INSTRUCTION BOOK

for

MODEL 890

RADIO FREQUENCY LOAD

Model 890, RF Load

SUMMARY OF CHARACTERISTICS

ELECTRICAL SPECIFICATIONS

Power Rating	50KW (5000 ft. max elevation).
RF Circuit Impedance	50 or 51.5 ohms - See types in text. 6-1/8 inch coaxial line.
Frequency Range	0-220 megacycles per second.
Modulation	CW, AM, FM or TV Types Signals. Not suitable for use on pulsed power similar to radar.
Ambient Air Temperature	Maximum 45°C Minimum 15°C
AC Power Required	230v or 115v 60 cyc, single phase 1-1/8 KW

MECHANICAL SPECIFICATIONS

Water Flow	20 gpm (30°C max).
Water Connections	1-1/4 inch hose.
Intermediate Coolant	26 gallons - Dowtherm "A" Coolant.
Weight	1000 pounds.
Dimensions	See Figure 1.
Vent Plug	Fully disengage thread before operating unit.

INSTRUCTION MANUAL
for
Model 890 - 50KW RF Load

SECTION I - GENERAL DESCRIPTION

The Bird Electronic Model 890, shown in outline illustration Figure 1, is a termination type Radio Frequency Load for up to 50 Kilowatts of RF Power. The frequency range is from dc to 220 megacycles per second. The load is so designed as to be virtually reflectionless, having less than 1.1 to 1 VSWR in its stated frequency range. The power input is through a 6-1/8 flanged or * unflanged type coaxial line connector with the coupling on the top side of equipment. The rf power is converted to heat in the load resistor, and dissipated by means of a water cooling system.

The Model 890 RF Load may serve as part of an absorption Wattmeter when used in conjunction with a Bird THRULINE Wattmeter attached directly to its input connector. Table below lists applicable arrangement of types:

RF Load	Model	890	8902	8903	8904	Use THRULINE Model listed directly below
THRULINE	Model	490	4901	4902	4901	respective load.

This type installation permits direct reading power measurements up to 50 KW on 6-1/8 inch coaxial lines.

The RF Load equipment consists essentially of a load resistor, an intermediate coolant, a heat exchanger (cooling coil), and a motor driven pump providing constant coolant circulation. The entire system is mounted on a four-wheeled low-level truck having a special locking jack. Two upright steel cylinders, which are joined at the top through a conduit, and at the bottom through the motor-driven centrifugal pump, house the first three above mentioned elements and comprise the

* Model 890 51.5Ω unflanged connector
Model 8903 50Ω EIA flanged "

coolant circuit; see Figure 2, Installation Schematic. The smaller cylinder contains the load resistor, while the larger one contains the water conducting cooling coils which are also immersed in the circulating dielectric coolant.

A 230-115 volt 60-cycle ac motor is used to drive the circulating pump. The coolant tank is provided with thermoswitches which protect the rf load equipment, and which control the flow of water through the inlet water pipe.

SECTION II - THEORY OF OPERATION

The radio-frequency power is fed into the top of the load unit (smaller steel cylinder) through a teflon sealed coaxial conductor at the top. Housed in the lower end of a length of transmission line which projects into this cylinder is the load resistor. The outer conductor of the transmission line is exponentially tapered down about the resistor to provide a reduction of surge impedance directly proportional to distance. Thus at the high end of the resistor the characteristic impedance is 50.0 (or 51.5) ohms. Halfway down the resistor, the impedance is 25.0 (or 25.75) ohms to compensate for the resistance already passed over. At the low end of the resistor section, the transmission line outer conductor joins the inner. The teflon seal at the top of the cylinder provides both mechanical support for the transmission line inner conductor and a seal against coolant leakage.

The intermediate coolant, which has been chosen for chemical inactivity to prevent damage to the resistor, carries heat away from the load resistor and provides a uniform dielectric constant for the transmission line. With rf power applied, the coolant is heated by the resistor. The motor-driven circulating pump causes the coolant to rise past the resistor and enter the heat exchanger through the conduit. At the same time, the lower temperature coolant in the heat exchanger flows to the bottom of the larger cylinder, into the pump, and is forced up past the resistor.

