for test).
II	#1 Motor does not start when elevator "UP" button is depressed. 3CR, 4CR and 10CR picked up.	1. 3CR3 contacts not closing.	1. Check continuity through 3CR3 contacts, equipment De-energized and 3CR operated manually. Terminals 11 to 86.
		2. Open circuit through normally closed contacts 6CR1, 17LS1 or 8CR6.	2. Check continuity as follows: Terminals — Contacts 86 to 63 — 6CR1 63 to 53 — 17LS1 53 to 62 — 8CR6 Also check continuity through the normally closed contacts of the auxiliary relay.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
II	(Cont'd)	3. Faulty micro switch on timing relay in motor control cabinet.	3. Disconnect micro switch and operate manually while checking with an ohmeter for proper operation.
		4. Operating linkage out of adjustment.	4. After determining that the micro switch is all right adjust the linkage to operate the switch near the end of the timing stroke.
		5. Auxiliary relay energized (AR)	5. Reset overloads and depress "Stop" button.
III	No response when "UP" button is depressed on Master Station. (Doors closed - Elevator on pedestals). Elevator operates satisfactorily when doors are open.	1. Circuit through 21LS open. (21LS not depressed).	1. Check continuity through 21LS contacts. Terminals 11 to 25.
		2. Selector switch or wiring through selector switch faulty.	2. Check continuity through selector switch and wiring. Terminals 25 to 22.
IV	No response when "UP" button is depressed at elevator station. Elevator operates properly from Master Control Station.	1. Selector switch or wiring at selector switch faulty.	1. Check continuity through "UP" button and wiring on elevator. Terminals 2 to 26 at cabinet.
V	#1 Motor starts but does not shift to "run"; continues to by-pass.	1. Micro switch on motor timing relay did not operate.	1. With equipment energized check continuity on micro switch terminals on timing relay in #1 motor control cabinet with a voltmeter. There should be no voltage across "Common" and "Normally Open" terminals. Voltage here indicates open contacts.
		2. Faulty micro switch.	2. Disconnect wires from micro switch and operate manually. Check for continuity between "Common" and "Normally Open"; also "Common" and "Normally Closed".

TROUBLE	POSSIBLE CAUSES	REMEDIES
V (Con't)	3. Operating linkage out of adjustment.	3. Adjust operating linkage, after checking that micro switch is operating properly, to operate switch near the end of its stroke.
	4. Timing Relay out of adjustment (in #1 motor control cabinet).	4. Adjust timer to allow motor to shift to 100% line voltage at two (2) seconds after motor starts.
VI #2 Motor does not start and elevator rises on #1 pump.	1. Circuit through 19LS open.	1. Check continuity through 19LS contacts. Terminals 54 to 70.
	2. 2TR2 contacts not closing.	2. With equipment energized check continuity on micro switch terminals on 2TR with a voltmeter. There should be no voltage across terminals 11 to 54. Voltage here indicates open contacts.
	a. Faulty micro switch.	a. Disconnect wires 29 and 54. Operate switch manually and check for proper operation with an ohmeter.
	b. Operating linkage out of adjustment (2TR relay).	b. Adjust operating linkage, after checking that micro switch is operating properly, to operate switch near the end of the timing stroke.
	3. 2 TR out of adjustment.	3. Adjust timer to allow motor to start two (2) seconds after up button is depressed.
	4. 2TR coil burned out.	4. Check continuity through coil terminals 29 to 93. (Disconnect coil at terminal 93 for this test).
	5. Open circuit to 2TR at 3CR6 contacts.	5. Check continuity through 3CR6 contacts with a voltmeter while 3CR is energized. Terminals 62 to 93 (on 3CR relay). Voltage here indicates open contacts.
	6. 1CR5 contacts open.	6. Check continuity through 1CR5 contacts. Terminals 55 to 70 (on 1CR relay).

