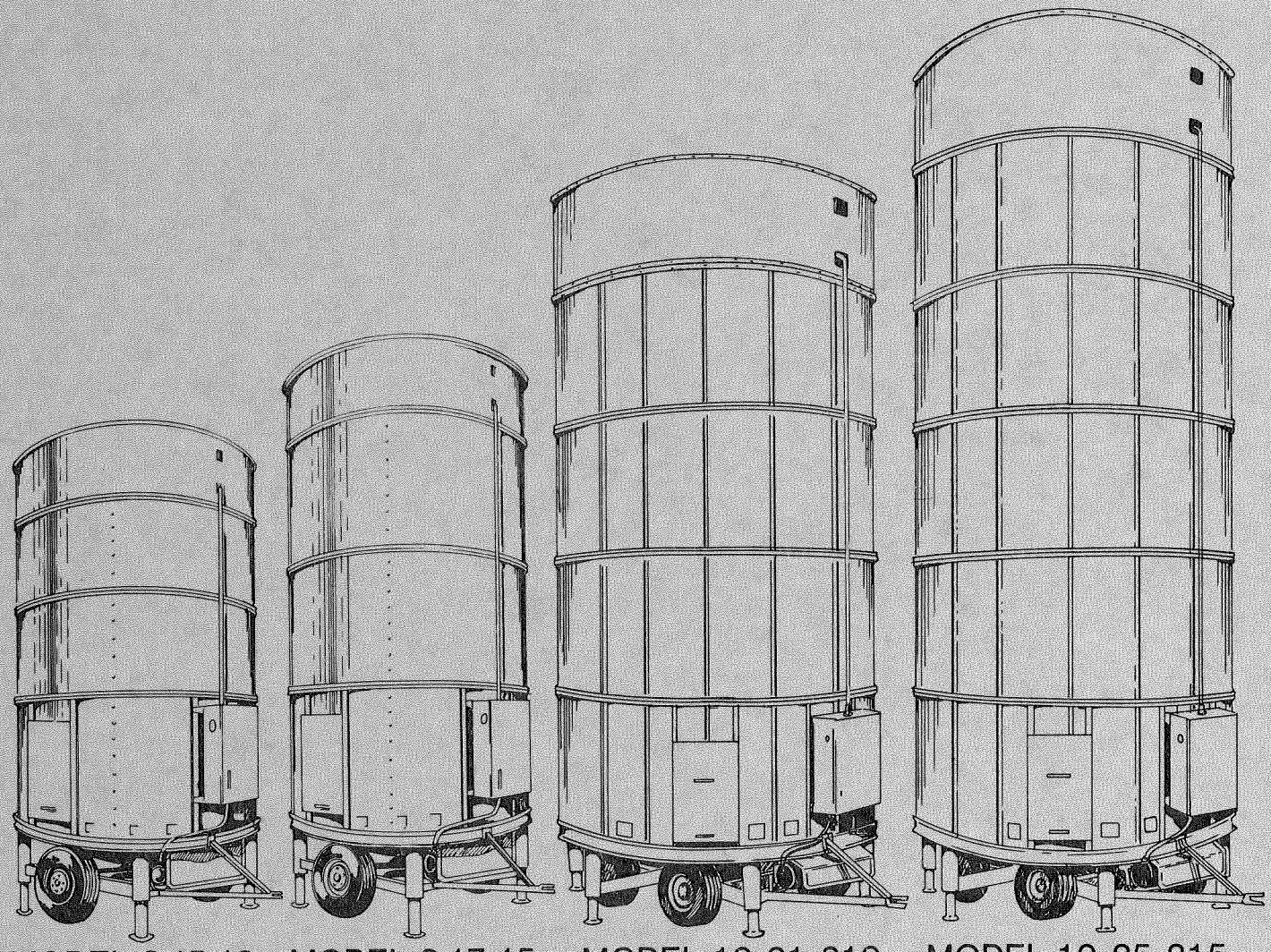
BUTLER®

KAN-SUN®

CONTINUOUS FLOW GRAIN DRYER

SERVICE MANUAL



MODEL 8-15-10 MODEL 8-17-15 MODEL 10-21-210 MODEL 10-25-215

BUTLER®

BUTLER MANUFACTURING COMPANY

AGRI-PRODUCTS DIV., 7400 EAST 13TH STREET, KANSAS CITY, MO. 64126

FORM NO. 439280-R—6/78

PRINTED IN U.S.A.

INTRODUCTION

This KAN-SUN service manual is intended to be a supplement to the owner's manual and should be used in conjunction with it. The trouble shooting guide in the owner's manual helps identify the area of trouble. This manual gives specific checkout procedures for individual parts or systems. All wiring diagrams are in the owner's manual.

The following test equipment is needed:
Model 80 Tester
Volt Ohm Meter (1 megohm impedence or higher)
Fused Jumper Wire

Always disconnect power supply to the dryer before making alterations on the control panel or other parts of the dryer. When checks must be made on a live panel (voltage checks), be sure to wear dry, well insulated footwear and keep hands well away from all wire connections, terminal strips or any power conducting part of the panel. It is best to use a meter with alligator type leads which can be attached to the "cold" connections before power is turned on for the checkout.

Always be sure that no one has entered the dryer before turning power on and making operational checks.

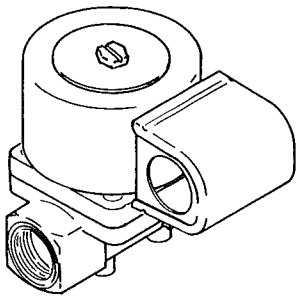
Always be careful to not break LP gas connections or tubing, as escaping LP can very seriously damage human tissue.

Always be sure that the dryer is properly grounded (to a driven ground) before attempting to service it.

On 10' units there are two controllers, one for each burner. Each one creates its own spark, but as the gas supply must be common, the gas valve power from circuit 1 is the input power to circuit 2 so that both must work or neither one will. The second circuit also has an ignitor neon lamp to show it is functioning.

After 3 tries for ignition the reset button will pop out to protect the circuit until the ignition problem is resolved.

A monitor may be tested in place with a Model 80 tester.



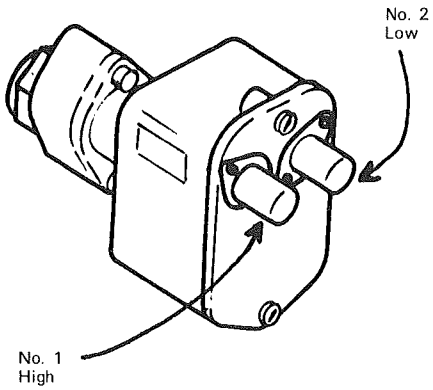
SOLENOID VALVES:

Electromagnetic gas valves control the fuel flow. The normally closed valves are powered by the flame controller. On natural gas units, four valves are required and are operated by a slave relay signalled by the flame controller.

Solenoid travel may be checked with the fan and meter motors shut off and the gas shut off. With the control switch in operate, place a fused (1 amp) jumper between PC 6 & 21 on 8' or PC 5 & 21 on 10'. This will cause the solenoids to bang when the switch is moved to start-up. A magnetic pull can also be felt on a screwdriver laid on top of the solenoid cover.

The solenoid may be disassembled for cleaning or repair. See parts section of owners manual.

HYDROSTATIC PRESSURE SWITCH:

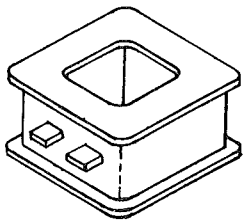


An electro-hydraulic switch that shuts off the machine if hydraulic pressure to discharge grain becomes too high (blockage) or too low (broken belt). Normal operation should be above 100 psi and below 1000 psi. Due to switch R_1, (see schematic) the high pressure switch is always functional, but low pressure is acknowledged only in the "operate" mode. Adjustment: Remove front shield and shift box cover. With the dryer operating in **start up** and **manual moisture control,** turn the low pressure screw (#2 on right) clockwise two turns and remove R3 Relay. Manually decrease the metering system speed until the discharge system is in neutral. Turn low pressure screw counter clockwise until metering motor stops. Repeat above to confirm setting. Dryer should shut down within ten seconds of drive stop when operating normally in "operate."

To test the high pressure switch, install the startup-operate relay. One side of the meter motor auxiliary switch should have 115 volts to ground with the meter motor "off."

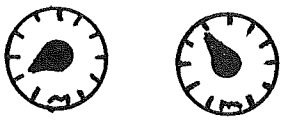
COIL:

A wound coil creates magnetic force to close the motor contactors. Power hooked directly to the coil should energize the contactor.



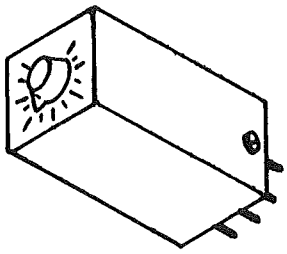
DELAY RELAY: (Replaces 6 and 60 Second Timers)

An adjustable delay timer is used for two functions. One timer is set for 15 ± 1 seconds to give a purge of air in the dryer to prevent explosion of any accumulated gas upon ignition.



6 Sec. 15 Sec.
EAGLE SIGNAL EXAMPLE

A second timer is used on 10' dryers to delay the start of the second fan to prevent electrical overload. It is set for 6 ± 1 seconds. Either one may be tested in the model 30 or 80 tester. The number two fan neon lamp will indicate operation of a timer used in the number two fan socket.

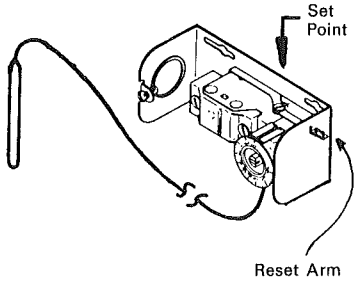


A purge timer will show 115 volts to ground from P.C. 3 (8'), P.C. 1 (10') when activated.

Repair is limited to resoldering of loose wires or components.

