CONTROL CIRCUITS
for
HELIARC
Trade-Mark
WELDING

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Be sure this information reaches the operator. You can get extra copies through any Linde office.
A. Introduction

In order to obtain a maximum in economy and effective operation from any process, it is essential that suitable means for controlling the process be available. The controls selected should be effective and suited to the particular job to be done.

The purpose of this booklet is to acquaint you with the various methods available for controlling HELIARC welding. There are three primary purposes for the control circuits: to control the power supply delivering welding current to the HELIARC torch, to control the flow of shielding gas delivered to the torch, and to control the flow of cooling water delivered to the torch.

There are many ways of setting up these controls. The illustrations in this booklet are intended only to give you an idea of the simplest means of acquiring the necessary controls for HELIARC welding. Many of the circuits illustrated are available as built-in units with modern power supplies. Before an attempt is made to build these circuits yourself, you should first ascertain whether the particular control circuit desired, or its equivalent, is available with a particular power supply.

B. Factors Affecting Selection of Control Circuits

The type of control circuit selected for a particular HELIARC welding application will be largely determined by the following factors:

1. SAFETY - No particular hazard exists in most applications. However, as with other welding methods, automatic controls for safety are important when welding in wet locations or on scaffolding.

2. ARGON CONSERVATION - The cost of this shielding gas is relatively high and waste is expensive. Devices to prevent waste can save their own cost in a short time. By such conservation measures, the process will have lower costs and, consequently, a wider field of application.

3. RADIO INTERFERENCE - Radio interference may be caused by the high-frequency current which is sometimes used to start or stabilize the arc. This interference can be reduced to a minimum by following the installation instructions provided by the manufacturer of the high-frequency generator and power supply.

4. CRATER CRACKING - Some materials (HASTELLOY C, STELLITE Grade 21, MULTIMET, and Inconel alloys) will develop a slag coating if air strikes the weld puddle before solidification is complete. This can be avoided if the argon flow continues after the welding current is broken. The continued argon protection will reduce crater cracking and make restarting easier.

5. PROTECTION OF EQUIPMENT - If the torch is placed on a grounded surface when high-frequency current is in use, arcing through the gas cup will occur. If an insulated resting place is not provided for the torch, an automatic means for turning off the power is highly desirable.

6. WATER SHUTOFF - If cooling water is allowed to run during non-welding periods when atmospheric temperature and humidity are high, and cooling-water temperature is low, water will condense on equipment. Where these conditions exist, the installation of equipment to turn the water "on" and "off" is recommended.

7. CONVENIENCE - Control of operation should be convenient. If it is not, carelessness or improper operation of a control circuit may result.

C. Recommendations

In order to obtain the best process operation, all users of the HELIARC process are urged to use electrical controls, particularly for argon conservation.

In the following sections several types of controls are suggested so that the simplest and least expensive control unit for a particular operation can be obtained. Where a suitable control unit cannot be procured from a vendor, the customer is urged to build the unit himself.

The terms HASTELLOY, HELIARC, STELLITE, and MULTIMET are registered trade-marks of Union Carbide Corporation.
II. CONSTRUCTION OF CONTROL CIRCUITS

A. General Features

1. Circuit Parts and Symbols

In the circuits shown in the following sections, some component parts of one circuit are common to other circuits. For this reason, the general information given for one circuit can be applied to all circuits. The circuits are numbered and titled for easy reference. A complete nomenclature list is supplied in Table I.

2. The Hand Torch Switch

a. Description and Operation

In the circuits illustrated in this booklet, a torch switch is shown for the initial control of the various functions. If the customer prefers, a foot-switch may be substituted in the place of the torch switch.

The torch switch is in the torch handle. For safety reasons, it is operated at low voltage rather than at the 115 volts used for the other parts of the circuit. A value of 28 volts was chosen to operate the switch because transformers for this voltage are readily available.