The cooling coil is a helix of finned copper tubing. The cooling water is made to flow through the helix where it picks up and carries off heat from the intermediate coolant.

As mentioned previously, water eventually carries off the heat from the rf energy flowing into the load. The lower the inlet temperature of the water, the more heat it can dissipate. As the power and water temperature inputs to the load vary, the actual water requirement of the load varies.

The water saver valve will minimize required water flow into the cooling coil. It is controlled by the water saver thermoswitch located at the top of the large steel cylinder. In this manner, the water will flow only when the intermediate coolant temperature reaches a certain maximum limit (45°C, 113°F). Thus the water flow is automatically cut off when the load is not in operation. 115-volt electrical power for the water saver valve, which is tapped from the motor winding, should be available when the power is on at the transmitter.

In operation, the water saver valve solenoid is energized when the water saver thermoswitch closes. The solenoid opens a small pilot valve which admits water at full line pressure to a spring loaded diaphragm. The pressure exerted on the diaphragm actuates the main valve allowing water to flow into the load. Upon de-energization of the coil, the pilot valve closes, the pressure over the diaphragm dissipates into the low pressure (outlet) water line, and the spring closes the main valve stopping the flow of water into the load.

In addition to the water saver thermoswitch, an over temperature thermoswitch and an under temperature thermoswitch are also located at the top of the larger steel cylinder. These switches should be connected together in series with the transmitter interlock circuit, or if desired, to an auxiliary aural alarm system. The latter method will prevent the disablement of the transmitter during the actual operation on the air in cases where the rf load is stored in a location that is cool enough to cause the under temperature thermoswitch to open.

The over temperature switch, when properly connected, will prevent an excessive rise of the intermediate coolant temperature (above 60°C, 140°F) and thereby preclude any damage to the resistor element. The under temperature thermoswitch, connected as above, will prevent the application of rf power if the coolant temperature is below 15 degrees C (59 degrees F). Since the coolant possesses the property of a high boiling point, it also has a correspondingly high freezing temperature (approx. 12°C). If the coolant were congealed, circulation of the coolant would not be possible and heat would not be carried away from the load resistor.

An additional heater control thermoswitch may be supplied as optional equipment when specifically ordered. If supplied, the thermoswitch is located inside the thermoswitch box on top of the larger steel cylinder. This control is used in conjunction with an heating element incorporated* within the cooling coils, and will close if the temperature of the coolant should drop below 20°C, 68°F. Thus at temperatures below this level, 230 volts is energized to the heater element and this will prevent freezing of the intermediate coolant.

* Not regular equipment, supplied only when specifically ordered.

SECTION III - INSTALLATION

The unit may be used in both fixed and portable locations. For use as a portable unit, a truck lock at one end is mounted on the underside of the transport to keep the unit fixed while connected to the transmission system. Holes, 5/8-inch in diameter, are provided in the transport for fixed floor mounting.

Refer to the outline drawing Figure 1 and the installation schematic Figure 2 and proceed as follows:

1. Place the unit in proper location.

2. Connect the water inlet pipe (the higher pipe - with water saver valve installed) to a water source capable of delivering 20 gallons per minute. The maximum permissable input water temperature is 30°C (86°F).

3. Connect the water outlet pipe to a convenient drainage. Use 1-1/4 inch standard pipe or hose for both inlet and outlet lines.

4. Make the electrical connections to the unit at the terminal box located directly under the pump housing, as follows: -

a. The over temperature and under temperature switches (at terminals 3 and 4) are connected in series with the transmitter interlock circuit.

b. (1) Connect 230 volts or 115 volt 60-cycle power supply to terminals 1 and 2.

c. (2) The 890 equipment is normally furnished with the pump motor wired for 230-volt supply. For 115-volt operation, follow the installation schematic drawing Figure 2, remove motor junction box cover where shown and re-wire the connections as designated by color codes. Tape all joints safely and restore junction box cover.