	TROUBLE	POSSIBLE CAUSES	REMEDIES
VI	(Cont'd)	7. Auxiliary relay contacts open.	7. Reset overloads, press "Stop" button; then check continuity across normally closed contacts of auxiliary relay. (in #2 motor control cabinet.)
		8. Faulty micro switch on timing relay in #2 motor control cabinet.	8. While equipment is energized (after all preceeding tests have been made) check for voltage across normally closed and common terminals of the micro switch on timing relay in #2 Motor Control Cabinet. Voltage across these terminals indicates a bad switch.
VII	#2 Motor starts but does not shift to "Run" and continues to by-pass.	1. Micro switch on motor timing relay did not operate.	1. With equipment energized check continuity on micro switch terminals on timing relay in #2 motor control cabinet with a voltmeter. There should be no voltage across "Common" and "Normally Open" terminals. Voltage here indicates open contacts.
		2. Faulty micro switch.	2. Disconnect wires from micro switch and operate manually. Check for cintinuity between "Common" and "Normally Open"; also "Common" and "Normally Closed".
		3. Operating linkage out of adjustment.	3. Adjust operating linkage, after checking that Micro switch is operating properly, to operate switch near the end of its stroke.
		4. Timing Relay out of adjustment (in #2 motor control cabinet).	4. Adjust timer to allow motor to shift to 100% line voltage at two (2) seconds after motor starts.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
VIII	#1 Motor starts and shifts to "Run" but #1 pump continues to by-pass.	1. S5 or SA1 valve not adjusted properly.	1. Adjust S5 or SA1 according to recommended procedure.
		2. S5, S6 and SA1 coils not energizing.	2. Check for voltage between terminals 40 & 29. If no voltage is present here check for voltage across these terminals in the following order: 87 to 88 (1CR4 Contacts) 88 to 68 (2CR4 Contacts) 68 to 67 (1MR1 Contacts) 67 to 40 (6CR4 Contacts) Voltage across any of the above contacts indicates open circuit at this point. (This test must be made with elevator up circuit energized).
		3. S5 coil burned out or open.	3. Check continuity through S5 coil. (This must be done at the valve by disconnecting the coil).
		4. Mechanical failure in S5.	4. Disassemble S5 valve; clean; replace any worn, broken or bent components; reassemble; adjust and test.
		5. SA1 coil burned out or open.	5. Check continuity through SA1 coil. (This must be done by disconnecting the coil.)
		6. Mechanical failure in SA1 valve.	6. Disassemble SA1 valve; clean; replace any worn, broken or bent components; reassemble; adjust and test.
		7. Pump failure. Pump will not put out enough pressure to operate elevator.	7. If all other causes have been investigated and eliminated, check for pump failure according to the recommended procedure.

contacts of the auxiliary relay.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
IX	#1 motor starts and pump by-passes, but when it shifts to "run" pressure relief valve opens and continues to chatter.	1. Mechanical failure of S6 valve.	1. Disassemble S6 valve; clean; replace any worn, broken or bent components; reassemble; adjust & test.
		2. S6 valve not adjusted properly.	2. Adjust S6 valve according to recommended procedure.
		3. Burned out or open coil on S6 valve.	3. Check continuity through S6 coil. (This must be cone at the valve by disconnecting the coil.)
X	Pressure relief valve chatters for several seconds only.	1. S5 closing before S6 opens.	1. Speed up opening of S6 or slow down closing of S5.
XI	#2 Motor starts as soon as "UP" button is activated (no2 second delay.)	1. 2TR2 closes with no time delay because of adjustment.	1. Adjust timing relay to start #2 motor 2 seconds after "UP" button is activated.
		2. Faulty micro switch on 2TR relay.	2. Disconnect wires and operate switch manually. Check for proper operation with ohmeter.
		3. Mechanical failure of diaphram or check valve in 2TR relay.	3. If it has been determined that micro switch is good and adjustment does not change time delay, remove 2TR; disassemble; replace diaphrem assembly; assemble, adjust and test.
XII	#2 Motor starts at full line voltage.	1. Timing Relay in motor control cabinet closes with no time delay.	1. Adjust motor timing relay to allow a two (2) second starting period.
		2. Faulty micro switch on timing relay in #2 motor control cabinet.	2. Disconnect wires and operate switch manually. Check for proper operation with ohmeter

	TROUBLE	POSSIBLE CAUSES	REMEDIES
XII	(Cont'd)	3. Mechanical failure of diaphram or check valve in timing relay in #2 Motor Control Cabinet.	3. It it has been determined that micro switch is and adjustment does not change time delay, remove 2TR; disassemble; replace diaphram assembly; assemble, adjust and test.
XIII	#1 Motor starts at full line voltage.	1. Timing relay in motor control cabinet closes with no time delay. 2. Faulty micro switch on timing relay, in #1 motor control cabinet. 3. Mechanical failureof diaphran or check valve in timing relay in #1 motor control cabinet.	1. Adjust motor timing relay to allow a two (2) second starting period. 2. Disconnect wires and operate switch manually. Check for proper operation with ohmeter. 3. If it has been determined that micro switch is good and adjustment does not change time delay, remove 2TR; disassemble; replace diaphram assembly; assemble, adjust and test.
XIV	#2 Motor does not come up to speed until elevator rises several feet. NOTE: This condition will only apply when there exists an inadequate power supply.	1. By-pass valve not opening fast enough (SA2). 2. Mechanical failure of SA2.	1. Adjust valve according to recommended procedure. 2. Disassemble SA2 valve; clean; replace any worn, bent or broken components; reassemble and test.
XV	When #2 motor shifts to "RUN" elevator gains only little speed.	1. SA2 valve has not closed tightly or closes too slowly. 2. Ruptured disc in SA2 valve. 3. Pressure leaking past piston rings in valve.	1. Adjust valve according to recommended procedures. 2. Disassemble; clean; replace any worn, bent or broken components; reassembly; adjust and test. 3. Upon reassembly of SA2 valve be sure that the openings in the piston rings are staggered and all rings work freely in their groove.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
XVI	Time required for "Elevator Up" operation exceeds 32 seconds. (timing on motors is correct.)	1. SA2 valve has not closed tightly or closes too slowly.	1. Adjust valve according to recommended procedure.
		2. Ruptured disc in SA2 valve.	2. Disassemble; clean; replace any worn, bent or broken components; reassemble; adjust and test.
		3. Pressure leaking past piston rings in valve.	3. Upon reassembly of SA2 valve, be sure that the openings in the piston rings are staggered and all rings work freely in their grooves.
		4. SA1 and/or S5 valve not closing tightly or closing too slowly.	4. Adjust valve according to recommended procedure.
		5. Ruptured disc in SA1 and/or S5 valve.	5. Disassemble; clean; replace any worn, bent or broken components; reassemble; adjust and test.
		6. Pressure leaking past piston rings in valves.	6. Upon reassembly of SA1 and/or S5 valve, be sure that the openings in the piston rings are staggered and all rings work freely in their grooves.
		7. S6 valve restricting flow and #1 pump by passing through relief valve.	7. Adjust S6 valve according to recommended procedure.
XVII	Elevator rises to intermediate level and stops.	1. Selector switch or associated wiring faulty.	1. Check continuity in control relay cabinet Terminals 28 to 22 (Master station; selector in "Master" position.)
		2. 5 or 6LS2 not operated.	2. Check continuity through 5LS2 and 6LS2. Terminals 11 to 66
		3. 10CR coil burned out or has broken leads. NOTE: If elevator will operate properly from "Elevator" station causes 2 and 3 do not apply.	3. Check continuity through 10CR coil. Terminals 66 to 29. (Disconnect coil at terminal 66 for this test.)