HIGH LIMIT SWITCH:

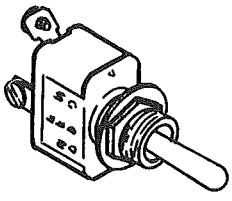
A capillary bulb temperature sensor will shut off the burner circuit if the plenum exceeds a preset temperature. If power goes thru the high limit switch, it will light the high limit lamp indicating power is available to the ignition controllers. If the temperature exceeds the high limit setting during startup, the limit switch will open, shutting off gas and ignition. After lowering the gas pressure the unit will restart without purge by pushing the high limit reset arm.



The plenum sensing bulb must be pointed down in the plenum.

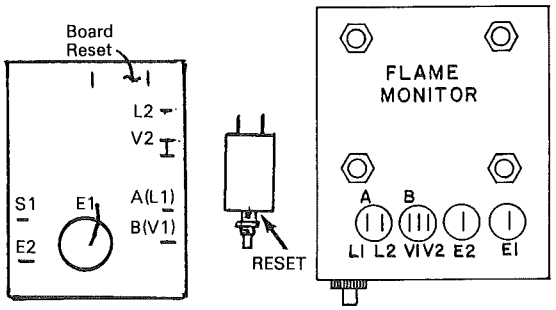
BURNER SWITCH:

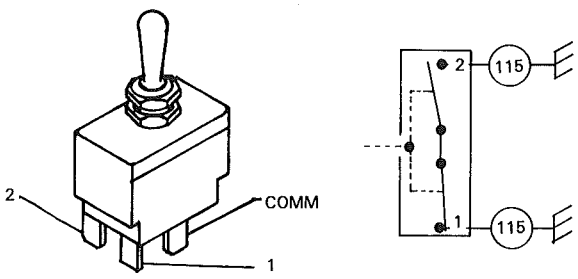
Switch controls all the burner circuits, **only if** the fan motor contactor is closed, which closes the fan motor auxiliary. With switch "on" a voltmeter should read 115V to ground at either terminal.

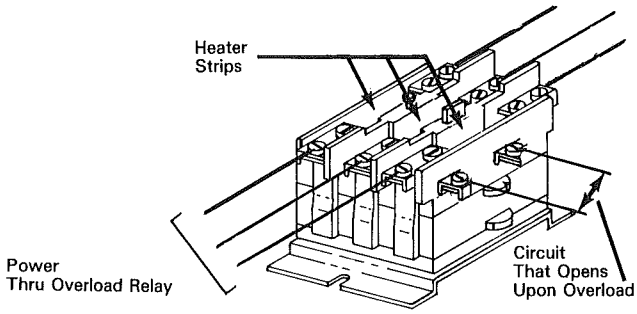


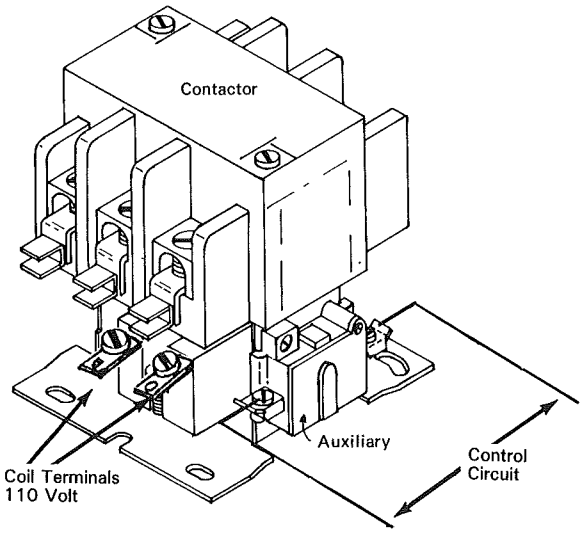
FLAME MONITOR CONTROL:

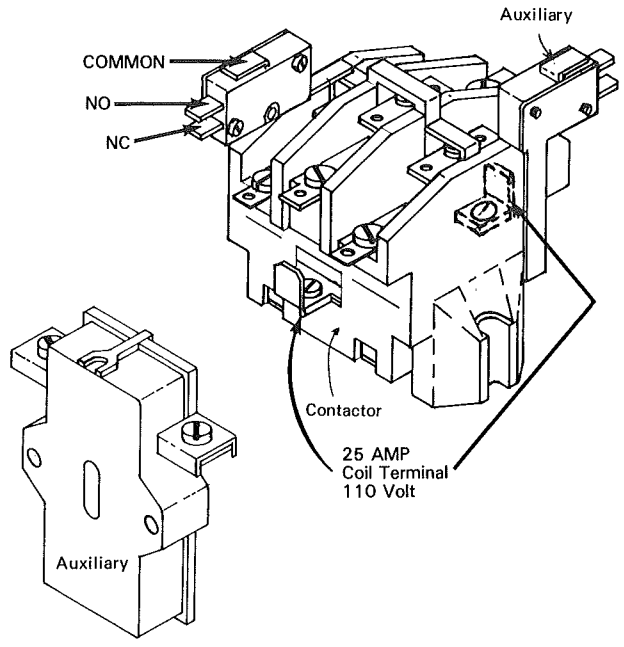
A solid state electronic circuit controls the ignition spark and gas supply. It automatically tries to create ignition and will shut off if flame is not achieved within 9 to 11 seconds. During operation it constantly monitors the flame and will try to relight if the flame goes out momentarily. When it is functioning, the ignitor neon lamp will be lit.











Models with toggle start switches have same function, check with volt meter. Terminal 2 should show 115V to ground when switch is in start position. Terminal 1 should show 115V to ground in run.

OVERLOAD RELAYS:

Single or Multipole mechanical switches attached or adjacent to devices that are sensitive to electrical heating. These switches automatically open if a continued excessive current load exists. They open up the contactor coil circuit and disengage the contactor. These may be disconnected and checked for continuity or checked for voltage to ground using a volt ohm meter. Unexplained nuisance trips may require installation of one size larger heater strips as shown in the parts section.

MAGNETIC CONTACTORS:

Electromagnetic operated contactors control power to motors. Operation is obvious by an audible engagement. An engaged contactor should show voltage to ground from L_1 & T_1; L_2 & T_2, etc. Repair kits for contact points are listed in parts.

AUXILIARY SWITCHES:

Fan and metering motor contactors each have a self contained contact set to maintain an engaged condition. These contacts also serve as elements in the burner and moisture control circuits to shut the unit down automatically in case of fan or metering problems.

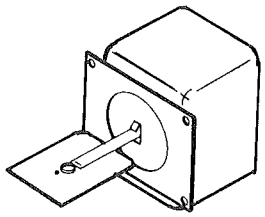
On pushbutton units: check motor auxiliary contacts for voltage to ground on both terminals with appropriate stop and start buttons both depressed.

On toggle switch units: remove and isolate run wire from switch, then check for voltage to ground on both auxiliary terminals with switch held in start position.

Auxiliaries on 25 Amp Contactor operate opposite to their terminal labels due to method of movement. For a normally open circuit attach to common and normally closed terminals.

To test the low pressure switch, remove the relay then push and hold the meter motor start button for 10 seconds. If the motor stops when the switch is released, the low pressure switch failed to close. Reduce the setting and retry if motor stops.

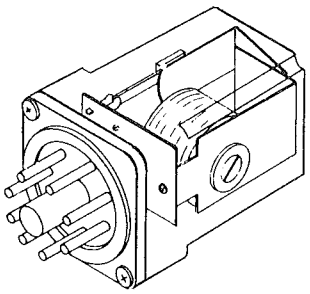
AIR SWITCH:



An air powered switch (2 on 10' units) is operated by air movement from the fan. This switch insures fan operation before the burner will ignite. An internal micro switch wired normally open may be checked with a continuity meter. Switch arm has formed metal stops that may require adjustment (bending) to allow full travel. In addition, an internal spring may be adjusted to increase or decrease force required to move paddle. Arm should have at least 1/16" clearance at metal stop when switch action occurs.

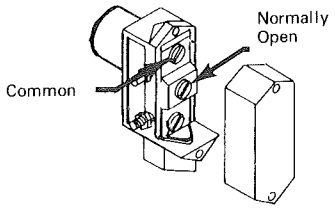
Neon lamps indicate switch is closed when operating.

STARTUP OPERATE RELAY:



The startup operate relay is a 10 amp DPDT magnetic relay controlled by the start up-operate switch to engage all safety interlocks. The operate section may not be used until all parts of the dryer are functioning properly. As shown in the schematic, every switch from the burner control thru the low bin sensor must be closed for the relay coil to be powered. The relay may be tested in the Model 30 or 80 tester.

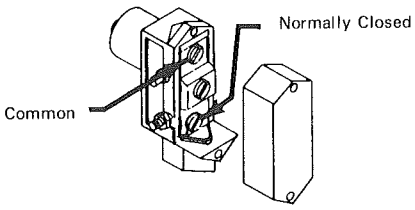
LOW BIN SWITCH:



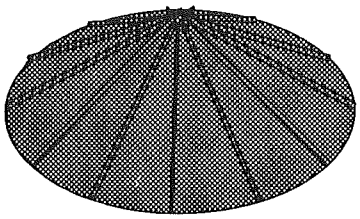
Grain pressure in the holding bin holds this normally open micro switch closed to allow operation in the "operate" mode. If grain drops below the switch the dryer will shut off in "operate." If power goes thru this switch the low bin neon will be lit when the metering motor is on.

The switch may be adjusted in and out with the slotted mounting bracket. It should be positioned so grain level above the diaphram will cause the contacts to close while grain level below the diaphram allows it to remain open. An operating schematic is shown with the Electrical Requirements Page.

BIN FILL SWITCH:

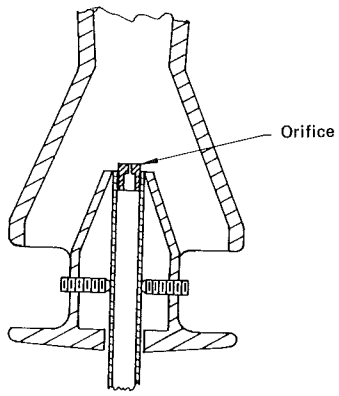


The top diaphram actuated switch located on the holding bin wall is to control an auxiliary contactor (not supplied) to operate a fill auger. Grain pressure will open a normally closed micro switch to stop filling. It may be adjusted in mounting slots to improve operation. An operating schematic is shown with the Electrical Requirements Page.