Circuits 1, 2, and 3 illustrate the torch switch (TS) in series with the torch switch relay, TSR. In this way the operating relays within the control circuit all depend on the operation of the torch switch. With the torch switch open, the control relays are inoperative. NOTE: The control voltage in any HELIARC pilot or control circuit should not exceed 28 volts. This applies to hand or foot switch control.

b. Installation

The switch used is a commercial type adapted for the standard HELIARC torch and is not provided; it must be purchased separately and installed in the handle.

The switch may be fastened to the side of the handle with screws or it may be installed on top in a notch cut in the torch handle. When the notching method is used, insulating tape is wrapped around the internal copper body shell on which the switch will rest. In both cases the switch and torch handles are covered with insulating tape after the installation. The tape should not interfere with operation of the switch button. Any possible strain on the wires leading into the switch is relieved by running the cable through holes drilled in the torch handle.

3. Shielding Gas and Cooling Water Flow Control

All of the control circuits, (Circuits 1 through 4), are designed for feeding shielding gas and cooling water prior to starting the weld and for continuing the flow for a short period after the completion of the weld. In this way, adequate gas shielding of the weld, as well as cooling of the torch, is ensured.

In all of the circuits pictured in this booklet, a motorized time-delay relay is employed for the post weld flow of the shielding gas and cooling water. A second type of relay, a pneumatic time-delay relay, is equally satisfactory for this control function; both types are listed in Table II for your convenience.

If the pneumatic time-delay relay is preferred, a slight alteration in each of the circuits is necessary. Refer to Figure 6 for an illustration of the substitution of this relay.

Positive protection against torch and cable overheating can be provided by the use of a water flow switch (Torch Saver). The flow switch contains a set of normally open contacts, IFS-1 in the circuit diagrams), which are placed in series with the welding contactor coil or the generator field relay coil. Contact IFS-1 closes when the proper quantity of water is flowing to the torch and opens if the flow of cooling water fails. Thus if the torch is not receiving the correct amount of water the welding current is stopped, preventing the torch and cables from overheating.

Two types of flow switches are available: a medium-duty and a heavy-duty. The flow switches are treated
in detail in Form 9748 entitled "Instructions for Using Torch Saver I and Torch Saver II, Pressure Flow Switches", available upon request from any LINDE office.

4. High-Frequency Control

Circuits 2, 3, and 4 include the application of superimposed high-frequency for starting purposes when using D.C. power supplies, and for both starting and stabilization when using A.C. power supplies. A high-frequency relay, designed to introduce the high-frequency on open circuit voltage, and to cut it off once the arc has been established, is included in Circuits 2b and 4a.

B. Control Circuits for HELIARC Welding

CIRCUIT NO. 1

1. CIRCUIT NO. 1 — Manual Switch Control, using Generator Field Interruption or Welding Circuit Interruption.

Description

Two variations of this circuit are shown, one for field interruption of the power supply, and the other for welding circuit interruption. When the torch switch is depressed, the Torch Switch Relay TSR is energized, and in turn energizes the Welding Contactor and the Argon and Water Solenoid Valves, ASV and WSV. Relay TSR also de-energizes the Time Delay Relay TDR.

When the torch switch is released, the contactor (GFR or WC) shuts off the welding current. The Time Delay Relay (TDR) holds the argon and water valves open for a short period after the torch switch is released. The timer then times out and causes the valves to close.

Because of the circuit arrangement, TDR will time out when the Main Line Switch MLS is first closed, so that there will be a short period of gas flow as soon as the unit is turned on. If a pneumatic timer is used, as shown in Figure 6, this initial gas flow will not occur.

The torch switch is of the momentary contact type — that is, it remains "on" only while it is held depressed. A torch switch of the maintained contact type (one that remains "off" or "on" without being held) is not recommended for this circuit. Failure by the operator to turn off the switch at the end of a weld would defeat the primary purpose of the circuit — that of argon conservation.

