INSTRUCTION MANUAL

MODEL 7515A

MAGNETIZER

Starting with S/N 31556

Revised 2-21-2000

IMPORTANT

THE FIXTURE MUST BE CONNECTED BEFORE TURNING ON THE MAGNETIZER. THE MAGNETIZER WILL NOT FUNCTION UNLESS A FIXTURE IS PROPERLY CONNECTED.

BEFORE FIRST USE, FOLLOW THE INSTRUCTIONS IN SECTION III FOR PROPER “FORMING” OF CAPACITORS.

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I. GENERAL DESCRIPTION

The Model 7515A is a low energy, low voltage, capacitive discharge-type magnetizer capable of saturating all alnico and barium ferrite magnetic materials. Energy levels from 380 to 2800 Watt-Seconds (Joules) are available. The Model 7515A is easily adapted to a wide variety of production and laboratory magnetizing requirements.

A modern, solid state electronics control circuit, coupled with a high current SCR and fixture, makes this magnetizer a highly reliable, low maintenance unit. The electronic voltage control circuit prevents the unit from being discharged before the preset energy level has been reached, thereby preventing incomplete magnetization.

Simplified fixture design and fabrication are made possible by the low operating voltage (425 volts maximum). The Model 7515A, with all electronic circuitry and capacitors enclosed in a metal cabinet, is also designed for maximum operator safety when used with Magnetic Instrumentation, Inc. approved fixtures.

II. ELECTRONICS CABINET

A. Specifications

Magnetizing Current	2500 to 5000 Amps depending on energy level of unit. (The maximum rated output current for the Model 7515A is 500A/capacitor.)
Output Voltage	50 Volts to 425 Volts (set by user)
Power Input	120 Volts 50/60 Hz (Optional 220 Volts). See serial tag for input power of each unit.

B. Front Panel Controls

Power ON-OFF Switch

This switch is a combination on-off switch and circuit breaker. With the switch on and proper power supplied, the power-on light will be illuminated.

Fuse

This ¼ Amp Slo-Blo fuse protects the control circuitry and low voltage power supply. This fuse is located on the back of the control chassis.

Panel Meter

The panel meter is a 0 to 500 volt analog meter. It continuously monitors the voltage of the energy storage capacitor bank.

Voltage Control

This potentiometer is used to control the voltage to which the energy storage capacitor bank is charged. Voltage may be increased by turning the knob clockwise. Voltage may be decreased by turning off the power-on switch (circuit breaker) or by initiating the magnetize function, thereby discharging the capacitor bank through the fixture. NOTE: When initially setting the voltage it is best to start with the voltage control knob at minimum and slowly adjust this control clockwise so as not to overshoot the desired level.

Lights and Push Button Switches

The lights act as ready indicators. If the white light is illuminated, it indicates that the magnetizer is ready to charge. If the green light is illuminated, it indicates the magnetizer has been charged to the preset voltage and is ready to discharge. The push-buttons provide a means of initiating the desired function. The charge push-button is active only when the magnetizer is ready to charge, as indicated by the charge light. The magnetize push-button is active only when the magnetizer is ready to discharge, as indicated by the magnetize light.

Function Select Switch

Push Charge/Push Magnetize (Center Position)

In this mode of operation a manual initiation of the charge and magnetize functions is required. Press the charge push-button when the white ready-to-charge light is on. The magnetizer will charge to the preset voltage level, as set by the voltage control knob, and turn on the green ready to magnetize light while maintaining the desired charge level. Voltage may be increased by turning the voltage control knob clockwise, or the magnetizer may be discharged by pressing the magnetize push-button, provided the green ready-to-magnetize light is illuminated.

Push Charge/Auto Magnetize (Left)

In this mode of operation the charge function must be initiated by pressing the charge push-button. Upon reaching the preset voltage level the magnetizer will automatically discharge.

Auto Charge/Push Magnetize (Right)
In this mode of operation the magnetizer will automatically charge to the preset voltage level and maintain this level until the magnetize push-button is pressed. After a short period of "off time" the magnetizer will recharge automatically and be ready for the next cycle.