PERFORATED ROOF:

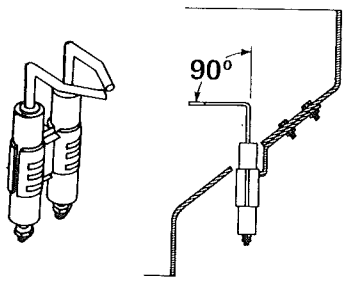
The perforated roof cone allows additional exposure to heated air when cover plates are removed. See specific grain drying instructions about removal.



BURNER:

The gun type burner has an adjustable air inlet for primary combustion air. The air gap may be adjusted up to 1/4" open (normal 3/16") to give a blue flame with yellow tips. Standard LP gas units are shipped with a 3/16" orifice installed. Natural gas units use no orifice but a conversion orifice is shipped loose for LP use. To install or remove an orifice without disassembling (76 and later) use a 5/16 hex Allen socket with a long extension to unscrew the orifice. On older machines with a knurled orifice, the burner casting must be slid down the vertical gas line until the orifice is exposed.

Carbon build up in the flared unit above the burner casting is due to insufficient air for combusion. Clean and/or readjust the metal burner baffle on the low end of the casting.

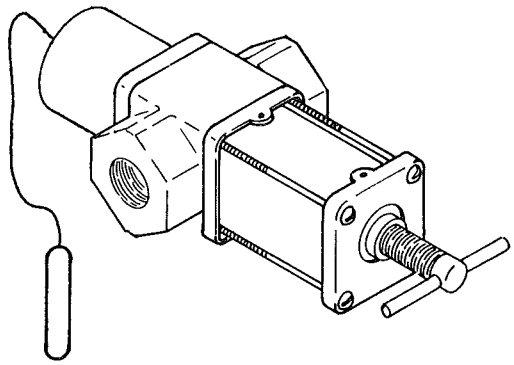


ELECTRODES:

Ignition (and flame detection) probes ignite the fuel and monitor the flame. The electrodes should be gapped 1/8" (± 1/32") and clean of carbon. Cracked ceramic on the probes may cause arcing.

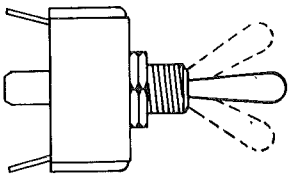
MODULATING VALVE:

The modulating valve is installed between the regulator and burner to aid in maintaining a constant drying temperature during ambient changes. A sensing bulb in the plenum chamber senses temperature changes and varies fuel flow accordingly (bulb must be pointed down). An exploded view is shown in the owners manual to aid in cleaning or repairing the unit.



INCREASE DECREASE SWITCH:

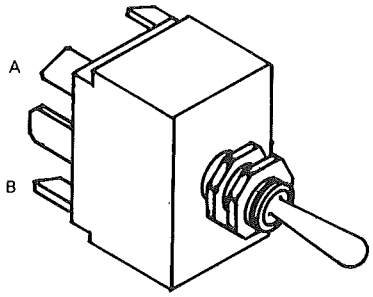
A SPDT spring loaded, center off switch used to manually position the shift assembly. Check switch action with the dryer powered in startup. The center must always show 115 volts to ground. Either side must show 115 volts to ground when that side is activated.



MANUAL/AUTOMATIC SWITCH:

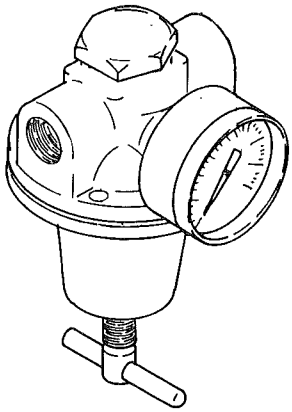
A 2PDT switch to set the moisture control system for manual or automatic control. Contacts should be checked with a volt meter.

115 volts at A terminals in manual position.
115 volts at B terminals in automatic position.



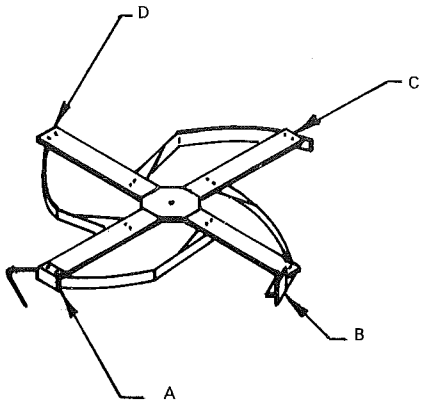
PRESSURE REGULATOR:

The pressure regulator maintains a steady fuel pressure into the modulating valve. A dial type pressure gauge indicates regulator outlet pressure only when the gas solenoid valves are open. An exploded view is shown in the owners manual to aid in cleaning or repairing the unit.



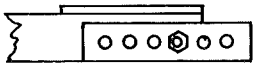
SWEEP ASSEMBLY:

The sweep assembly moves dried grain from the outer edge of the dryer to the center sump for discharge. The gear box supporting the assembly must be centered with respect to the lower edge of the inner perforated walls. The sweep arms must travel parallel to the lower edge of the inner wall without binding on the floor. Leveling is accomplished by shimming the gear box or individual sweep arms at the center bolting plate. End plates should be positioned as shown.

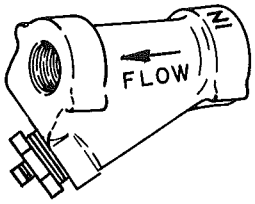



A


B


C


D



GAS STRAINER:

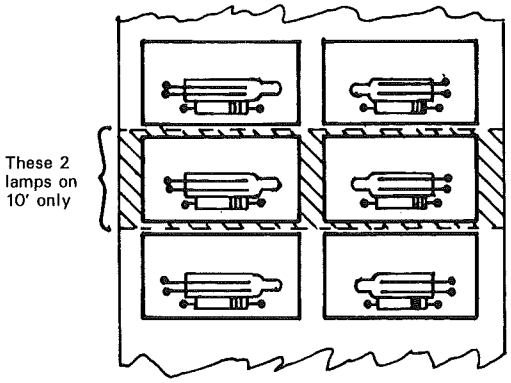
A Y-type strainer is used on each dryer to prevent large particles from entering the pressure regulator. Scale from supply piping and tank may plug the strainer especially if a tank with a bottom fitting is used. Frequent blockage of the strainer indicates a need for a new line and/or tank or a very large strainer near the tank. Blockage in a strainer is often evident by frost buildup or an extremely cool point in an otherwise normal line.

FUNCTION LAMPS:

Small clear neon lamps (4 on 8', 6 on 10') on the burner printed circuit board indicate the operation of various components.

The air lamps indicate sail switches are activated by the fans.

The high limit lamp indicates power thru the high limit switch.



The ignitor lamps indicate output of the ignition controller B (or V1) terminal. On an 8' unit this indicates gas valve power. On a 10' unit, ignitor #1 lamp indicates power is supplied for the input of #2. Ignitor #2 lamp indicates the second controller is supplying power for the gas valves. The lamps will not indicate whether ignition spark is being supplied.

The low bin lamp indicates the holding bin is filled with grain. It lights only when the metering system is operating.

The lamps have no effect on system operation.

Operating sequence of these lamps is very important when discussing operation by telephone.

HYDROSTATIC TRANSMISSION:

A variable stroke hydraulic pump drives a fixed stroke hydraulic motor which powers the discharge system. The pump stroke is varied to change discharge speed.

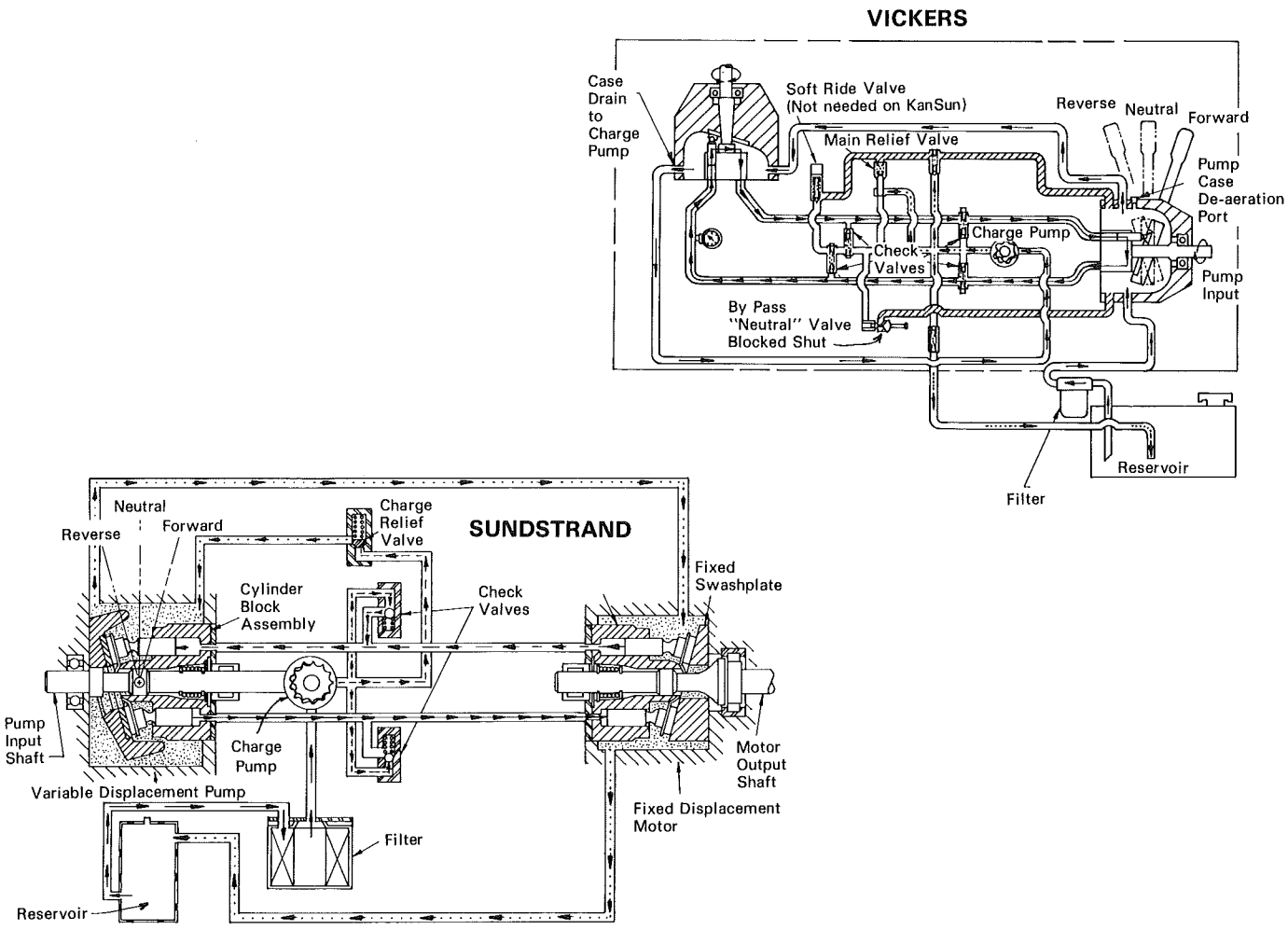
Pre 1976 models used a Vickers combined pump-motor transmission while later units have a two piece Sundstrand transmission.