This unit is low in cost and satisfactory for argon and water conservation, safety, equipment protection, and crater cracking. It is recommended for short downhand welds. The torch switch must be held in the closed position while welding. It is, therefore, not recommended for long welds or welds in awkward positions.

Refer to Table II in the rear of this booklet for ordering information on the components of Circuit No. 1.

CIRCUIT NO. 2

2. CIRCUIT NO. 2 — Manual Switch Control, Using Rectified D.C.

Description

Two variations of this circuit are shown, one for scratch-starting, the other for high-frequency starting. With the main line switch closed, depressing the torch switch TS causes a welding contactor to close thus energizing the welding rectifier. The argon and water solenoid valves are energized through the action of the torch switch relay, TSR, as long as the torch switch is closed.

At the end of the weld, the torch switch is released and the contactor WC breaks the welding circuit, shutting off all welding power. Both the argon and water valves are held open through the action of the time delay relay TDR, and after a short time are closed as the relay times out.

Figure 2 illustrates scratch-starting wherein contact between the torch and the workpiece initiates the welding action. Figure 2b illustrates high-frequency starting with rectified power. As the rectifier becomes energized, the open-circuit relay contact 1OCR-1 closes energizing the high-frequency generator. The application of the high-frequency discharge between the torch electrode and the workpiece starts the arc and welding current flows. At this point, 1OCR-1 contact opens removing the high-frequency unit from the welding circuit.

This circuit is satisfactory from the standpoint of equipment protection and also has the advantage of low cost.

Refer to Table II in the rear of this booklet for ordering information on the circuit components.
CIRCUIT NO. 3

3. CIRCUIT NO. 3 — Manual Switch Control, Using High-Frequency Stabilized A.C.

Description

The sequence of operations for Circuit 3 is much the same as that described for Circuits 1 and 2. Argon and water start to flow when TS is operated. Welding contactors in the primary of the welding transformer are closed as soon as TS is closed and the high-frequency generator is activated. The high-frequency discharge starts the arc, welding current flows, and the high-frequency remains on throughout the welding cycle stabilizing the arc.

Releasing TS cuts off the welding transformer and high-frequency generator and the welding current stops. Argon and water continue to flow until TDR times out.

Refer to Table II in the rear of this booklet for ordering information on the circuit components.

CIRCUIT NO. 4

4. CIRCUIT No. 4 — Automatic Push-Button Control, Using Rectified D.C. with High-Frequency Starting or High-Frequency Stabilized A.C. Power.

Description

In circuit No. 4, the torch switch is replaced by push-button start and stop switches. As before, the argon and water valves are originally opened as soon as the main line switch is closed. By pressing the weld start push-button switch, WSPB, the welding transformer and high-frequency generator, or the Motor-Generator or Rectifier and High-Frequency generator, are energized, and the argon and water valves are kept open through the action of the starting relay, ASR.

For d.c. welding, an open-circuit relay, OCR, on the output side of the d.c. source is energized by the power supply open circuit voltage. The relay's contact 1OCR-1 closes energizing the high-frequency generator, and a high-frequency discharge is produced between the torch and the workpiece. The arc is thus initiated and welding current flows. OCR then de-energizes and cuts off the high-frequency generator.

For a.c. welding, contactors 2WC-1 and 2WC-2 close as soon as WSPB is depressed and the primaries of the welding transformer and the high-frequency generator are energized. The high-frequency discharge initiates the arc, welding current starts, and the high-frequency remains on to stabilize the welding arc.

In both circuits, pressing WFPB at the end of the weld disconnects the welding power supply and stops all the welding current. Argon and water continue to flow until the time delay relay, TDR, times out.

The weld start and weld finish push-button may be replaced very easily by cam-operated limit switches for completely mechanized HELIARC welding.

Refer to Table II in the rear of this booklet for ordering information on circuit components.