5. Make the transmission line connection to the unit. Transmission line

input is to a 6-1/8", 50.0 or 51.5 ohm coaxial flanged or unflanged coupling.

6. Remove the vent plug (painted red) from the top of the heat exchanger tank. The equipment is now ready for operation.

7. Recheck - characteristics of indicator lights.

(1) GREEN lighted up - Pump motor on MANUALLY.

(2) YELLOW lighted up - Water saver valve open (water running).

(3) RED lighted up - coolant heater on. (Used only with R.F. Load units where special coolant heater equipment may have been supplied.

C A U T I O N

Do not apply RF power to the load unless vent plug hole is open.

SECTION IV - OPERATION

To place the unit in operation, follow this procedure:

1. Make certain that water pressure is on at the water saver valve.

2. Check the dielectric coolant level by removing the filler plug located on top of the heat exchanger (larger cylinder). The coolant level must be within 5-1/2 inches of the filler-plug opening.

3. Ascertain that the coolant vent plug has been removed. This will allow the coolant to expand as the temperature increases.

4. Operate the manual pump switch to ON, GREEN light on thermoswitch housing should go ON.

5. Apply rf power. SPECIAL CAUTION - Do not apply rf power unless the GREEN light is ON.

6. Shortly after rf power is applied, the water saver valve should open to allow cooling water to flow through the heat exchanger. YELLOW indicator light goes ON - watch for this. The valve will then operate intermittently, depending on inlet water temperature and power input.

7. After shutting off rf power, allow water supply to continue to run. In ordinary usage do not turn off water supply at source. The water saver will prevent any further flow after the load has cooled, and water supply will be assured for next operation. The manual pump motor switch should be turned off shortly AFTER rf power has been stopped.

SECTION V - MAINTENANCE

1. General

The RF Load will require little in the way of maintenance. The outside surface of the instrument should be wiped free of dust or dirt when necessary. Inhibisol* tetrachlorethylene, or other dry solvent applied on a cotton swab stick may be used on the input connector if excessive grime or moisture are present. To secure best electrical connection, take special care to clean the metallic contact surfaces (outside of the outer and inside of the inner conductor) and to thoroughly clean the exposed (horizontal) face of the teflon insulator on the input connector. If carbon tetrachloride is used, DO NOT BREATH FUMES, have good ventilation, and observe other precautions usual for this material. Wiping with dry solvent may also be helpful for cleaning of other connections throughout the equipment.

In ordinary service, the equipment will not require any regular adjustments, only a periodic inspection to the extent of coolant level check and motor lubrication as described in par. 4 below.

Check the coolant level periodically. Replenish if level is more than 5-1/2 inches from the filler-plug opening. Use only the coolant referenced in the parts list (Item 27).

2. Load Resistor

Accurate measurement of dc resistance between the inner and outer conductors of the input coupling will provide a good check of the condition of the load resistor. For this measurement, use a resistance bridge with an accuracy of one percent (1%) or better at 50 ohms. When the load is

* A non-flammable, non-toxic dry cleaning agent manufactured by the Penetone Co., Tenafly, New Jersey.

at room temperature, the measured resistance should be within one ohm of the value stamped on the name plate.

To change the load resistor assembly remove all eight bolts around the periphery of the top flange of load tank. Lift out the complete unit (with top Plate) and replace with a new assembly (Item 13 in Spare Parts List). This load resistor component should be disassembled only by the manufacturer. Return the burned out unit and order a replacement Item 13 from Bird Electronic Corporation. Use new O-Ring seal provided when replacing resistor housing assembly.

3. Thermoswitches and Other Controls

CAUTION - be sure to DISCONNECT the 230-115 volt POWER SUPPLY and the transmitter INTERLOCK LINES, i.e. all four wires to the terminal box should be disconnected, before attempting any maintenance work on electrically wired components throughout the Model 890. Terminal box (See Section III) is on the dolly opposite motor switch, with four 10-32 x 3/8 screws on lid. For access to motor terminals, remove cover plate (two screws) on right side of end cap - opposite data plate. The procedures for replacing all of the wired installations here is normal for any electrical equipment of this voltage. Follow wiring diagram in Schematic Installation, Figure 2, for any required information.