	TROUBLE	POSSIBLE CAUSES	REMEDIES
XVIII	Elevator rises but stops at a point 5 to 10 feet above floor level.	1. Break in cable to Elevator Control Station.	1. Check continuity through cable lines 13-2-26-22.
		2. 5 or 6LS2 contacts opened while elevator was operating.	2. Check if 10CR is picked up. If not refer to steps 2 and 3 above. (Item XVII).
XIX	Elevator lowers but stops at a point 5 to 10 feet above floor level.	1. Break in cable to Elevator Control Station.	1. Check continuity through cable lines 12-4-26.
XX	When #2 motor cuts out (19LS contacted) elevator stops rising. #1 motor continues to run.	1. S5 or SA1 valve has not closed tightly or closes too slowly.	1. Adjust valve according to recommended procedure.
		2. Ruptured disc in S5 or SA1 valve.	2. Disassemble; clean; replace any worn, bent or broken components. Reassemble; adjust and test.
		3. Pressure leaking past piston rings in either S5 or SA1 valve.	3. Upon reassembly of the valve, be sure that the openings in the piston rings are staggered about the circumference and all rings work freely in their grooves.
		4. Failure of check valve at #2 pump.	4. Close the hand valve in the #2 pump by-pass line. If the check valve is faulty #2 pump will run backward.
		5. Mechanical failure of S6 valve.	5. Disassemble S6 valve and clean thoroughly. Replace any worn, bent or broken components. Reassemble, adjust and test.
		6. Burned out or open coil on S6 valve.	6. Check continuity through S6 coil. (This must be done at the valve by disconnecting the coil.)

	TROUBLE	POSSIBLE CAUSES	REMEDIES
XX	(Cont'd)	7. Pump failure: #1 pump will not put out enough pressure to operate the elevator.	7. If all other possible causes have been checked and eliminated, check for pump failure according to the recommended procedure.
		8. Open circuit to 55,56,SA1, valves.	8. Check voltage across terminals 87-40. Points 87-88, 88-68, 68-67, 67-40 should be checked if no voltage is present from 87-40.
XXI	Elevator rises above locking bars but bars do not engage.	1. 17LS2 contacts open - 17LS did not operate properly.	1. Check continuity through 17LS2 contacts. Terminals 11 to 52
		2. 3CR4 contacts open. Contacts broken or out of place.	2. Check continuity across 3CR4 contacts. Terminals 11 to 52. (Equipment de-energized, contactor held in manually.)
		3. S2A coil burned out or open.	3. Check for continuity through S2A coil line 42 to 29. (Disconnect coil at terminal 42 for this check.)
		4. 4-way valve not shifting because of dirt in the pilot assembly. "O" ring seal on pilot spool may be displaced, binding the spool.	4. Remove S2A pilot valve assembly. Disassemble, clean and flush. Replace "O" ring seal if imperfect. Reassemble and test.
		5. Coil grounded.	5. Disconnect S2A coil at terminal 42. Make insulation resistance test from line 42 to ground.
		6. Low control voltage - coil will not overcome spring tension. (This is evidenced by vibrating pilot plunger. Coil will hold if assisted manually and locking bars will operate.	6. Check that control voltage is a minimum of 110 volts at terminals 3L1 and 3L2. If control voltage is 110 volts or higher, and all other causes have been eliminated, the spring above the pilot spool may be shortened <u>not more than one spiral</u>.