(Continued on page 14)

Table I - Composite Nomenclature List for HELIARC Control Circuits

<table>
<thead>
<tr>
<th>ASR</th>
<th>Auxiliary Starting Relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASV</td>
<td>Argon Solenoid Valve</td>
</tr>
<tr>
<td>BL</td>
<td>Ballast Lamp</td>
</tr>
<tr>
<td>C1</td>
<td>Condenser, 0.5 mfd, 600-volt.</td>
</tr>
<tr>
<td>F1, F2</td>
<td>Fuses, 10 amp., standard</td>
</tr>
<tr>
<td>FS</td>
<td>Flow Switch</td>
</tr>
<tr>
<td>GFR</td>
<td>Generator Field Relay</td>
</tr>
<tr>
<td>MLS</td>
<td>Main Line Switch</td>
</tr>
<tr>
<td>OCR</td>
<td>Open-Circuit Relay</td>
</tr>
<tr>
<td>PTD</td>
<td>Pneumatic Time Delay Relay</td>
</tr>
<tr>
<td>SR</td>
<td>Starting Relay</td>
</tr>
<tr>
<td>T</td>
<td>Torch</td>
</tr>
<tr>
<td>TDR</td>
<td>Time Delay Relay (Motorized)</td>
</tr>
<tr>
<td>TR1</td>
<td>Transformer, 115-volt/25.2-volt a.c.</td>
</tr>
<tr>
<td>TS</td>
<td>Torch Switch</td>
</tr>
<tr>
<td>TSR</td>
<td>Torch Switch Relay</td>
</tr>
<tr>
<td>W</td>
<td>Workpiece</td>
</tr>
<tr>
<td>WC</td>
<td>Welding Contactor</td>
</tr>
<tr>
<td>WFPB</td>
<td>Weld Finish Pushbutton</td>
</tr>
<tr>
<td>WGA</td>
<td>Welding Generator Armature</td>
</tr>
<tr>
<td>WS</td>
<td>Water Switch</td>
</tr>
<tr>
<td>WSPB</td>
<td>Weld Start Pushbutton</td>
</tr>
<tr>
<td>WSV</td>
<td>Water Solenoid Valve</td>
</tr>
</tbody>
</table>
**TO START**

1) Close Main Line Switch

- TR1-1P1 energized
- TDR energized
- ASV energized
- WSV energized
- argon flows
- water flows
- 1FS-1 closes

after short delay, 1TDR-1 opens, shutting off the argon and water
1FS-1 opens

2) Close TS

TSR energized

- 2TSR-1 (N.O.) closes
- GFR energized
- 3GFR-1, 3GFR-2, and 3GFR-3 close
- WGF energized
- Welding Circuit Interruption

electrode contacts work
short-circuit current flows
electrode withdrawn, arc established
welding current flows

**TO STOP**

1) Release TS

TSR de-energized

- 2TSR-1 (N.O.) opens
- 2TSR-1 (N.C.) closes
- 2TSR-2 opens
- GFR de-energized
- 3GFR-1, 3GFR-2, and 3GFR-3 open
- WGF de-energized
- Welding Circuit Interruption
- arc is broken

after short delay 1TDR-1 opens

- ASV de-energized
- WSV de-energized
- argon flow stops
- water flow stops
- 1FS-1 opens

*Sequence of Operations for Circuit No. 1 (Fig. 1)*
FIG. 1a – Generator Field Interruption

FIG. 1b – Welding Circuit Interruption

For nomenclature, see Table 1.