Proper service intervals and lubricants are listed under seasonal maintenance. The Vickers oil reservoir should be full to the fill hose fitting during operation. The Sundstrand oil level should be 2-3/4" to 3" below the top of the filler neck. It requires 6 quarts of oil.

Problems beyond those covered in the two following pages are probably beyond normal field repair and attempts to repair may cause further damage and loss of warranty. Contact the Butler Service Department for further service needs.

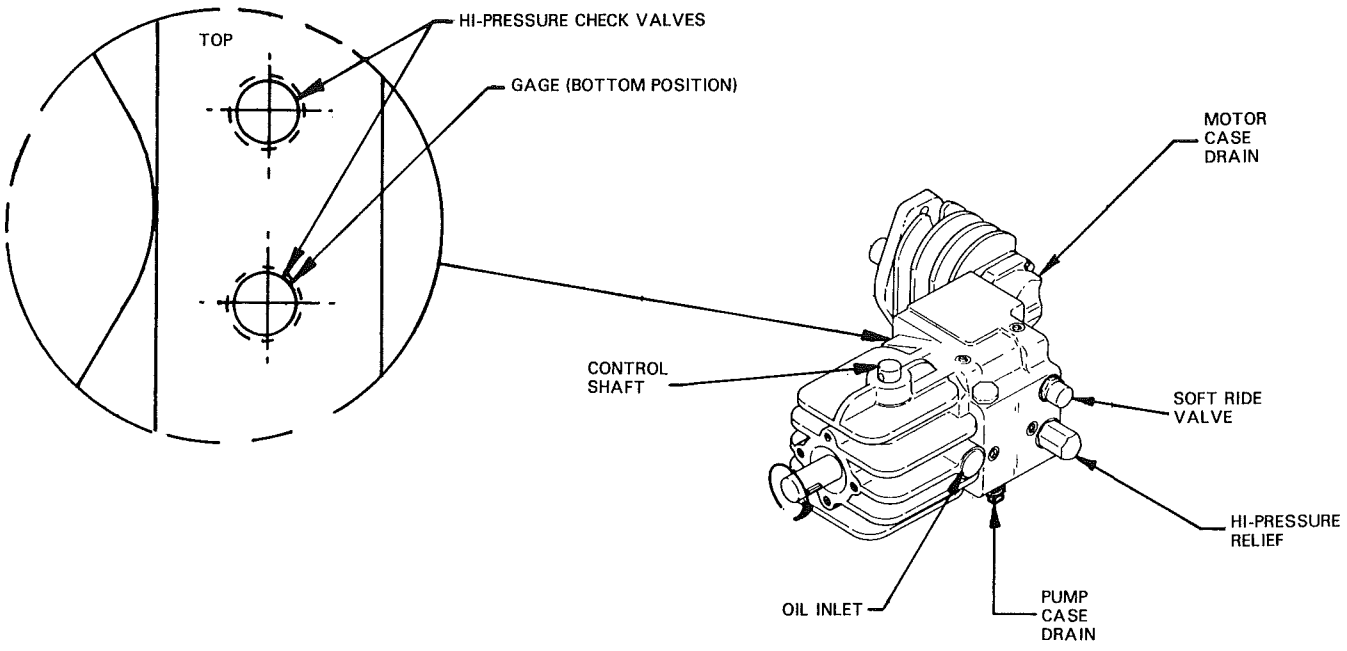
Sundstrand will not accept direct business with the end customer. Parts returned for warranty and/or repair work must be accompanied by return authorization from Sundstrand through Butler. These arrangements should be made through the Butler dealer and Area Sales Representative.

Vickers has phased out production of the T66 transmission. They have a transmission repair service that will rebuild units if they still stock the necessary parts. An estimate can be requested. Fully rebuilt transmissions carry a new warranty. Send a purchase order and transmission to Vickers Division, Unit Repair, 350 North York Rd., Bensonville, Illinois 60106, (312) 595-4680.



VICKERS TROUBLE SHOOTING

PROBLEM	CAUSE	CHECK
1. 0 gauge pressure, unit will not run forward or reverse.	A. Low Oil	A. Oil Level
	B. Air in line	B. Fill all parts and lines or pump into filter until oil flows out of check port on tank.
	C. Charge Pump lost Prime	C. Prime from motor to charge pump
	D. Pump running in reverse.	D. Check 5 H.P. metering motor for CCW rotation from shaft end.
	E. Soft ride valve stuck open.	E. Remove 7/8 plug on front of unit. Remove and discard orifice wire in Poppet Sub Assy. We do not use the soft ride feature.
2. 50 PSI gauge pressure. Unit won't run in reverse.	A. Replenishing check valve stuck open.	A. Remove check valves under 1/4 inch set screws on top and bottom of the pump block. Check for contamination in valve.
	B. High pressure check valve stuck open.	B. Remove 5/16 set screw just above where the pressure gauge connects to the unit to expose valve seat. This seat is removed with a 1/4 inch hex wrench. Check for contaimination on valve seat and free movement of pin inside Poppet.
3. Unit will not start under load unless returned to neutral.	A. Soft ride valve stuck open.	A. Remove 7/8 plug on front of unit. Discard orifice wire in Poppet sub assy. We do not use the soft ride feature.



SUNDSTRAND TROUBLE SHOOTING

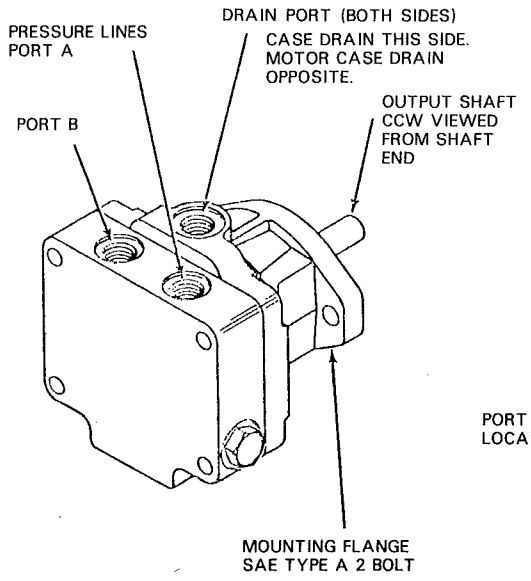
PROBLEM	CAUSE	CHECK
1. 0 gauge pressure unit will not run in reverse	A. Low Oil	A. Oil level
	B. Air in line.	B. 1. Crack inlet line from filter to pump and bleed off air. 2. Crack highest joint or motor.
	C. Pump running in reverse.	C. Check Electric motor rotation. Should be counterclockwise from shaft end.
2. 90 PSI gauge pressure *unit will not run in reverse	A. Charge check valve stuck open.	A. Remove slotted head cap screws from end of pump. Check for contamination under steel balls.
3. Unit will not run forward or reverse. 0 charge pressure — Should have 90 to 180 PSI.	A. Charge relief valve stuck open.	A. Remove 5/8 cap screw located by the control shaft. Inspect Poppet for contamination.

Note 1. Reversing the Hydrostatic will sometimes free stuck valves.