4. Pump-Motor Maintenance

Lubricate the pump-motor bearings periodically by placing a small amount of grease in the grease holes of the motor. These holes are located respectively at the base of a vertical slot on the rear face of the motor, and on top main housing directly in front of the pump nameplate. Each of these threaded holes is closed with a headless screw, slotted - easily removable with an ordinary screwdriver. See tag attached to the motor for type of lubrication required. Do not use oil to lubricate the motor and be careful not to overlubricate the motor. This is a capacitor-start induction motor, it does not have any brushes.

Should the pump seals become leaky or the motor bearings worn, return the pump-motor assembly (Item 1) to Bird Electronic Corp. for repair or replacement. To remove this assembly from the load equipment, proceed as follows: Be sure to DRAIN off COOLANT into suitable clean containers before loosening either gasket on the pump inlet flange (Item 8) or at the lower end of load (Item 7). Drain cock is at bottom of heat exchanger tank on the terminal box and pump side. Unscrew bolts and nuts on these flanges, remove two hold-down bolts on two rear feet of motor, and the pump-motor is free. Do not attempt to replace pump seals or motor bearings in the field unless the personnel is thoroughly familiar with this type of mechanical equipment.

If the pump-motor assembly (Item 1) has been removed, or is replaced, it is advisable to use new gasket for the pump flange and load flange (Item 7 and 8 respectively). These gaskets are asbestos filled inside teflon envelopes and do not require a sealing compound.

5. Water Saver Valve

If the water saver valve (Item 30) should become inoperative and need cleaning, remove the bonnet from the valve, clean the passage with a wire, clean the strainer, and re-assemble. If water hammer is noted as the water saver valve closes, remove the acorn nut protruding from the side of the valve body, loosen the check nut and tighten the leak-off stud until the hammer is eliminated. The check nut and leak-off stud are located under the acorn nut. Retighten the check nut and replace the acorn nut.