C. Connections

Magnetizing Fixture (Front Panel)

The 5-pin circular connector is used to connect the magnetizing fixture to the magnetizer. This connector is electrically interlocked to prevent the magnetizer from operating without a fixture connected. IMPORTANT: When connecting a fixture to the magnetizer, observe the cabling and connector for signs of wear. Connecting a badly worn fixture to the magnetizer may pose a hazardous condition to the operator. Make sure this connector is firmly seated. A poor connection may cause electrical arcing and/or a low magnetizing field within the fixture.

External Trigger (Rear Panel)

These two 2-pin connectors may be used to externally control the magnetizer. A dry contact closure will initiate the function desired. Both charge and magnetize external trigger inputs duplicate the function of the charge and magnetize push-buttons on the front panel.

III. SET UP INSTRUCTIONS

This step-by-step set-up procedure must be followed to insure long, reliable equipment performance.

1. Place both the electronics cabinet and magnetizing fixture in their final operating location.

2. Connect water source to fixture, if required.

3. Connect the magnetizing fixture cables to the fixture connector on the electronics cabinet.

4. Set voltage control at minimum voltage (full counter-clockwise), and function select switch to push charge/push magnetize (center) position.

5. Connect AC power cord to a 120 volt, 50/60 Hz (or 220 volt, 50/60Hz, if applicable) grounded power outlet.

6. Turn on electronics cabinet power switch.

7. The white ready-to-charge light should be on. Press the charge push-button. The capacitor bank will charge to approximately 50 volts as indicated on the voltmeter.

8. Upon reaching minimum voltage, the green ready-to-magnetize light will come on. Press the magnetize push-button. The magnetizer will discharge through the fixture and remain idle for approximately 4 seconds.

9. After this short period of off-time the white light will come back on, allowing the charge cycle to be reinitiated.

Initial Break-In

10. Set the magnetizer to minimum voltage and turn on. Adjust voltage for 100 volts and allow a minimum of 1/2 hour for capacitors to form. Then adjust voltage control to 200 volts and allow a minimum of 1/2 hour for capacitors to form. Continue to raise voltage using 100 volt increments at 1/2 hour intervals until the proper operating voltage has been reached. Allow the magnetizer to form at this voltage for at least 45 minutes before operating.

Failure to follow the above procedure will lead to premature failure of the capacitors.

11. Daily warm-up requires only about five minutes at each 100-volt step.

IV. MAGNETIZER CIRCUIT DESCRIPTION

A capacitive discharge magnetizer functions by supplying large amounts of energy in a short time to a magnetizing fixture. This magnetizing pulse is milliseconds in length and is drawn through a discharge switch from the capacitor bank. The capacitor bank is charged by drawing small amounts of power from the power line over several seconds. The basic magnetizer consists of a capacitor charging circuit, capacitor bank, discharge circuit, voltage control circuit, power supply and logic circuit. (See magnetizer schematic for complete circuit details.)

A. Capacitor Charging Circuit

The capacitor charging circuit consists of a current limited transformer T1, fullwave rectifier DB 101, SCR101, R101 and the capacitor bank. The charging circuit is controlled by the logic circuit through SCR101. During capacitor charging, transformer T1 provides a charging current of approximately 12 amps maximum. R101 limits inrush current to the capacitor bank.

B. Discharge Circuit

The discharge circuit, which provides the magnetizing current, consists of the main discharge SCR, SCR Fire Control Circuit Board, SCR gate circuitry (located on control chassis), reverse current blocking diode, and the magnetizing fixture. Provided the capacitor bank is charged to the preset voltage level and the magnetize function has been initiated, the control circuit gives a gate signal to the SCR Fire Control Board (fire input Hi and Lo). The SCR Fire Control Board gates the SCR with a conditioned signal allowing current from the high energy capacitor bank to discharge through the magnetizing fixture. During the discharge pulse the charge circuit is disabled to prevent the SCR from holding on. The reverse current blocking diode begins conducting current when the capacitor bank is near zero volts, preventing negative current from flowing through the magnetizing fixture. Once current through the magnetizing fixture falls below the SCR holding current, the SCR turns off and the system will be ready to recharge, as indicated by the white ready-to-charge light.