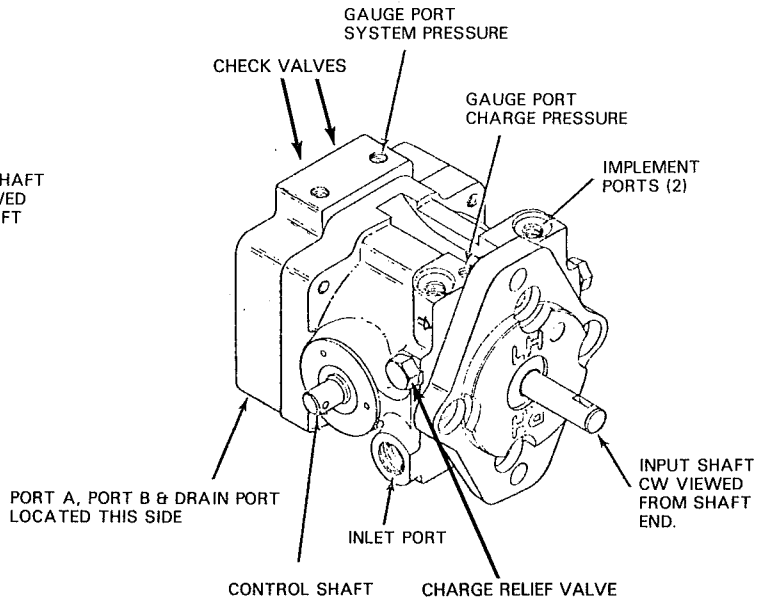
*To run unit in reverse:

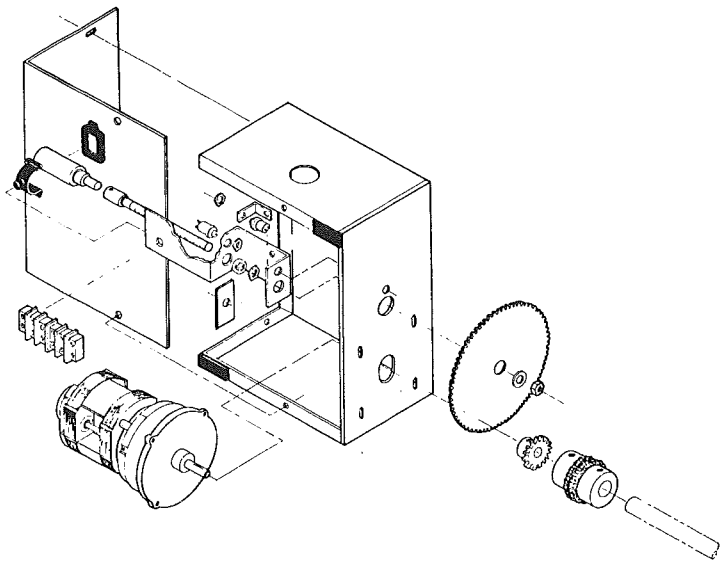
1. Disconnect drive to prevent damage.
2. Move shifting arm to the right past neutral to reverse.

MOTOR



PUMP





SHIFTING ASSEMBLY:

A forward-reverse motor controlled by the moisture control circuit adjusts the stroke of the hydrostatic pump. As the stroke is changed, a servo potentiometer is adjusted to balance the thermistor resistance to the control panel setting. Normally closed micro switches limit the travel in either direction by interrupting the motor circuit.

The shift assembly should position the hydrostatic pump in neutral (no rotation) just before the travel limit switch shuts off the shift motor and about two turns before the shaft mounted potentiometer reaches the end of its rotation. See the next page for adjustment procedure.

MOISTURE CONTROL BOARD: (STRUTHERS DUNN)

The moisture control board is a printed circuit board to switch the shift motor for discharge rate changes. Two triacs (solid state switches) on the board provide switching action while the resistors and capacitors protect the triacs from voltage peaks during switching. Direct substitution with a known good circuit board is a fast way to checkout a suspect unit. Any exam should be in conjunction with the null relay.

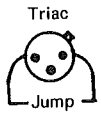
Malfunctions are generally of the following varities: poor pin connections to the null relay, broken solder joints, failed triacs, or broken components.

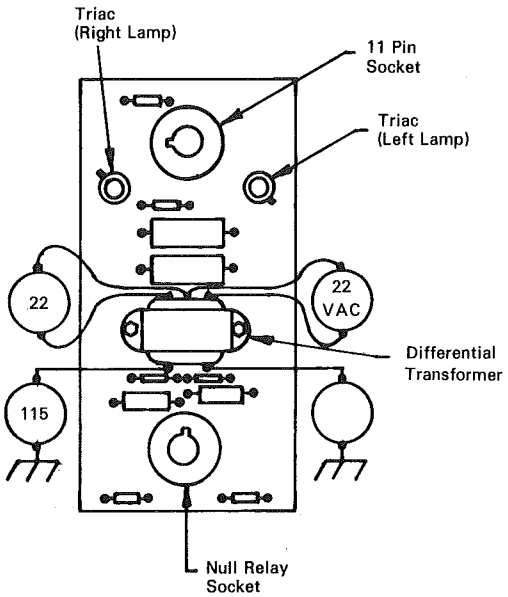
Pin connections may be tightened by springing the elements of the socket together with a pick or knife blade while the power is off.

Broken solder joints may be seen under a lamp while wiggling various components. These may be easily resoldered preventing intermittant problems.

Failed triacs, resistors, or capacitors may be replaced if an available electronics supply house can match them. Parts may also be used from scrap boards.

Moisture board tests in the Model 80 tester require use of a known good null relay which may be stored in the tester's "Null storage" socket. Install only the moisture board and 11 pin plug. Switch main power "ON." If either lamp and the motor turns on, the board has a failed closed triac. If the left lamp is on, the triac (3/8" diameter steel or plastic 'can') toward the hinge side of the test box is defective. The right lamp indicates the front triac is defective.





SHIFT ASSEMBLY ADJUSTMENT

Vickers

1. Disconnect chain.
2. Manually (with increase-decrease switch) shift to minimum pump pressure and zero output shaft rotation. Feel pump for good neutral.
3. Disconnect power.
4. Adjust swivel linkage so pointer is neutral.
5. Disconnect screw terminal end of gray wire that runs from left limit switch (one with red wire).
6. Attach continuity meter to red wire terminal of switch and gray wire just disconnected. Switch should show closed.
7. Slowly turn larger chain sprocket by hand CW (from outside box) till meter shows switch open.
8. Remove meter.
9. Reattach chain, oil and adjust tension by sliding motor.
10. Reattach gray wire.
11. Turn chain drive assembly CCW (from outside box) till potentiometer set screw appears. Note amount shaft is turned.
12. Loosen set screw and unsnap pot. holder.
13. Turn pot. shaft fully CW, then back up two turns, plus that noted in step 11.
14. Remount.
15. Tighten set screw.

    Examine hydro shifter arm for looseness at pump control input shaft. If loose, remove 1/4" diameter machine screw and install 1/4" x 1" drive pin.

Sundstrand

1. Loosen large gear.
2. Manually (with increase-decrease switch) shift to minimum pump pressure and zero motor rotation. Feel pump for good neutral.
3. Disconnect power.
4. Disconnect screw terminal end of gray wire that runs from the left limit switch (one with red wire).
5. Attach continuity meter to red wire terminal of switch and gray wire just disconnected. Switch should show closed.
6. Slowly turn larger gear shaft by hand CCW (from outside box) till meter shows switch opens.
7. Remove meter.
8. Tighten large gear to shaft and adjust tooth engagement by sliding motor, if required. Adjust large gear in or out on shaft for vertical alignment.
9. Re-attach gray wire.
10. Turn chain splice CCW (from outside box) till potentiometer set screw appears. Note amount shaft is turned.
11. Loosen set screw and unsnap pot. holder.
12. Turn pot shaft fully CCW, than back up two turns, plus that noted in step ten.
13. Remount.
14. Tighten set screw.
15. Re-install front guard and adjust so that large sheetmetal gear does not contact guard.

Install the null relay and dial the "Struthers Dunn" control knob slowly clockwise then counterclockwise to determine if the unit will operate in both directions with a clean turn on and turn off point. Failure to operate in one direction or the other may indicate a loose connection, failed triac, or open transformer winding. Check and repair any loose joints and connections. Remove the null relay and measure the moisture board transformer primary voltage. One primary wire must show 115 volts to ground.

The secondary side of the transformer should show 22 volts from the center lead to either outside lead.

If no obvious damage is seen and the transformer output is right, a triac may be failed open. Install a good null relay and switch main power "ON." Turn SD control knob toward direction that will not activate a panel lamp. Use an insulated jumper wire to jump pins as shown on the triac related to the lamp that will not light. If the jumper wire causes the lamp to light and motor to run, the triac is failed open. Confirm an open triac by testing with a second null relay.

NULL RELAY:

The null relay is an epoxy encapsulated control circuit that analyzes the difference between control panel setpoint and the thermistor, plus servo pot resistance. It sends a signal to one or the other triacs on the moisture board to adjust the shift mechanism to maintain a balance point. As the signals to the null relay are 0.27 volts or less; clean, tight, dry connection between the relay and moisture board is essential. The heater lamp is placed specifically to keep this connection dry. To test a null relay requires use of a known good moisture board as tested in the preceeding section.

Turn the control knob clockwise and counterclockwise to determine that both sides of the null relay and moisture board are functioning. Failure to operate in either or both directions indicates internal failure.

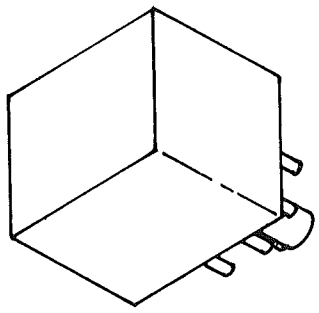
Turn the control clockwise slowly until the left lamp just comes on then counterclockwise until the right lamp just comes on. The span between turn on points (deadband) should be between 1-1/2 and 3 small divisions on the backplate of the Model 80 tester or between 10 and 20 divisions of the dryer microdial.

Turn the control clockwise several divisions and let the system rebalance. The indicator lamp should turn off without blinking as soon as balance is obtained. Repeat test several times counterclockwise and clockwise. Blinking is generally caused by: moisture on or in the base of the null relay, conductive residue from cleaning/lubricating tuner aerosols, or poor pin contact. The relay may be dried in an oven at 125°F. for two hours or over the defroster of a motor vehicle. Oil and goo from tuner cleaner is best removed using Freon degreaser or similar solvent followed by air drying for ten minutes to evaporate cleaner. Pin contact may be improved by sanding: flux, corrosion, and/or solder splatter off all pins. Solder balls on the pin ends damage the moisture board sockets.

Use of shellac or other sealers on the null relay base is generally not effective as very low voltage leakage across a damp surface causes malfunction. Better results are obtained by keeping the relay dry through use of a null heater lamp or heat directed by heat lamp or trouble light. Temperatures over 160° F. will accelerate aging of the board and relay components.

Shift motor and lamps should show the same type function at the clockwise turn on point as seen at the counterclockwise turn on point.