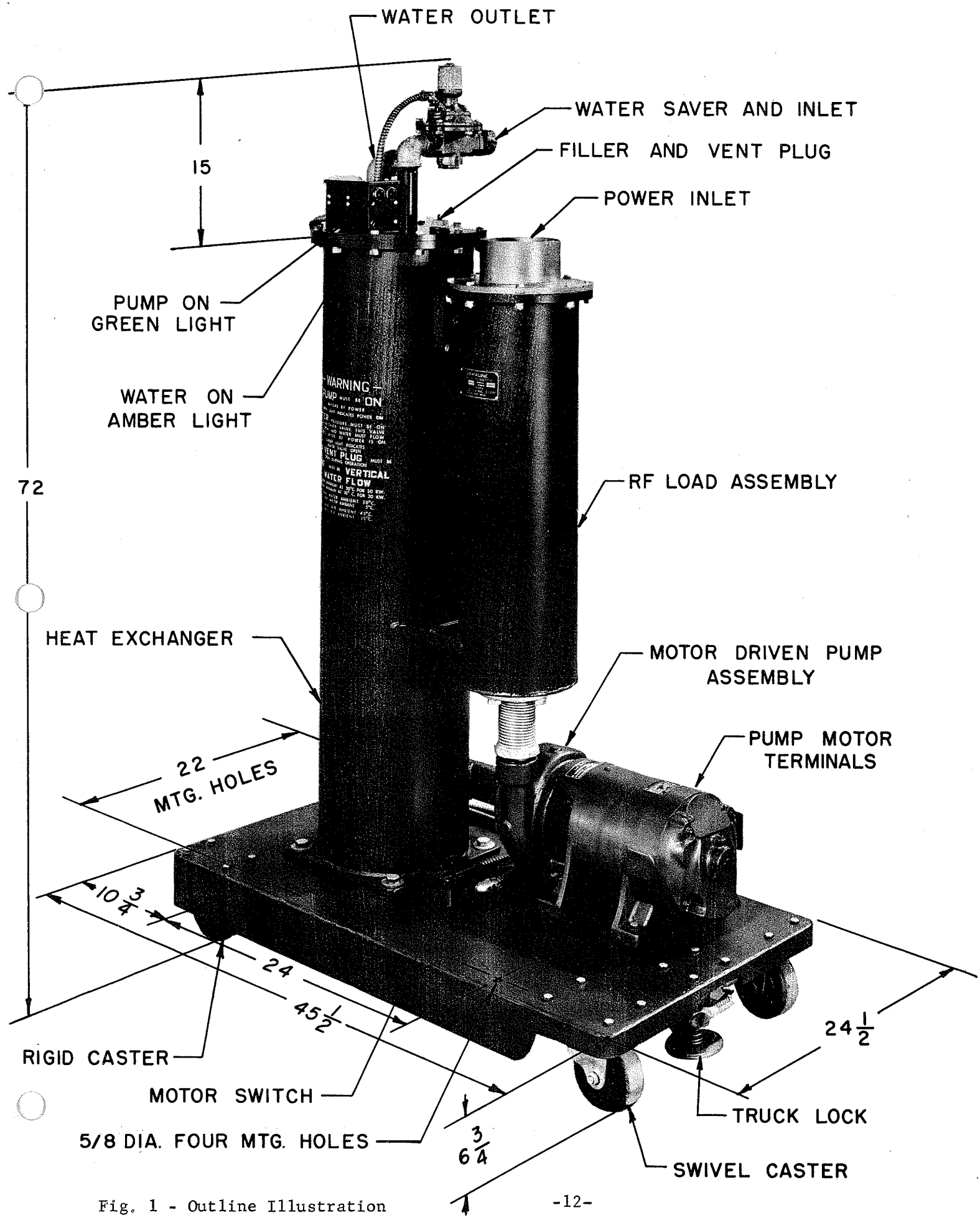

Fig. 1 - Outline Illustration

6. List of Replaceable Parts for Model 890 RF Loads

Item	Req'd		Bird Elec. Part No.
1	1	PUMP, MOTOR, 60 cyc: Replacement set furnished with: 1 - Gasket, Load Flange (Item 7) 1 - Gasket, Pump Flange (Item 8)	502202
2	(1)	PUMP, MOTOR DRIVEN, 50 cyc: Replacement set. Same as Item 1 except for 50 cyc motor.	502212
3	1	PIPE ASSEMBLY, Flexible	502044
7	2	GASKET, LOAD FLANGE	502049
8	1	GASKET, PUMP INLET FLANGE	502050
9	2	CASTER, FIXED	502052
10	2	CASTER, SWIVEL	502053
11	1	TRUCK LOCK	502054
13	1	RESISTOR & HOUSING ASSY: Incl O-Ring Seal	
		For Model 890	890034
		For " 8902 & 8904	890226
		For " 8903	890302
16	1	THERMOSWITCH, WATER SAVER	502115
17	1	THERMOSWITCH, UNDER TEMP	502116
18	1	THERMOSWITCH, OVER TEMP	890071
27	26 gal	COOLANT for MODEL 890 (5 gal. can)	5140
28	1	FILLER and VENT PLUG, Assembly	502100
29	1	PLUG, ACCESS	502103
30	1	VALVE, WATER SAVER	890069
31	(2)	HOSE ASSEMBLY, WATER SUPPLY	890077
32	4	WASHER, Water Hose - 1-1/4 inch std.	5054-1
33	1	LIGHT ASSY, Water On: Amber	5006-1
34	1	LIGHT ASSY, Pump On: Green	5006-4
35	-	JEWEL ONLY, Amber: p/o Item 33	5056-1
36	-	JEWEL ONLY, Green: p/o Item 34	5056-4
39	2	HOSE NIPPLE, Cast Brass: 1-1/4 Str. Male to 1-1/4 Taper Male, No. 19 Sherman	5057
40	(1)	HOSE NIPPLE, Cast brass: 1-1/4 Str. Male to 1-1/4 Taper Female, No. 18 Sherman	5058
41	1	SWITCH, MOTOR	5062
42	-	BULB, INDICATOR LAMP (Box of 10)	5144