C. Voltage Control Circuit

The voltage control circuit consists of a voltage divider and a Schmitt trigger. Voltage control POT101 provides the actual pre-set voltage level reference as part of the voltage divider. The Schmitt trigger is made up of Q308, Q309 and associated components. When the capacitor bank is at voltage, Q309 is off and Q308 is on.

D. Power Supply (Power Supply and Relay Board 10401433)

The power supply provides a regulated ±15 volts and unregulated ±24 volts. Unregulated voltage is supplied by T101, DB201, and associated components. The regulated ± volts is supplied through regulator IC201, IC202, POT201, C201 and associated components.

E. Magnetizer Logic Circuit (Magnetizer Control Board 10408494)

Technical Description – Charge Circuit:

The charge circuit on this board requires the use of an external potentiometer. The value of this potentiometer is dictated by the maximum voltage of the magnetizer. In 400 volt systems the external potentiometer will be 350 kohms, and in 800 volt systems the potentiometer will be 750 kohms. The external potentiometer is wired so that minimum voltage will equal zero-ohms and maximum voltage will be its total resistance. One end of this potentiometer is tied to the high voltage (negative) side of capacitor bank, and the other end is tied to the voltage control reference input Pin 11. This potentiometer along with R323 (47K), pot 302 (5K), and R324 (3.6K which is tied to capacitor bank ground) make up a voltage divider. This voltage divider may be adjusted by pot 302 for a maximum voltage to be adjusted on the capacitor bank. The junction of R323 and pot 302 feeds the base of transistor Q309. Q309 and Q308 make up a schmitt trigger circuit that controls the charge function. Hysteresis of voltage control is adjusted by R326. (5.1K nominal) (To increase the hysteresis decrease R326.)

The collector of Q308 feeds two circuits:

1. Q307 and Q303 serve to enable a magnetize condition. Q303 must be on, signifying the capacitor bank is not charging, before the collector of Q302 will be allowed to go low upon the initiation of the magnetize signal (+15V applied to Pin 17 of header connector). This assures that the capacitor bank is at the correct voltage level and is not charging before allowing the magnetize or discharge function to be initiated.

2. Q308 also controls the circuit that drives the gate signal to the charging SCR(s), (providing ground to the charging bridge) from Pin 7 of the header connector. To enable a charge condition, ground (supply common) must be applied to Pin 7 of header connector, allowing the collector of Q311 to go low. A low level on the collector of Q311 turns on Q312 allowing the +24V supply to be seen through R333 and D305 to Pin 7 of header connector (gate of charging SCR(s). When Q312 is off the -24V supply through R334, R333 and R339 (D305 is now reverse biased) creates a negative potential to be seen at Pin 7 of header connector (gate of charging SCR(s) holding the SCR(s) off. Q313 is used to drive an at-voltage (ready to magnetize indicator or relay coil) signal. If ground (supply common) is applied to Pin 8 of header connector (emitter of Q313), and the -24V supply through a relay coil or an

indicator is applied to Pin 5 of header connector, this coil/indicator will be on when Q312 is off.

Technical Description – Discharge Circuit:

Pin 17 of the header connector should be used to initiate the discharge function. When the +15VDC supply is applied to Pin 17 of the header connector Q302 will be turned-on and provided Q303 is on, (signifying the charge circuit is not-active), ground (supply common) is seen at Pin 12 of header connector. Pin 12 of header connector is used to start the discharge timing sequence. When Pin 12 of the header connector goes low 2 conditions have happened.

1. The capacitor bank has been charged to the preset voltage level and the charge function is not currently active.
2. A magnetize (fire) signal has been provided.
   At the same time Pin 12 of the header connector goes low, Q310 is turned on holding Q312 (charging transistor) off, disabling the charge function. The 3-Timer Chain IC301, IC302, IC303 is enabled by Pin 10 of header connector, (Ov on Pin 10 = disable/+15V on Pin 10 = Enable), and triggered by Pin 19 of header connector (Ov = trigger).