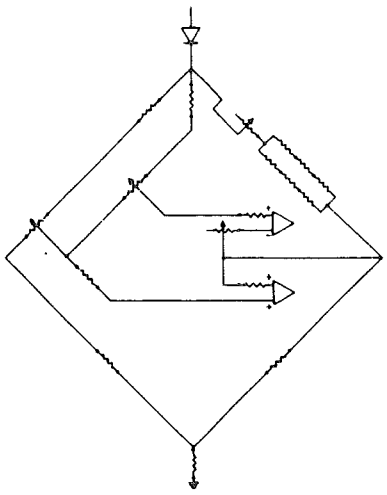
Null relays are not internally repairable. A broken center pin will not affect operation if kept dry and installed in the proper position.



POTENTIOMETERS:

Wire wound potentiometers (variable resistors) are used in the moisture control system. One is servo operated and is located in the shift assembly in series with the thermistors. The set point pot is on the control panel. As the thermistor resistance goes up the shift motor lowers the servo pot resistance so the servo plus thermistor resistances balance the panel setting. As the shift motor lowers the servo pot resistance, it decreases the hydraulic pump stroke and reduces the discharge rate to maintain a desired temperature (moisture content).

The potentiometers may be checked for linear and continuous resistance changes using an ohmmeter. To set the servo pot during repair, see the Vickers or Sundstrand shift assembly instructions.



Bridge Circuit

MOISTURE CONTROL BOARD (FENWAL)

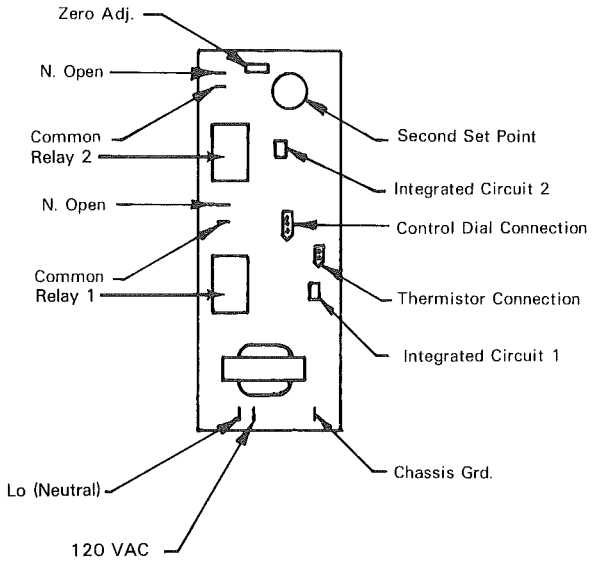
The Fenwal moisture control board is a printed circuit board to switch the shift motor for discharge rate changes. Two mechanical relays provide shift motor switching. The circuit is essentially a wheatstone bridge with the thermistors, servo and set point (panel) potentiometers making up the variable bridge legs. Two integrated circuits (black rectangles with 8 leads) determine if the shifter should increase or decrease the discharge rate to balance the control point resistance with the combined thermistor and servo pot resistance.

If a thermistor or servo pot lead to the controller is broken the unit will stop the shift motor in automatic. If the 3 pin panel control is unplugged from the circuit board it will shift to maximum speed.

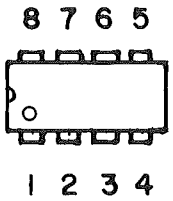
The "second set point" Potentiometer opposite the transformer is to control the deadband or null width. The "zero adjust" trimmer next to the second set point is factory set for the minimum deadband and should not be turned.

Each time the controller balances it should shut off without reversing. If the unit reverses at shut off or both moisture control lamps come on, turn the "second set point" control clockwise just enough to prevent reversing.

The Model 80 tester may be used to reset controllers after component replacement or to recalibrate.



Fenwal Controller



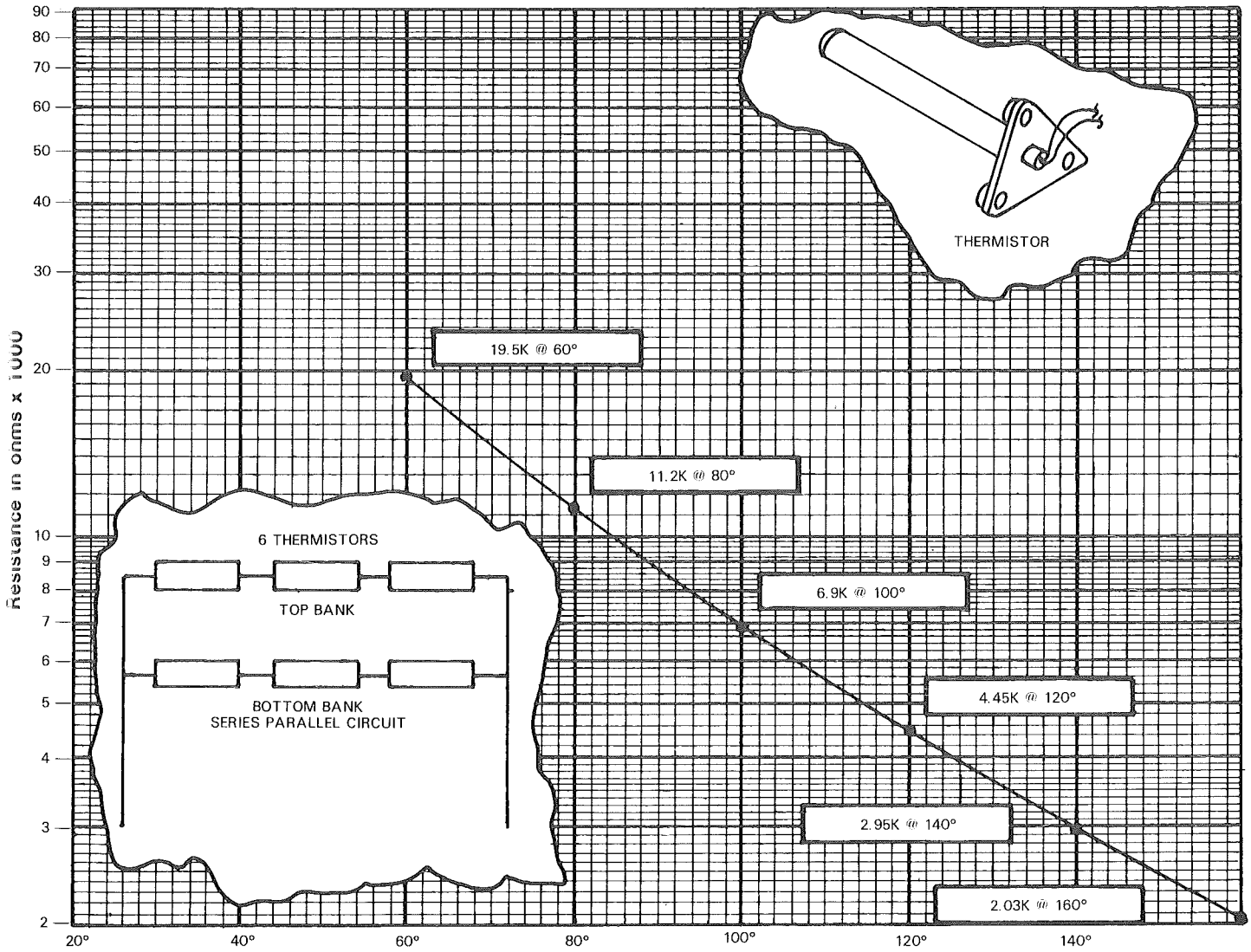
Integrated Circuit "Chip"

THERMISTORS:

Thermistors are heat sensitive resistance elements that decrease in resistance when heated. The combination of three sensors in series parallel to three others in series gives an averaging effect of overall grain temperature.

To measure total resistance, disconnect the blue wires that enter the upper right corner of the control box. An Ohm meter reading should compare ± 10% with the attached temperature versus resistance chart if all six thermistors are functioning properly. Each thermistor in a group of 6 has 2/3 or .67 of the total resistance shown. Remember sensors read approximately grain temperature not plenum temperature. A steady reading, within acceptable range over several minutes indicates proper operation. Watch the total resistance from a cold dryer start up to an operating temperature 10-20 degrees above where suspected trouble occurs. A broken internal thermistor circuit might open at a certain temperature and close at other temperatures. If the initial reading indicates trouble separate upper and lower banks at the center box of the lower bank and test each bank separately. Each bank should read twice that shown on the resistance chart. Thermistor failure may be due to an open, short, or intermittant circuit. A short may be internal or to the dryer shell. It may be necessary to watch each thermistor resistance reading several minutes to find an irregularity. As resistance changes slowly in a good thermistor, any jump or wiggle indicates trouble in a thermistor, junction, or wire.

After examining thermistors, the connections should always be resoldered. The soldered ends should be coated with Silicone (bathtub) sealer and wire nuts screwed on. Thermistors are not repairable. In most cases, at least one thermistor may be bypassed as long as the set point dial will give a balanced condition.



SERVICE

SHUT OFF POWER AND FUEL TO PREVENT ELECTROCUTION AND BURNING

Most components are listed by name with functional description and check out means in the component section. Certain electrical components may be tested in the Model 80 tester 438398.