FIG. 1 – Circuit No. 1 – HELIARC Manual Switch Control with D.C. Power (Welding Generator)
TO START

1) Close Main Line Switch

- TR1-1P1 energized
- TDR energized
- ASV energized
- WSV energized
- argon flows
- water flows
- 1FS-1 closes

after time delay, 1TDR-1 opens shutting off the argon and water
1FS-1 opens

2) TS closed

- 2TSR-1 (N.O.) closes
- TSR energized
- WC energized
  (after 1FS-1 closes)
- 2TSR-1 (N.C.) opens
- TDR de-energized
- 1TDR-1 closes
- ASV and WSV energized
- argon and water flow
- 1FS-1 closes

electrode contacts workpiece
rectifier delivers short-circuit current
electrode withdrawn, arc is established
welding current flows

D.C. Power, Scratch Starting

TO STOP

1) Release TS

- 2TSR-1 (N.O.) opens
- TSR de-energized
- WC de-energized
- 2TSR-1 (N.C.) closes
- TDR energized
- 2TSR-2 opens
- 3WC-1, 3WC-2, and 3WC-3 open
- rectifier de-activated
- welding current stops
- arc is broken

after short time delay, 1TDR-1 opens

ASV de-energized
argon flow stops

WVS de-energized
water flow stops
1FS-1 opens

Sequence of Operations for Circuit No. 2 (Fig. 2)
FIG. 2a – D.C. Power with Scratch Starting

FIG. 2b – D.C. Power with H-F Starting

CONNECT TO VOLTAGE SPECIFIED ON HIGH FREQUENCY GENERATOR NAMEPLATE
TO START

1) Close Main Line Switch
   - TR1-1P1 energized
   - TDR energized
   - ASV energized
   - WSV energized
   - argon flows
   - water flows
   - 1FS-1 closes

   after short delay, 1TDR-1 opens, shutting off the argon and water
   1FS-1 opens

2) Depress TS
   - TSR energized
   - 2TSR-1 (N.O.) closes
   - WC energized
   - (after 1FS-1 closes)
   - 2WC-1 and 2WC-2 closes

   2TSR-1 (N.C.) opens

   2TSR-2 closes

   TDR de-energized

   1TDR-1 closes

   ASV and WSV energized

   argon and water flow

   1FS-1 closes

   welding transformer energized

   high-frequency generator energized

   arc is established

   welding current flows

TO STOP

1) Release TS
   - TSR de-energized
   - 2TSR-1 (N.O.) opens
   - WC de-energized
   - 2WC-1 and 2WC-2 open

   2TSR-1 (N.C.) closes

   2TSR-2 closes

   TDR energized

   welding transformer de-energized

   high-frequency generator de-energized

   arc is broken

   welding current stops

   after short delay, 1TDR-1 opens

   ASV de-energized

   argon flow stops

   WSV de-energized

   water flow stops

   1FS-1 opens

Sequence of Operations for Circuit No. 3 (Fig. 3)
FIG. 3 – Circuit No. 3 – HELIARC Manual Switch Control with A.C. Power (High-Frequency Stabilized)

CONNECT TO VOLTAGE SPECIFIED ON HF GENERATOR NAMEPLATE

For nomenclature, see Table I.
TO START

1) Close Main Line Switch

TDR energized

WSV energized

ASV energized

gas flows

water flows

after short delay, 1TDR-1 opens and argon and water ceases to flow

1FS-1 opens

2) Depress WSPB

SR energized

2SR-1 closes

2SR-2 (N.O.) closes

2SR-2 (N.C.) opens

1ASR-1 closes

WC energized

TDR de-energized

1TDR-1 closes

ASV and WSV energized

argon and water flow

1FS-1 closes

3WC-1, 3WC-2, and 3WC-3 close

rectifier energized

OCR energized

IOCR-1 closes

high-frequency generator energized

arc is initiated

rectifier delivers welding current

OCR de-energized

IOCR-1 opens

high-frequency generator de-energized

welding continues

welding transformer energized

high-frequency generator energized

arc is initiated

transformer delivers welding current

D.C. Power with High-Frequency Stabilization

A.C. Power with High-Frequency Stabilization

TO STOP

1) Depress WFPB

SR de-energized

2SR-1 opens

2SR-2 (N.O.) opens

2SR-2 (N.C.) closes

1ASR-1 opens

bypass of open 1WSPB-1 is broken

WC de-energized

TDR energized

3WC-1, 3WC-2, and 3WC-3 open

rectifier de-energized

flow of welding current stops

D.C. Power with High-Frequency Stabilization

after short delay, 1TDR-1 opens

ASV de-energized

argon flow stops

WSV de-energized

water flow stops

1FS-1 opens

Sequence of Operations for Circuit No. 4 (Fig. 4)
FIG. 4 – Circuit No. 4 – HE LIARC Automatic Pushbutton Control with D.C. (High-Frequency Starting), or A.C. (High-Frequency Stabilized)