TROUBLE	POSSIBLE CAUSES	REMEDIES
	7. Drain line clogged or closed off preventing valve from shifting.	7. Make sure the valves on drain lnes are wide open and lines are free of any restriction.
	8. Hand valves in hydraulic lines closed or flow control valve shutting off flow.	8. Check that hand valves are wide open and the flow control valve adjusting screw is turned in (clockwise) as far as it will go.
XXII Locking bars engage but elevator does not level.	1. All limit switches that measure extended length of locking bars did not operate to drop out 4CR.	1. Check continuity terminals 11 to 47. (9 thru 12LS). Continuity here indicates one or more limit switches did not operate.
	2. Open circuit to S3 valve.	2. Check continuity through this circuit as follows: Terminals 11 to 5 (pressure switch) Terminals 5 to 1 (4CR1 contacts) Terminals 1 to 92 (3CR5 contacts) Terminals 92 to 46 (5CR6 contacts)
	3. S3 coil burned out.	3. Check continuity through coil terminals 46 to 29. (Disconnect coil at terminal 46 for this test).
	4. S3 not opening because of adjustment.	4. Adjust S3 valve according to recommended procedure.
	5. Mechanical failure in S3 valve.	5. Disassemble S3 valve; clean; replace worn, bent or broken components. Reassemble, adjust and test.
XXIII #2 motor does not stop when elevator nears locking bars.	1. 19LS is not operating when it contacts its cam.	1. Check that 19LS will stop #2 motor by operating it manually. Adjust switch or cam to allow enough throw on switch to make it operate.

TROUBLE	POSSIBLE CAUSES	REMEDIES
II (Cont'd)	2. Line 54 or 70 grounded, holding #2 motor circuit energized.	2. Disconnect lines 54 and 70 at control cabinet and make insulation resistance test from wire to ground.
	3. Line 41 grounded	3. Disconnect 41 at control relay cabinet and make insulation resistance test from wire to ground.
	NOTE: If line 3L1 was not installed as a "Neutral" (Grounded) conductor, causes 2&3 do not apply.	
Elevator rises above locking bars, bars engage but #1 pump continues to run. Elevator does not level.	1. Ground on line 40, holding #1 motor circuit energized.	1. Disconnect line 40 at control cabinet and make insulation resistance test from wire to ground.
	2. Line 53 grounded.	2. Disconnect line 53 at control cabinet and make insulation resistance test from wire to ground.
	NOTE: If line 3L1 was not installed as a "Neutral" (grounded) conductor these causes do not apply.	
#1 motor does not stop when elevator is above locking bars. Bars do not engage.	1. 17LS is not operating when it contacts its cam.	1. Check that 17LS will stop #1 motor by operating it manually. Adjust switch on cam to allow enough throw on arm to operate time switch.
Elevator levels before locking bars are fully engaged.	1. Locking bar limit switches (9,10,11, and 12LS) are not adjusted to measure fully extended length.	1. If operating cam is mounted on the linkage: Readjust locking bar limit switches, while locking bars are retracted, so they have just enough clearance to operate when bars retract. If operating cam is mounted on the locking bar; adjust limit switches to operate when locking bars are fully extended.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN THE "ELEVATOR DOWN" CIRCUIT

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	No response when "DOWN" button is depressed.	1. Selector switch or associated wiring faulty.	1. Check continuity through switch and wiring. Terminals 11 to 15 (Master Station selected) at cabinet. Terminals 28 to 26 (Elevator Station selected) at cabinet.
		2. Circuit through push buttons is faulty.	2. Check continuity as follows: (At relay control cabinet) Terminals 15 to 4 (Master Up button) Button depressed for test. Terminals 26 to 4 (Elevator Up button) Button depressed for test. Terminals 4 to 12 (Elevator Down button) Terminals 12 to 12A (Master Down button) Terminals 3L2 to 14 (Master "STOP") Terminals 14 to 29 (Elevator "STOP")
		3. 18LS1 contacts not closed.	3. 18LS is operated or stuck in the operated position. Check continuity through 18LS1. Terminals 12A to 3.
		4. 5CR coil burned out or has broken leads.	4. Check continuity through 5CR coil. Terminals 3 to 29. (Disconnect coil at Terminal 3 for this test.)
II	5CR picks up but #1 motor does not start.	1. 17LS on its cam.	1. Check for continuity through 17LS1 contacts. Terminals 53 to 63.
		2. Open circuit to #1 motor.	2. Check continuity as follows: Terminals 11 to 86 - 5CR3 contacts (5CR operated manually) Terminals 86 to 63 - 6CR1 contacts Terminals 53 to 62 - 8CR6 contacts Also check continuity through the normally closed