PROBLEM	SOLUTION
Motor(s) fail to start (no power supply).	Check "START UP — OPERATE" switch for startup position.
	Check for power on all lines at 4 terminal block.
	Check for 110-120 volts at control transformer secondary.
	Check No. 3 fuse.
	Reset overloads on motor starter(s).
	Check for voltage thru "STOP" and "START" switches.
	Check auxiliary electrical interlock if motor runs with start switch in start position.
	Check holding coil on starter(s).
	Check for loose wires on starter(s).
	Check No. 2 timer on 10' machine when second fan motor does not attempt to start.
Fan motor(s) hum, but fail to start, or turn slowly.	Check for adequate voltage (180 volts minimum at terminal block when start switch is engaged).
	Check for improperly wired motor.
	Check for loose connections.
	Check motor bearings (spin blade by hand).
	Check phase box(s) for faulty capacitors. (Single phase machines only.)
	Phase box relay may be stuck open or opening too soon.
Magnetic starter(s) trip out repeatedly.	Measure line voltage with all motors running (207 VAC min. 245 VAC max).
	Measure amperage thru each motor lead and compare with motor nameplate (Reference page 4).
	Check heaters for correct size. (See operator's manual).
	Check starter(s) for loose connections.
	Check for improperly wired motor.
No. 2 Fan runs backwards (1 ph)	No. 2 timer set for more than 6 seconds.
Fan(s) run backward (3 ph)	If meter motor also runs backward, switch two wires on the main terminal block.
	If any single motor runs backward, switch two of its three leads.
Machine runs through purge period, but fails to ignite or flame out occurs before temperature reaches high limit setting.	Check gas pressure, regulator and modulating valve setting.
	Check flame monitoring control(s) for malfunction. See ignitor lamps to indicate power thru monitor.
	Check high limit. (High limit light indicates power thru switch).
	Check purge timer and socket if no power to P.C. 3 (8') or P.C. 1 (10').
	Check probes for proper gap, cracks, or shorting.
	Check secondary and high tension lines for cracks or nicks.
	Check for loose ground on terminal blocks.
	Check solenoids.
	Check temperature gauge for accurary (measure at heat chamber clean out pipe.

SERVICE (Continued)

PROBLEM	SOLUTION
High limit control kicks out repeatedly.	Check high limit control setting.
	Check for clogged heating chamber walls.
	Check temperature gauge for accuracy (measure at heat chamber clean out pipe).
	Check high limit control for malfunction or loose connection.
Machine stops when switched into the "OPERATE" circuit.	Meter motor and low bin lamp must be on.
	Switch moved too fast — try again slowly.
	Check low bin switch.
	Check hydrostatic pressure switch circuit no. 2.
	Check "STARTUP-OPERATE" switch.
Machine will not achieve desired temperature or temperature is erratic.	Check supply tank fill and pressure.
	Check regulator and modulating valve for proper adjustment.
	Check temperature gauge.
	Check excess flow valve at fuel supply for clicking noise or frost indicating blockage.
	Check for frost on supply line indicating blockage.
	Check strainer and regulator screens for dirt.
	Check vaporizer and gas lines for leaks.
	See Normal Operating Conditions on fuel requirements page.
Pressure gauge indicates excessive pressure.	Check regulator and modulating valve for proper adjustment per operators manual.
	Check screens and check valves for contamination.
	Check pressure gauge.
	Check burner orifice. (L.P. gas machines only)
Machine uses excessive fuel. See page 3 for definition of "Normal."	Check for overdrying.
	Check for proper grain level in holding bin.
	Check vaporizer and gas lines for leaks.
	Check air gap on burner castings.
Uneven moisture content of the discharged grain.	Check fill auger for proper positioning and fines distribution.
	Check to see if machine is level.
	Check for even burn on two burner units.
	Check metering arm. (Centered in dryer with arms sweeping parallel to the lower edge of the inner perforated wall.)
	Check "MOISTURE MATIC" (See moisture matic trouble shooting section).

SERVICE (Continued)

PROBLEM	SOLUTION
Machine will not operate continuously in "operate."	Watch function lamps in "start up" for indication of circuit causing problem.
	Check air switch adjustment, travel, and contamination.
	Check low bin switch.
	Check probes and ignition wires.
	Check high limit switch.
	Check meter motor auxiliary.
	Check flame monitoring control(s) for malfunction or loose connections. (Use Model 80 tester).
	Check hydrostatic pressure switch, circuit 1 and circuit 2.
	Check "Start up-Operate" switch.
	Check "Start up-Operate" relay.
	Attach Model 80 tester with external circuit tester and run in "startup" to find cause.
	Check moisture matic if machine shuts down in neutral.
Grain flow thru the columns is uneven.	Check for even grain filling. (May be off center causing uneven distribution of grain and fines on the roof cone.)
	Check to see if machine is properly leveled.
	Check for foreign material at perimeter of base and at bottom of columns.
	Check metering arm (may be off center causing grain to move down a column faster on one side of the machine than the other).
	Check for plugged column.
	Ignore drop rate at door section.
Fans run but purge lamp will not light.	Check No. 4 fuse.
	Check air switch(es), air lamps indicate power to purge timer.
	Check burner switch.
	Check fan motor auxiliary.
	Check purge timer and socket including solder on back of printed circuit board.
Solenoids chatter or will not open.	Push reset in flame controller.
	Check No. 4 fuse.
	Check Ignitor lamp on 8' or ignitor 2 lamp on 10' for indication of power to solenoids.
	Check for ground or loose connection. Either will cause ignitor to refire and chatter valves.
	Check probes and leads.
	Check flame monitoring control(s) with Model 80 tester.
	Check coils in solenoid valves.
	Check diaphragms.

STRUTHERS DUNN MOISTURE CONTROL SERVICE

PROBLEM	SOLUTION
Shifting motor fails to operate in manual.	1. Check no. 2 fuse — if blown see step 2. 2. Check for short on P.C. board or between P.C. 8 (10') or P.C. 9 (8') and motor. 3. If another fuse blows when power is turned on check for short between P.C. 8 (10') or P.C. 9 (8') and "Increase-Decrease" switch. 4. If fuse blows when right lamp comes on, check for short between P.C. 8 (10') or P.C. 9 (8') and brown motor lead and for defective shift motor. 5. If fuse blows when left lamp comes on, check for short between P.C. 8 (10') or P.C. 9 (8') and red motor lead and for defective shift motor. 6. Check "Increase — Decrease" switch. Check "Manual — Automatic switch." 7. Check travel limit switches.
Lamps balance manually, but motor won't run automatically.	Open ground wire from terminal D to black motor lead. Motor powered in both directions at once due to damp null relay socket area.
Moisture matic will not control moisture.	Remove 11 pin plug and null relay. Clean and polish all pins with Freon degreaser or similar solvent without lubricant. With 11 pin plug disconnected, use a pick or knife blade to spring the null relay and 11 pin socket prongs together for a tighter fit.
Moisture matic will not control moisture after servicing pins and sockets.	Remove the blue thermistor wire from terminal F and install a 10K potentiometer between terminals A and F. If the lights can be balanced off and will react to changes in the 10K pot jumper, the problem is in the thermistor circuit.
Check of entire thermistor circuit.	Remove blue wires from terminals A and F. Check for continuity between blue wires and for shorts to the machine. Refer to the thermistor chart to determine the expected ohm reading. See components sections. The best procedure is to attach an ohm meter to a cold machine and observe the resistance change from cold to 20° F. above normal operating temperature. The resistance change must be steady. Any jump indicates a bad connection or thermistor which must then be found by elimination.
Check of top and bottom rows of thermistors separately.	Remove blue wires from terminals A and F. Disconnect the upper and lower banks in the lower center junction box. Check ohm reading for 3 thermistor series on each bank against resistance chart. Three thermistors will read double the chart value shown for 6 series/parallel. Check for shorts between the thermistor leads and dryer shell. Watch ohm reading during operation and while gently pulling and pushing on thermistor lead wires. Run the dryer 1 day on either bank of thermistors. If moisture control is ± 1% bank is functioning properly. Then start adding remaining thermistors into circuit one at a time until a bad thermistor is found.

STRUTHERS DUNN MOISTURE CONTROL SERVICE (Continued)

PROBLEM	SOLUTION
Individual thermistor examination One thermistor reads 2/3 of the chart value for 6 as shown.	A thermistor securely clipped to an ohm meter should never show a jump or flicker in the indicating needle or digital display. Resistance from one thermistor to another may vary on a dryer due to different column temperatures caused by fines distribution, wind, discharge speed, etc. An oven thermometer probed into the grain adjacent to a thermistor will give a temperature to compare to the thermistor chart. Thermistors over ±5% from the chart temperature compared to the thermometer reading should be considered suspect. A thermistor suspected of trouble may be bypassed to determine if its elimination resolved a problem. Check for resistance changes and shorts while moving leads.
Reconnection of thermistors and leads.	Clean and twist thermistor wire connections, then solder with resin core solder. Dip each soldered joint into silicone (bathtub) sealer. Twist a wire nut on over the sealer.
Moisture matic will not function normally with a 10K jumper between A-F.	Check for 8' earth ground rod. Ground from L2 of flame controller to frame of dryer. Replace null relay with known good relay. Replace moisture control circuit board with a known good one and reinstall the old null relay. Check for zero backlash at bolt or pin that connects the shift arm to the hydrostatic pump. It should have a tight 1/4" drive pin installed. Check for trash buildup around the thermistors affecting heated air flow.

STRUTHERS DUNN MOISTURE CONTROL SERVICE (Continued)

MOISTURE MATIC LAMPS WILL BE CALLED HIGH AND LOW IN PRE 1976 DRYERS AND RIGHT AND LEFT IN LATER DRYERS.

HIGH — LOW RIGHT — LEFT	MOISTURE MATIC PROBLEM IN AUTOMATIC	POSSIBLE CAUSES
On	Motor decreases to neutral.	Excessive moisture change of grain while drying at a very slow rate. May require restarting in manual until speed is reestablished. Open thermistor circuit between pin 1 of the 11 pin plug and the lower thermistor junction box. Open thermistor circuit between pin 2 of the 11 pin plug and the lower thermistor junction box. This circuit includes the shirt motor 10K pot. Moisture or poor pin contact on null relay and socket.
On	Motor won't decrease in auto, but will increase in auto. Both lamps can be balanced on. Lamps can be balanced off in manual.	Open circuit from terminal C to decrease side of motor. Defective decrease side of motor.
On	Motor won't increase in auto, but will decrease in auto. Both lamps can be balanced on. Lamps can be balanced off in manual.	Open circuit from terminal G to increase side of motor. Defective increase side of motor.
On & On	Motor won't increase or decrease in automatic. Lamps can be balanced off in manual.	Open ground wire from terminal D to black motor lead (ground). Motor powered both directions at once due to damp or damaged null relay. Possible interference from a flame controller (try grounding).
On	Motor will increase to full speed in auto.	Open circuit between terminal G and pin 3 of 11 pin plug. Defective 30K pot in control panel.
On or On	Lamp(s) on with null relay removed.	Triac on moisture board is failed closed. Replace triac or board.
Off Off	Motor will not increase when high lamp is on — will decrease when low lamp is on.	Open circuit from terminal E to Auto-Manual switch. Auto-Manual switch is defective.
Off Off	Motor will not decrease when low lamp is on — will increase when high lamp is on.	Open circuit from terminal C to Auto-Manual switch. Auto-Manual switch is defective.