**NOTE 1**
WC IS A 3-POLE CONTACTOR WHEN USING D.C. POWER, 2-POLE WHEN USING A.C. STABILIZED.

**NOTE 2**
IF A MOTOR-GENERATOR IS USED IN PLACE OF THE RECTIFIER ILLUSTRATED, THE WELDING CONTACTOR (WC) NEED BE ONLY A ONE-POLE CONTACTOR PLACED IN THE CABLE LEADING FROM THE MOTOR-GENERATOR TO THE TORCH. (PRECEDING THE BALLAST LAMP (BL) AND OPEN CIRCUIT RELAY (OCR) IF HIGH FREQUENCY IS BEING USED.)

**NOTE 3**
CAM-OPERATED LIMIT SWITCHES CAN BE USED IN PLACE OF THE PUSH BUTTON SWITCHES, QUICKLY ADAPTING THE CIRCUIT FOR MECHANIZED HE LIARC WELDING.

CONNECT TO VOLTAGE SPECIFIED ON HF GENERATOR NAMEPLATE.

For nomenclature, see Table 1.
C. Selection of Argon Control Relay

All of the circuits, Figs. 1 through 4, illustrate the use of a motorized time delay relay for controlling the flow of shielding gas and cooling water. It is possible in each of these circuits to substitute a pneumatic time delay relay for the motorized relay. The choice is yours to make. Each relay is listed in Table II.

If the pneumatic relay is preferred, a slight alteration must be made in each of the control circuits. For your convenience, the segment of the control circuit utilizing the motorized relay is illustrated in Figure 5 below. Figure 6 indicates the circuit required if the pneumatic time delay relay is used. The substitution can be made in any of the circuits treated in this booklet.

D. Continuous Water Flow

Each of the circuits illustrated in this booklet shows the water solenoid valve, (WSV), as the automatic shut-off type. At the end of a short time interval, both the argon and water are shut off.

If the customer prefers to have continuous water feed, without any interruption in the water flow from one welding sequence to the next, he can do so through use of the circuits illustrated in Figures 7 and 8 below.