	TROUBLE	POSSIBLE CAUSES	REMEDIES
II	(Cont'd)	3. Faulty micro switch on timing relay in #1 motor control cabinet.	3. Disconnect micro switch and operate manually while checking with an ohmeter for proper operation.
III	Elevator rises above locking bars but bars do not retract.	1. 5CR4 or 6CR2 contains open.	1. With "DOWN" circuit energized: Check for voltage across the S2B coil. Terminals 43 to 29. If no voltage is present here (43 to 29) check for voltage as follows: Terminals 11 to 64 (5CR4 contacts) Terminals 64 to 43 (6CR2 contacts) Voltage at either of these points indicates open contacts.
		2. S2B coil burned out or open.	2. Check for continuity thru S2B coil line 43 to terminal 29. (Disconnect coil at terminal 43 for this test.)
		3. 4-way valve not shifting because of dirt in pilot assembly. "O" ring seal on pilot spool may be displaced, binding the spool .	3. Remove S2B pilot valve assembly. Disassemble, clean and flush. Replace "O" ring seal if imperfect. Reassemble and test.
		4. Coil grounded.	4. Disconnect S2B coil at terminal 43. Make insulation resistance test from line 43 to ground.
		5. Low control voltage - coil will not overcome spring tension. (This is evidenced by vibrating pilot plunger. Coil will hold if assisted manually and locking bars will operate.)	5. Check that control voltage is a minimum of 110 volts at terminals 3L1 and 3L2. If control voltage is 110 volts or higher and all other causes have been eliminated the spring above the pilot spool may be shortened, but <u>not more than one</u> (1) <u>spiral</u>.
		6. Drain line clogged or closed off, preventing valve from shifting.	6. Make sure the valves on drain lines are wide open and lines are free of any restriction.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
III	(Cont'd)	7. Hand valves in hydraulic lines closed or flow control valve shutting off flow.	7. Check that hand valves are wide open and the flow control valve adjusting screw is turned in (clockwise) as far as it will go.
IV	Elevator rises above locking bars, bars retract; elevator does not lower.	1. One of limit switches (13 - 14 - 15 - 16LS) did not operate.	1. Because these limit switches are wired in series we cannot test each switch from the control cabinet. Terminals 64 to 51 will read continuity thru all of them. Check if these switches have operated by operating them manually.
		2. 6CR relay coil burned out.	2. Check continuity thru 6CR coil. Terminals 51 to 29. (Disconnect coil at terminal 51 for this test.)
		3. 6CR3 contacts did not close.	3. If 6CR has picked up check for voltage across 6CR3 contacts, terminals 11 to 45. Voltage across these terminals indicated open contacts.
V	Elevator lowers very slowly.	1. S4 valve not opening because of burned out coil.	1. Check for continuity thru the coil terminals 45 to 29. (Disconnect coil at terminal 45 for this test.)
		2. Mechanical failure in S4 valve. (Pilot valve assembly).	2. Disassemble S4 valve; clean; replace any worn, broken or bent components, reassemble, adjust and test.
		3. S4 valve out of adjustment.	3. Adjust S3 and S4 valve according to recommended procedure.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
VI	Elevator lowers very rapidly - does not level to pedestals and slams hard.	1. Dirt in S4 pilot orifice.	1. Disassemble S4 valve, clean thoroughly (remove pilot adjusting screw and clean with wire); replace any worn, bent or broken components. Reassemble, adjust and test.
		2. 18LS not operating when elevator nears pedestals.	2. With elevator on pedestals check continuity across terminals 12A to 3. (There should be no reading.) Check visually or operate 18LS while elevator is lowering.
VII	Elevator will not level to floor when - stop button is momentarily depressed in levelling zone.	1. 20LS is not being operated in the leveling zone.	1. Operate 20LS manually to determine if switch is operating properly. Adjust switch or cam to give enough motion to operate switch.
		2. Mechanical failure in S3 valve. (Pilot valve assembly).	2. Disassemble and clean S3 valve. Replace any worn, bent or broken components. Reassemble, adjust, and test.
		3. S3 coil burned out.	3. Check that the coil is producing a magnetic field Check continuity through the coil, terminals 46 to 29. (Disconnect coil at terminal 46 for this test.)
		NOTE: If elevator platform will level onto locking bars or pedestals, S3 valve is working.	
VIII	Elevator "Drifts" 6 inches or more when "STOP" button is depressed.	1. S3 valve closing too slowly.	1. Adjust S3 valve according to recommended procedure.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
IX	#1 motor starts but does not shift to "RUN"; continues to by-pass.	1. Micro switch on motor timing relay did not operate.	1. With equipment energized check continuity on Micro switch terminals on timing relay in #1 motor control cabinet with a voltmeter. There should be no voltage across "Common" and "normally Open" terminals. Voltage here indicates open contacts.
		2. Faulty micro switch.	2. Disconnect wires from micro switch and operate manually. Check for continuity between "Common" and "Normally Open"; also "Common" and "Normally Closed".
		3. Operating linkage out of adjustment.	3. Adjust operating linkage, after checking that micro switch is operating properly, to operate switch near the end of its stroke.
		4. Timing relay out of adjustment (in #1 motor control cabinet.)	4. Adjust timer to allow motor to shift to 100% line voltage at two (2) seconds after motor starts.
X	#1 motor starts and shifts to "RUN" but #1 pump continues to by-pass.	1. S5 or SA1 valve not adjusted properly.	1. Adjust S5 or SA1 according to recommended procedure.
		2. S5, S6 and SA1 coils not energizing.	2. Check for voltage between terminals 40 & 29. If no voltage is present here check for voltage across these terminals in the following order. 87 to 88 (1CR4 contacts) 88 to 68 (2CR4 contacts) 68 to 67 (1MR1 contacts) 67 to 40 (6CR4 contacts) Voltage across any of the above contacts indicates open circuit at this point. (This test must be made with elevator up circuit energized.)
		3. S5 coil burned out or open.	3. Check continuity through S5 coil. (This must be done at the valve by disconnecting the coil.)