STRUTHERS DUNN MOISTURE CONTROL SERVICE (Continued)

MOISTURE MATIC LAMPS WILL BE CALLED HIGH AND LOW IN PRE 1976 DRYERS AND RIGHT AND LEFT IN LATER DRYERS.

HIGH — LOW	RIGHT — LIFT	MOISTURE MATIC PROBLEM IN AUTOMATIC	
Off	Off	System runs to full speed or neutral when it automatically adjusts.	Loose sprocket on shaft coupling in shift assembly. Defective 10K pot Leads reversed to 10K pot
	No null	Lamps won't balance.	Defective 30K panel pot. (Open circuit 1 end, low resistance at other.)
	Blink alternately	Lamps won't balance and/or flicker — may blink alternately until fuse number 1 blows. A heater is available to keep the relay dry.	Null relay and/or socket are damp or corroded. Clean and polish pins and socket. Dry relay in oven at 125° F. 1 hour and replace. Replace null relay.
	On	Low lamp won't balance off. High lamps won't balance on.	Replace null relay.
	On	High lamp won't balance off. Low lamp won't balance on.	Replace null relay.

Check	Ohmmeter ON 11 Pin Plug. Pins No.:	Read
10K pot	2 & 9	0-10,000 ohms (10 turns)
30K pot	3 & 2	0-30,000 ohms
Thermistors	9 & 1	See chart
Thermistors plus 10K pot	2 & 1	Chart plus 10K pot

FENWAL MOISTURE CONTROL SERVICE

PROBLEM	SOLUTION
Shifting motor fails to operate in manual.	1. Check no. 2 fuse — if blown, see step 2. 2. Check for short on P.C. board or between P.C. 8 (10') or P.C. 9 (8') and motor. 3. If another fuse blows when power is turned on, check for short between P.C. 8 (10') or P.C. 9 (8') and increase-decrease switch. 4. If fuse blows when right lamp comes on, check for short between P.C. 8 (10') or P.C. 9 (8') and brown motor lead and for defective shift motor. 5. If fuse blows when left lamp comes on, check for short between P.C. 8 (10') or P.C. 9 (8') and red motor lead and for defective motor. 6. Check "increase" — "decrease" switch. Check "manual" — "automatic" switch. 7. Check travel limit switches.
Lamps balance manually, but motor won't run automatically.	Open ground wire between black motor lead and ground side of control transformer.
Moisture matic will not control moisture.	Remove the blue thermistor wire from the moisture board and install a 10K potentiometer between the two thermistor terminals. If the lights can be balanced off and will react to changes in the 10K pot jumper, the problem is in the thermistor circuit.
Check of entire thermistor circuit.	Remove the blue teflon coated wire from the moisture board thermistor terminal. Check for continuity between this wire and its mate on the terminal strip in the bottom of the control box. Check the wires for shorts to the dryer. Refer to the thermistor chart to determine the expected ohm reading. The best procedure is to attach an ohm meter to a cold machine and observe the resistance change from cold to 20° F. above normal operating temperature. The resistance change must be steady. Any jump indicates a bad connection or thermistor which must then be found by elimination.
Check of top and bottom rows of thermistors separately.	Check ohm reading for 3 thermistor series on each bank against resistance chart. Three thermistors will read double the chart value shown for 6 series/parallel. Check for shorts between the thermistor leads and dryer shell. Watch ohm reading during operation and while gently pulling and pushing on thermistor lead wires. Run the dryer 1 day on either bank of thermistors. If moisture control is ±1% bank is functioning properly. Then start adding remaining thermistors into circuit one at a time until a bad thermistor is found.
Individual thermistor examination (One thermistor reads 2/3 of the chart value for 6 as shown).	A thermistor securely clipped to an ohm meter should never show a jump or flicker in the indicating needle or digital display. Resistance from one thermistor to another may vary on a dryer due to different column temperatures caused by fines distribution, wind, discharge speed, etc. An oven thermometer probed into the grain adjacent to a thermistor will give a temperature to compare to the thermistor chart. Thermistors over ±5% from the chart temperature compared to the thermometer reading should be considered suspect. A thermistor suspected of trouble may be bypassed to determine if its elimination resolved a problem. Check for resistance changes and shorts while moving leads.

FENWAL MOISTURE CONTROL SERVICE (Continued)

PROBLEM	SOLUTION
Reconnection of thermistors and leads.	Clean and twist thermistor wire connections, then solder with resin core solder. Dip each woldered joint into silicone (bathtub) sealer. Twist a wire nut on over the sealer.
Moisture matic will not function normally with a 10K jumper between the two terminals where blue thermistor wires normally connect.	Check for 8' earth ground rod. Ground from L2 of flame controller to frame of dryer. Check moisture board on Model 80 tester. Replace moisture control circuit board with a known good one. Check for zero backlash at bolt or pin that connects the shift arm to the hydrostatic pump. It should have a tight 1/4" drive pin installed. Check for trash buildup around the thermistors affecting heated air flow.

MOISTURE MATIC LAMPS WILL BE CALLED HIGH AND LOW IN PRE 1976 DRYERS AND RIGHT AND LEFT IN LATER DRYERS.

HIGH — LOW RIGHT — LEFT		MOISTURE MATIC PROBLEM IN AUTOMATIC	POSSIBLE CAUSES
	On	Motor decreases to neutral.	Excessive moisture change of grain while drying at a very slow rate. May require restarting in manual until speed is re-established. Control pot disconnected from moisture board.
Off	Off	Motor won't run in automatic. Neither lamp lights.	Open thermistor circuit between 1 terminal of the moisture board and the lower thermistor junction box. Open thermistor circuit between the other terminal of the moisture board and the lower thermistor junction box. This circuit includes the shift motor 10K pot.
	On	Motor won't decrease in auto, but will increase in auto. Either lamp can be balanced on. Motor will run in manual.	Open circuit from relay 1 of moisture board to decrease side of motor. Defective decrease side of motor.
On		Motor won't increase in auto, but will decrease in auto. Either lamp can be balanced on. Motor will run in manual.	Open circuit from relay 2 of moisture board to increase side of motor. Defective increase side of motor.

FENWAL MOISTURE CONTROL SERVICE (Continued)

HIGH — LOW RIGHT — LEFT	MOISTURE MATIC PROBLEM IN AUTOMATIC	POSSIBLE CAUSES
On or On	Motor won't increase or decrease in automatic. Lamps can be balanced off in manual.	Open ground wire between control transformer and black motor lead (ground). Possible interference from a flame controller (try grounding).
On or On	Lamp cannot be balanced off in manual or automatic.	Short Pin 8 on Ic_1 (if relay 1 is on) or Ic_2 to JP-11. If relay does not de-energize, check for welded contacts. If contacts are ok, replace Ic and recalibrate.
On	Motor will not increase when high lamp is on — will decrease when low lamp is on.	Open circuit between Brown motor lead and Auto-Manual switch. Defective increase side of motor. Auto-Manual switch is defective.
On	Motor will not decrease when low lamp is on — will increase when high lamp is on.	Open circuit between Red motor lead and Auto-Manual switch. Defective decrease side of motor. Auto-Manual switch is defective.
On or On	Systems runs to full speed or neutral when it automatically adjusts.	Loose sprocket on shaft coupling in shift assembly. Defective 10K pot. Leads reversed to 10K pot.
No null	Lamps won't balance.	Defective 1K panel pot. (Open circuit 1 end, low resistance at other). Thermistor(s) out of range.
Blink alternately	Lamps won't balance and/or flicker — may blink alternately until fuse number 1 blows.	Requires "second set point' adjust described under "Fenwal Controller." May also be reset using Model 80 tester.

TO CHECK	OHMMETER CONNECTION	READING
10K (Servo) Pot	Wires 214 & 215 from shift motor	0-10,000 OHMS (10 turns)
1K Panel Pot	Brown to Yellow Purple to Yellow	0-1,000 ohms 1,000 ohms
Thermistors	Blue teflon coated wires	See chart for readings
Thermistors plus 10K pot	Leads disconnected from moisture board Thermistor terminals	Thermistor chart plus 10K pot

FENWAL CIRCUIT BOARD SERVICE CHECK POINTS

Disconnect meter motor leads from contactor while testing. Refer to Page 21 for major parts identification. All parts on Circuit board are identified.

USE ONLY High impedance Volt meter for reading. Recommend: BK Precision 280 Digital Multimeter or other Field Effect Transistor or Vacuum Tube Voltmeter. Low impedance units such as Simpson 260 will interact with circuit logic giving false readings.

USE INSULATED PROBES

Check Item	Check Points	Expect	Analysis
Transformer Input	LO, 120	120 VAC	Input OK
Press down relay 1 arm then relay 2	Checks power thru relay	Raise/Lower lamps & Shift Motor Operate	Power Supplied through relays
Power to and from Ic_1 & Ic_2	Short Ic_1 Pins 3-4 Short Ic_2 Pins 3-4	Relay 1 closes Relay 2 closes	Power to and from Ic's OK. Ic and/or Signal may be bad. Relays are OK.
Thermistor Circuit (Lead Break)	Thermistor Pin 2 to "Arm" of 1K Panel dial	±.5 VDC to ±.5 VDC	Circuit is complete.
Rectifier C_1 & Resistor R_1	Ic_1&$_2$ Pin 1 to Grd.	12 VDC	Confirms Power to Ic_1 & Ic_2
SCR (inside Ic's) Completes Circuit	Ic_1 Pin 3 — Pin 4 Ic_2 Pin 3 — Pin 4	35 VDC .6 VDC	SCR is open SCR is closed