Two types of circuits are illustrated; one for use with the motorized time delay relay, and one for the pneumatic time delay relay. Through the use of the switch WS the flow of water can be either stopped automatically at the end of the welding period, or stopped at any time by manually opening the switch.
<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASR</td>
<td>97W48</td>
<td>Starting Relay - Potter and Brumfield, PR11A, 115-volts a.c., Double-Pole, Double-Throw</td>
</tr>
<tr>
<td>ASV</td>
<td>93W15</td>
<td>Argon Solenoid Valve - Automatic Switch Co., Solenoid Valve Cat. #82623, 115-volt, 60-cycle</td>
</tr>
<tr>
<td>BL</td>
<td>95W10</td>
<td>Ballast Lamp - General Electric Co., Frosted, 115-volt, 15-watt</td>
</tr>
<tr>
<td>C1</td>
<td>08W69</td>
<td>Condenser, 0.5 mfd., 600-volt</td>
</tr>
<tr>
<td>F1, F2</td>
<td>90W46</td>
<td>Fuse-3AG, 10 amp. - Glass Tube Type</td>
</tr>
<tr>
<td>GFR</td>
<td>89W48</td>
<td>Generator Field Relay - Square &quot;D&quot; Class 8502, Type BO-30, 115-volt, 60-cycle</td>
</tr>
<tr>
<td>OCR</td>
<td>80N21</td>
<td>Open-Circuit Relay</td>
</tr>
<tr>
<td>PTD</td>
<td>96W81</td>
<td>Time Delay Relay (Pneumatic) - Square &quot;D&quot; Type BO-1D, Adj. between 0.2 to 3.0 minutes</td>
</tr>
<tr>
<td>TDR</td>
<td>95W20</td>
<td>Time Delay Relay (Motorized) - Haydon Mfg. Co., Timer 0-57 seconds, 120-volt, 60-cycle, manufactured to commercial specifications</td>
</tr>
<tr>
<td>TS</td>
<td>-------</td>
<td>Torch Switch - General Electric Co., Switchette Size 1, No. CR1070-C-12213B3 (Momentary Contact Type)</td>
</tr>
<tr>
<td>TSR</td>
<td>97W54</td>
<td>Torch Switch Relay - Potter and Brumfield, PR11A 24-volt a.c., Double-Pole, Double-Throw</td>
</tr>
<tr>
<td>WC</td>
<td>-------</td>
<td>Welding Contactor - 115-volt a.c. (number of contacts as required)</td>
</tr>
<tr>
<td>WFPB</td>
<td>96W11</td>
<td>Weld Finish Pushbutton - Square &quot;D&quot; Class 9001 Red Operator Type &quot;TR-2&quot;</td>
</tr>
<tr>
<td>WSPB</td>
<td>96W14</td>
<td>Weld Start Pushbutton - Square &quot;D&quot; Class 9001 Black Operator Type &quot;TR-1&quot;</td>
</tr>
<tr>
<td>WSV</td>
<td>93W15</td>
<td>Water Solenoid Valve - Automatic Switch Co., Solenoid Valve Cat. #82623, 115-volt, 60-cycle</td>
</tr>
</tbody>
</table>
LINDE Supplies These Quality Products to the Nation's Industries

INDUSTRIAL GASES
LINDE Oxygen, Nitrogen, Argon, Neon, Helium, Krypton, Xenon, Hydrogen, and mixtures
PREST-O-LITE Acetylene

CALCIUM CARBIDE
UNION Calcium Carbide
CARBIC Processed Carbide

OXY-ACETYLENE EQUIPMENT
OXWELD Apparatus for Cutting, Joining, Treating, and Forming Metals
Acetylene Generators
Manifolds, Regulators and Valves
Welding Rods and Supplies
PUROX Welding and Cutting Apparatus
PREST-O-LITE Welding and Cutting Apparatus
PREST-O-LITE Air-Acetylene Apparatus and Small Tanks
CARBIC Acetylene Generators

ELECTRIC WELDING AND CUTTING EQUIPMENT
HELIARC Welding and Cutting Equipment
LINDE Sigma Welding Equipment
UNIONARC Welding Apparatus and Supplies
UNIONMELT Automatic Welding Apparatus and Supplies

SPECIAL EQUIPMENT
LINDE Jet-Piercing Equipment
Plate-Edge Preparation Equipment
Steel-Conditioning Machines
Sub-Zero Cold Treatment Equipment
Liquid Oxygen Converters
OXWELD Oxy-Acetylene Cutting Machines
Pressure-Welding Machines
PREST-O-LITE Cylinders, Shells, and Shapes

OXYGEN THERAPY SUPPLIES
LINDE Oxygen U.S.P.
Oxygen Regulators
OXWELD Oxygen Manifolds and Valves

SPECIAL PRODUCTS
LINDE Synthetic Sapphire, Ruby, Spinel, and Titania
Fine Alumina Abrasive
Molecular Sieves


LINDE COMPANY
DIVISION OF UNION CARBIDE CORPORATION

General Office: 30 East 42nd Street, New York 17, N. Y.
Sales Offices in Principal Cities—See Adjoining Column