<u>Timing sequence:</u>

Provided the timers are enabled, (Pin 10 of header connector at +15V), a low (Ov) applied to Pin 19 of header connector turns off Q301 allowing C303 to discharge. This starts timers IC301 and IC 302. IC301 turns on Q304 disabling the charge circuit through Q310, and maintains the low "firing" condition at Pin 12 of header connector. IC301 also turns on Q305 activating the first half of a two transistor "and" circuit. IC301's output Pin 3 will remain active (+15V) for the entire discharge cycle. Adjustable by the time of C301 10µfd; and POT301 500K 1 turn potentiometer. Timer IC302 is used to provide a delay between the start of the discharge cycle and actual discharge of capacitor banks to allow the charge circuit enough time to shut-off (approx: 100ms). When IC302's output returns to a low (timing cycle completed) C306 discharges and provides a trigger to IC303. Upon seeing the trigger the output of IC303 goes high (+15V) and turns on the second half of the "and" circuit Q306 causing pin 2 of header to go low (provided R340 is connected to +15VDC via pin 3 of header connector). This logic signal is normally used to trigger (start) an SCR driver board that in turn gates on the discharges SCR.

The basic logic circuitry consists of three MC1455 timing circuits, used as monostable multi-vibrators, and two transistor-type logic AND gates. As the voltage control delivers an up to voltage signal to Q303, a simultaneous fire signal from PB101 will complete the AND logic, energizing 201CR. Closure of 201CR initiates the timing action of IC301 and IC302. IC301 remains in the high state for four seconds enabling Q305. After approximately 100 msec as IC302 returns to its low state, IC303 is energized which, in conjunction with IC301, turns on transistors Q305 and Q306. This action connects the

ground of the 15 volt supply to the input of the SCR fire control board (10403363).

The four-second delay of IC301 holds the charging SCR SCR101 off, preventing the capacitor bank from attempting to charge during the discharge cycle.

The 10 millisecond delay allows sufficient time to insure that SCR101 is turned off before the capacitors are discharged.

The magnetize light is a three state indicator. When the light is continuously on, it indicates the capacitors are up to voltage; when the light blinks, it indicates that SCR101 is being turned on and off, maintaining the proper capacitor bank voltage. When the light is off, the capacitor bank has not been charged to the full voltage and the magnetize firing circuitry is disabled.

F. Logic Circuit (Main Cabinet)

Incorporated in the magnetizer are two relays, 1CR and 2CR, which safely drain the capacitor bank when the power to the magnetizer is turned off or when there is a momentary power failure.

Relays 1CR and 2CR are interconnected such that if power is interrupted to relay 1CR, a bleeder resistor is connected across the capacitor bank and relay 2CR is energized until the capacitor bank is discharged to a safe level. Relay 1CR cannot be re-energized until relay 2CR has de-energized.

V. MAGNETIZING FIXTURE

Fixtures are available from Magnetic Instrumentation, Inc. for use with the Model 7515A Magnetizer.

Fixtures not designed by Magnetic Instrumentation, Inc. should meet the specifications of the magnetizer. Magnetic Instrumentation, Inc. assumes no liability for the performance or safety of fixtures not designed and manufactured by Magnetic Instrumentation, Inc.

VI. CAPACITOR REPLACEMENT

BEFORE ATTEMPTING REPLACEMENT OF ANY CAPACITORS, VERIFY THAT THE CAPACITORS IN THE MAGNETIZER ARE DISCHARGED. THE FRONT PANEL METER SHOULD SHOW ZERO VOLTS.

All standard electrical and electronic industrial procedures must be followed in maintenance work on the magnetizer. When installing new capacitors, it is extremely important that polarity of the capacitors be observed as they are wired into the circuit. All connections to the capacitor bank must be verified as tight and free of corrosion or film.

After installing capacitors it is important to run the initial break-in procedure section III step 10.