TROUBLE	POSSIBLE CAUSES	REMEDIES
X (Cont'd)	4. Mechanical failure in S5.	4. Disassemble S5 valve; clean; replace any worn, broken or bent components; reassemble; adjust and test.
	5. SA1 coil burned out or open.	5. Check continuity thru SA1 coil. (This must be done by disconnecting the coil.)
	6. Mechanical failure in SA1 valve.	6. Disassemble SA1 valve; clean; replace any worn, broken or bent components; reassemble; adjust and test.
	7. Pump failure. Pump will not put out enough pressure to operate elevator.	7. If all other causes have been investigated and eliminated check for pump failure according to the recommended procedure.
XI #1 motor starts and pump by-passes, but when it shifts to "RUN" pressure relief valve opens and continues to chatter.	1. Mechanical failure of S6 valve.	1. Disassemble S6 valve; clean; replace any worn, broken or bent components; reassemble; adjust and test.
	2. S6 valve not adjusted properly.	2. Adjust S6 valve according to recommended procedure.
	3. Burned out or open coil on S6 valve.	3. Check continuity thru S6 coil. (This must be done at the valve by disconnecting the coil.)
XII Pressure relief valve chatters for several seconds only.	1. S5 closing before S6 opens.	1. Speed up opening of S6 or slow down closing of S5.
XIII Elevator rises when "Down" button is depressed. (Elevator below Locking Bars)	1. Locking bar extended, air in locking bar system.	1. Air bleed system according to recommended procedure.
	2. Cups in cylinder by-passing oil.	2. Remove cylinder; repair or replace.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
XIII	(Cont'd)	3. Limit switch not operated.	3. Adjust locking bar limit switches according to recommended procedure.
XIV	Elevator begins lowering before all locking bars have retracted. Platform lowers onto bars that have not retracted.	1. Limit switches 13LS-14LS-15LS-16LS not adjusted properly. Switches do not open when locking bars engage.	1. Adjust locking bar limit switches to operate at both limits of locking bar travel.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN "CONSOLE UP" OPERATION

TROUBLE	POSSIBLE CAUSES	REMEDIES
NOTE: All malfunctions listed in "Doors Open" and "Elevator Up" charts apply to "Console Up" operation. The few malfunctions listed here are peculiar to "Console" operation alone where coupling two operations automatically occurs.		
I Doors open completely and elevator begins to rise. Pressure relief valve opens on #1 pump and continues to chatter.	1. S6 valve - mechanical failure.	1. Disassemble S6 valve and clean thoroughly. Replace any worn, bentor broken components. Reassemble adjust and test.
	2. Check valve sticking closed.	2. Eliminate the possibility of S6 valve failure or maladjustment (Remove piston and pilot assembly if necessary). Check pressure on gauge with #2 pump and motor de-energized and #1 motor running.
	3. Faulty or grounded coil on S6 valve.	3. Check continuity thru S6 coil (at the coil). Disconnect line 40 at the terminal strip and make an insulation resistance test. (This will test S5, S6 and SA1 coils simultaneously). If insulation resistance is below 100,000 ohms the ground will have to be eliminated.
II When the doors reach the fully open position the #1 motor stops for an instant and then starts again.	1. 2TR1 contacts are not holding the #1 motor circuit energized when 1CR drops out and 3CR picks up.	1. Adjust 2TR1 operating linkage to operate switch within the timing stroke.
	2. Faulty micro switch.	2. Disconnect lines 17 and 86 and operate micro switch manually while checking for proper operation with an ohmeter.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
II	(Cont'd) If #2 motor does not start:	3. 2TR coil open or burned out.	3. Check continuity thru 2TR coil. Terminals 93 to 29. (Disconnect coil at terminal 93 for this test.)
		4. 7CR6 contacts not closed.	4. Check for voltage across 7CR6 contacts (circuit energized), terminals 62 to 93. Voltage at these terminals indicates open contacts.
III	Elevator raises above locking bars, bars engage and elevator levels. As soon as it touches the bars it raises again, reaches the top of its stroke and again levels. This continues until the launcher reaches the fully erected position.	1. 2TR1 contacts are not opening when 2TR is de-energized.	1. Readjust 2TR1 operating linkage so contacts will open when 2TR relay is de-energized.
IV	Launcher begins erecting before the doors are completely open.	1. Launcher interlock with doors wired incorrectly.	1. Check that the following connections correspond: Terminal — Douglas Conductor 30 — 1087D 31 — 1088B
		2. Missile Hydraulics turned on.	2. If missile hydraulics are turned on during console operation, elevator action will stop and launcher will begin erecting.
V	Launcher does not stop erecting when "STOP" button is depressed and held.	1. Launcher interlock with doors wired incorrectly.	1. Check that the following connections correspond: Terminal — Douglas Conductor 30 — 1087D 31 — 1088B