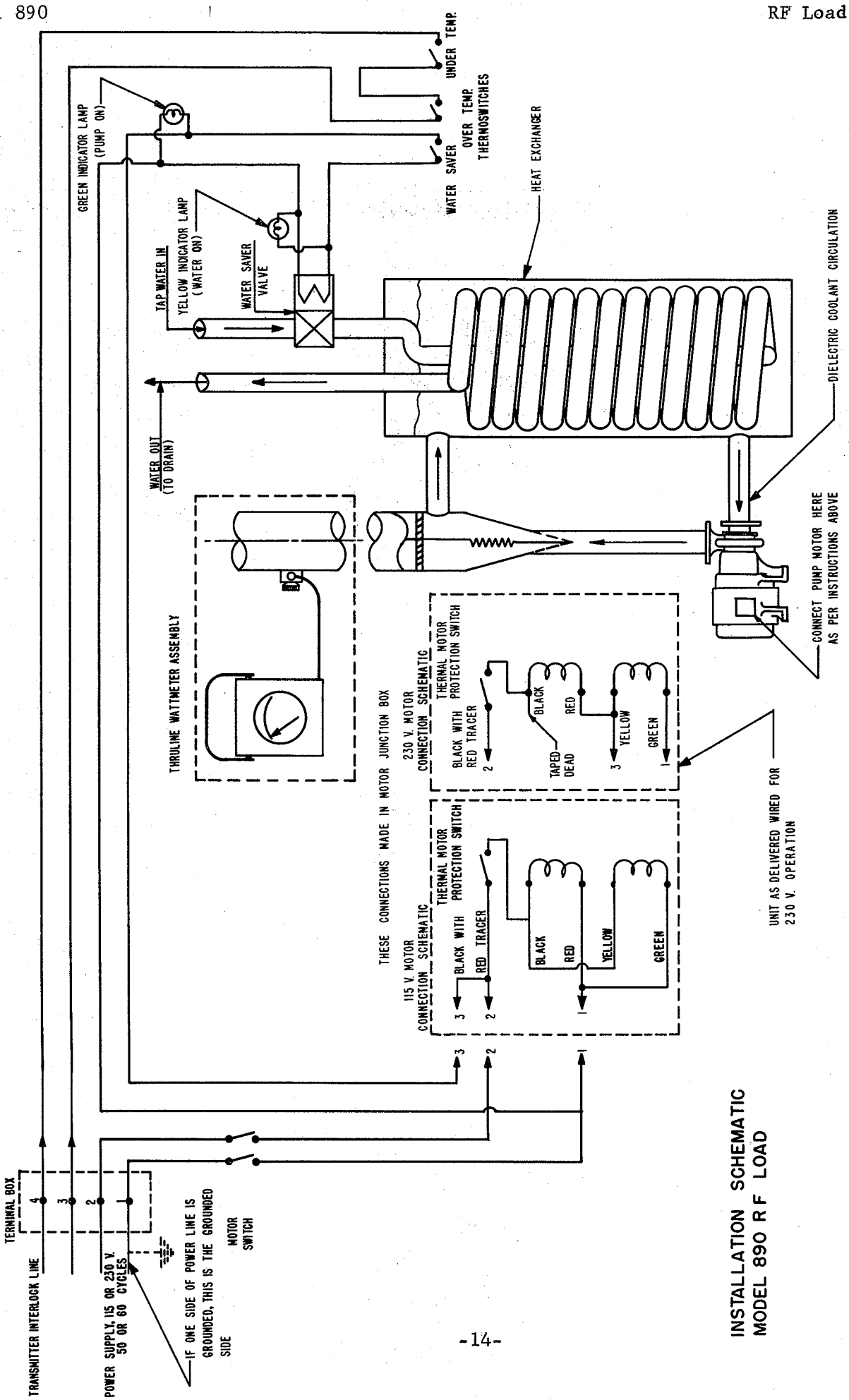

Fig. 2 Installation Schematic