Failure to follow the initial break-in procedure will lead to premature failure of the capacitors.

Three types of capacitor are used in this unit and are dependent on the energy level. Check the serial tag for the appropriate model number - energy level of your magnetizer.

Model Number	Replacement Cap	Type
7515A-1	3520 0322	860 μfd 450 VDC
7515A-2	3520 0322	860 μfd 450 VDC
7515A-3	3520 0319	1500 μfd 450 VDC
7515A-4	3520 0319	1500 μfd 450 VDC
7515A-5	3520 2611	3100 μfd 450 VDC
7515A-6	3520 2611	3100 μfd 450 VDC

VII. SERVICE AND MAINTENANCE

NOTE: Service and maintenance of this equipment requires trained personnel. Care is required for safety of service personnel. Voltages and currents are exposed with panels removed and are hazardous. This unit should be operated with panels removed ONLY if absolutely required for repair.

A. General Instructions

The Model 7515A Magnetizer is a combination of electrical and electronic components. Procedures consistent with safety and standard practices for each area should be used.

Regular service should be performed to insure proper connection of all capacitor bank terminals, SCR terminals and fixture terminals.

If water is used for fixture cooling, all water connections should be inspected regularly for leaks or obstructions.

A regular inspection of the fixture drain will prevent component failure due to overheating.

B. Test Equipment

Trouble shooting and repair can be carried out with the following equipment:

0 to 500 volt DC voltmeter
Oscilloscope with isolation transformer.

C. Panel Removal

NOTE: Panels should be removed only by trained personnel. There are exposed voltages and currents in the cabinet. Care must be used when removing panels. Panels should be removed only with equipment disconnected from AC line. Always check the capacitor bank voltage prior to beginning any repair. If the voltage is not zero, discharge the capacitors in a safe and proper manner before proceeding.

The electronics cabinet has a removable rear panel for access to circuits. The control chassis can be taken out by removing the front panel screws and disconnecting the rear fanning strip.

D. Adjustments

Time delay and maximum voltage setting on the printed circuit board are factory set and should not be tampered with in any way without consulting Magnetic Instrumentation, Inc.

E. Trouble Shooting

Prior to beginning any trouble shooting, all connections should be checked. This includes AC power to the electronics cabinet and water supply if required. All trouble shooting should be done at low capacitor bank voltage.

Symptom	Probable Cause
Capacitor bank will not charge, meter at 0 volts, pilot light on.	Fuse F101 Relays 1CR, 2CR. Fixture not connected. See Charging circuit.
Capacitor bank will not discharge.	Fixture connections. SCR. See discharge circuit.

Charging Circuit

Symptom	Probable Cause
Capacitor bank at proper voltage, ready lamp off.	Defective ready lamp.
Capacitor bank continues to charge past set point. Indicator lamp off.	Schmitt trigger. Voltage control pot open. SCR101 Anode shorted to chassis, SCR101 shorted.

Discharging Circuit

Before troubleshooting the discharge circuit, verify that the capacitor bank is at voltage and the ready lamp is on.

Symptom	Probable Cause
Capacitor bank remains at voltage. Indicator lamp remains bright.	Push button. Q303, Q302, Q307, 201CR.
Indicator lamp goes out then returns to on after delay, but capacitor bank remains at voltage.	Fixture connections. Fixture open. SCR and capacitor connections. Q305, Q306, T301, IC 302, IC 303.
Capacitor voltage goes below 0 volts after discharge.	Reverse Current. Diode D1 open.

VIII. RECOMMENDED SPARE PARTS

Quantity	Part Number	Description
1	10403363	SCR Fire Control Board
1	42603418	Main Discharge SCR
1	10008594	Capacitor Bank (for 7515A-1 Only)
1	10008596	Capacitor Bank (for 7515A-2 Only)
1	10008595	Capacitor Bank (for 7515A-3 Only)
1	10001851	Capacitor Bank (for 7515A-4 Only)
1	10007593	Capacitor Bank (for 7515A-5 Only)
1	10002759	Capacitor Bank (for 7515A-6 Only)