	TROUBLE	POSSIBLE CAUSES	REMEDIES
V	(Cont'd)	2. Short circuit in lines to launcher.	2. Disconnect wires at terminals 30 and 31. Check continuity at these terminals. (There should be no continuity at these points.)
VI	No response when launcher elevations switch is moved to "UP" position.	1. Open contacts in control circuit.	1. See that the following is accomplished: a. Selector switch at Master Station on "Console". b. 400 cycle power supply is on. c. D.C. power to launcher is "on". d. Launcher rail limit switches closed (2 switches e. Missile Hydraulics "OFF".
		2. Selector switch or associated wiring faulty.	2. Check continuity thru switch and wiring at control cabinet, terminals 17 to 17A.
VII	#1 Motor starts and elevator begins rising as soon as selector switch is moved to "Console" position. (Doors remain closed and elevator continues to rise.)	1. 2TR1 contacts did not open when 2TR was de-energized. Operating linkage out of adjustment.	1. Adjust 2TR1 operating linkage to operate switch within the timing stroke rather than at the very beginning of the stroke.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN "CONSOLE DOWN" OPERATION

TROUBLE	POSSIBLE CAUSES	REMEDIES
NOTE: All malfunctions in "Elevator Down" and "Doors Close" apply to "Console Down" operation. The few malfunctions listed here are peculiar to "Console" operation alone where coupling two operations occurs automatically.		
I. Elevator rises off locking bars, locking bars retract and elevator lowers but #1 motor stops for an instant as elevator nears pedestals, then restarts.	1. 18LS was contacted before 21LS was operated.	1. Adjust 21LS to allow it to operate before 18LS operates when elevator is lowering.
II Doors begin closing before launcher reaches horizontal position.	1. Jumper wire between terminals 44 and 44A. 2. Launcher limit switch connected incorrectly in relay control cabinet. 3. Launcher limit switch stuck in the operated position.	1. Remove jumper wire. 2. Check with Douglas publications for correct wiring to Cutler-Hammer control system. 3. Correct deficiency and lubricate switch with DC-4 Silicone grease.
III Launcher does not stop when "STOP" button is depressed and held.	1. Launcher interlock with doors wired incorrectly.	1. Check that the following connections correspond: Terminal — Douglas Conductor 30 — 1087D

	TROUBLE	POSSIBLE CAUSES	REMEDIES
III	(Cont'd)	2. Short circuit in lines to launcher.	2. Disconnect wires at terminals 30 and 31. Check continuity at these terminals. (There should be no continuity at these points).
IV	No response when launcher elevation switch is moved to "UP" position.	1. Circuit is not completed to control circuit.	1. See that the following is accomplished: a. Selector switch at Master Station on "Console". b. 400 cycle power supply is on. c. D.C. power to launcher "On". d. Launcher rail limit switches closed (2 switches). e. Missile Hydraulics "OFF".
		2. Selector switch or associated wiring faulty.	2. Check continuity thru switch and wiring at control cabinet, terminals 17 to 17A.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN CIRCUIT RELAYS

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	Contacts will not operate and remain in their normal position or make no contact at all.	1. Contacts or contact spring plate out of place.	1. Remove movable contact assembly and inspect to see that components have not been bent or damaged. Re-install, making sure contacts make and break properly before installing insulating cover.
		2. Insulating cover not installed correctly.	2. Be sure that insulating cover is under latches & pushed back far enough to slip into place.
		3. Contact bar pin not engaging armature lever.	3. Upon reassembly, operate relay manually to insure that pin on contact bar has engaged armature lever correctly and relay operates freely.
II	Relay chatters or hums loudly when energized.	1. Dirt, rust or foreign matter in air gap between armature and pole piece.	1. Remove armature assembly. Remove any rust or foreign matter from pole pieces and armature. Reassemble and test.
		2. Broken shading coil.	2. Remove armature assembly and inspect shading coil for a break or crack. Remove faulty shading coil and replace.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE IN TIMING RELAYS

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	Timing period is inconsistant. Timing period increases but never is less than what relay is adjusted for.	1. Dirt, dust or moisture in micrometer adjusting screw orfice.	1. Remove diaphram cover and disassembly timing adjusting screw components. Clean orfices, adjusting screw and fricition spring with safety solvent. Wipe clean and dry thoroughly. Reassemble, adjust and test. (Use no lubricant on any part of timing relay.)
II	Relay cannot be adjusted to give any time delay. Switches operate as soon as relay is energized.	1. Check valve sticking in the open position. Dirt, rust or corrosion in check valve of diaphram.	1. Remove diaphram and check valve assembly. Wash in safety solvent. Dry thoroughly with low pressure compressed air. Reassemble, adjust and test. (Use no lubricant on any part of timing relay.)
		2. Ruptured diaphram.	2. Remove timing relay; disassemble; replace diaphram assembly; assemble adjust and test.
III	Timing stroke can be adjusted to give normal time delay before switches operate, but relay does not have the instantaneous reset feature; diaphram is very slow returning to its normal position, or may not reset at all.	1. Check valve sticking in the closed position. Dirt, rust or corrosion in check valve of diaphram.	1. Remove diaphram and check valve assembly. Wash in safety solvent. Dry thoroughly with low pressure compressed air. Reassemble, adjust and test. (Use no lubricant on any part of timing relay.) Note: If relay does not operate properly after cleaning check valve assembly the diaphram must be replaced.
IV	Diaphram returns to its normal position but switches do not reset.	1. Operating linkage out of adjustment.	1. Adjust operating linkage to activate switch within the timed stroke.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE WITH LIMIT SWITCHES

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	Limit switch remains in the operated position.	1. Actuating assembly binding (was once forced beyond the normal limit of travel.)	1. Remove operating head, disassemble, and clean thoroughly with safety solvent. Remove any burrs from bearing surface of bearing block, shaft assembly and stops. Lubricate all bearing surfaces with a light coating of 130AA lubriplate. Reassemble, adjust and test.
II	Limit switch is not being operated. Contacts remain in their normal position.	1. Screw that holds key-pin washer loosens to the point where arm cannot actuate the switch.	1. Adjust the lever arm to its proper position; install key-pin washer and retaining screw; tighten securely.
III	Switch does not have "snap" action on "make" and "break" of contacts. (Only one Pair of contacts may be operating.)	1. Accumulation of moisture or water in switch at one time.	1. Remove movable contact assembly and dry all components of switch thoroughly with compressed air. Lubricate all bearing surfaces and pivot points with light machine oil. Reassemble and test.
IV	Limit switch has no control over the circuit; circuit cannot be opened.	1. Water in limit switch enclosure shorting out the contacts.	1. Remove moveable contact assembly and dry all components of switch thoroughly with compressed air. Lubricate all bearing surfaces and pivot points with light machine oil. Reassemble and test. Investigage conduit and fittings to determine where water entered piping. Eliminate the possibility.
		2. Wires to limit switches "grounded" or "shorted" because flexible conduit comes out of its fitting and cuts thru the insulation on the conductors.	2. Re-insulate wires. Replace if they have been nicked or weakened. Install flexible conduit in fitting and tighten securely.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE WITH TWO-WAY SOLENOID VALVES

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	Erratic valve action (speed of opening and closing inconsistant).	1. Loose disc screw.	1. Tighten securely. (use as a tool for tightening: Flat Steel Stock 6 x 1½" x 3/32").
		2. Dirt in valve.	2. Disassemble and clean throughly.
		3. Piston rings aligned, allowing pressure to by-pass.	3. Upon reassembly of valve, make sure the piston ring openings are staggered about the circumference and work freely in their grooves.
		4. Armature binding on shaft of pilot valve assembly.	4. Be sure the armature (sliding, fluted metal slug) slides freely on pilot valve assembly).
II	Valve adjustment very critical.	1. Peened pilot valve seat screw.	1. Replace with stainless steel type.
		2. Piston rings aligned, allowing pressure to by-pass.	2. Upon reassembly of valve, make sure the piston ring openings are staggered about the circumference and work freely in their grooves.
III	Valve will not open.	1. Cap on pilot valve assembly broken off. (Normally closed valves only).	1. Replace pilot valve assembly.
		2. Armature binding on shaft of pilot valve assembly.	2. Replace pilot valve assembly.
		3. Pilot adjustable orfice open too wide. (Beyond operating range of valve.)	3. Adjust valve according to recommended procedure.
IV	Valve will not close.	1. Bent pilot valve assembly. (Normally Open valves only.)	1. Replace seat screw with stainless steel type and replace pilot valve assembly.

	TROUBLE	POSSIBLE CAUSES	REMEDIES
IV	(Cont'd)	2. Bent pilot valve spring. (Normally Open valves only.)	2. Replace spring. Be sure the spring is installed over the shoulder or guides when reassembling valve.
		3. Guides on stainless steel seat screw bent.	3. Replace seat screw.
		4. Bent housing on cylinder cap.	4. Straighten if possible or replace cylinder cap.
V	Valve will not hold pressure.	1. Ruptured disc.	1. Replace disc.
		2. Piston rings aligned, allowing pressure to by-pass.	2. Upon reassembly of valve, make sure the piston ring openings are staggered about the circumference and work freely in their grooves.
VI	Valve cannot be adjusted to open wide enough; even when adjusting screw is seated.	1. Adjusting screw not closing off pilot orfice enough.	1. Replace pilot adjusting screw.

THE FOLLOWING CHART IS OUTLINED FOR TROUBLE WITH 4-WAY VALVES

	TROUBLE	POSSIBLE CAUSES	REMEDIES
I	Valve does not shift when energized. (Pressure relief valve opens in the case of door operation.)	1. Dirt in pilot assembly.	1. Remove pilot assembly. Disassemble, clean and flush.
		2. Displaced "O" ring on pilot spool.	2. Replace "O" ring seal.
		3. Coil grounded; "Leaking" voltage to ground.	3. Disconnect coil at terminal block in control relay cabinet and make insulation resistance test from this wire to ground. Coil — Terminal S1A — 38A S1B — 39A S2A — 42 S2B — 43
		4. Low control voltage.	4. Check that control voltage is a minimum of 110 volts at terminals 3L1 and 3L2 in control relay cabinet.
		5. Drain lines clogged or closed off.	5. Check that the valves on the drain lines are wide open and lines are free of any restriction.
		6. Coil will not overcome pilot valve spring tension.	6. If control voltage is 110 volts or higher at 3L1 and 3L2 terminals and all other causes have been eliminated, the spring above the pilot spool may be shortened; <u>but not more than one spiral</u>.
II	Oil leaks from solenoid housing.	1. Faulty "O" ring on pilot spool.	1. Remove pilot assembly. Disassemble, clean and flush. Replace "O" ring seal. Reassemble and test.