Operating Principles and Instructions

Oxweld

NA-7

STATIONARY AUTOMATIC MEDIUM-PRESSURE ACETYLENE GENERATOR

Listed under Re-examination Service of Underwriters' Laboratories Inc.

LINDE AIR PRODUCTS COMPANY
A Division of Union Carbide and Carbon Corporation

General Office: New York, N. Y. Offices in Principal Cities
IMPORTANT

Be sure you are familiar with the instructions for operating the OXWELD NA-7 generator before you place it in service or do any work on it whatever. If these instructions are not thoroughly understood, communicate with the nearest representative or office of Linde Air Products Company, and obtain further instructions before attempting the work.

Efficiency and safety necessitate compliance with ALL instructions.

Acetylene generators should be installed and operated in accordance with the standards of the National Board of Fire Underwriters, New York, N.Y., for the "Installation and Operation of Gas Systems for Welding and Cutting" (NBFU Pamphlet No. 51).

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Section I. Making Acetylene

Acetylene is a hydrocarbon gas; it is made up of carbon and hydrogen bonded together. The gas cannot be seen, but it has a characteristic odor that is easily recognized after one has once smelled it.

Acetylene is produced from the reaction of calcium carbide with water. Calcium carbide, frequently called simply "carbide", is a dark gray, stonelike material manufactured by smelting coke and lime in an electric furnace. The resultant product is crushed and carefully screened for size. It is important in acetylene generators to use ONLY the size of carbide for which the generator was designed. This assures complete reaction due to proper passage of the carbide particles through water in the generating chamber. The correct carbide size is always indicated on the nameplate of OXWELD generators.

When carbide is dropped into water, acetylene gas is formed and bubbles up through the water. A whitish residue of hydrated or slaked lime remains in the water. This reaction also gives off heat. In fact, when carbide is wet with an insufficient amount of water, enough heat can be given off to raise the temperature of the carbide enough to ignite an acetylene and air mixture. For this reason, water must never be used to put out a fire involving carbide.

(In OXWELD NA-7 Acetylene Generators, the heat produced in reacting the carbide is absorbed by the water which is continuously fed into the generating chamber through a series of sprays. Excessive temperatures in the generating chamber are prevented by a thermostatically-operated valve which adjusts the amount of water delivered by the sprays to the rate of the carbide feed.)

Carbide also will take up water vapor from the air, thereby giving off acetylene and slaking even though apparently no water is present. For this reason, UNION carbide is packed in sturdy airtight and watertight containers. Carbide should never be exposed to the atmosphere any longer than is absolutely necessary.

Both carbide and the slaked lime residue are somewhat caustic and tend to irritate a person's skin and mucous membranes. Touching the carbide or lime or breathing the dust should be avoided as much as possible. It is advisable to wear a respirator and gloves when opening carbide containers or when working with lime residue.

Regulations and laws forbid the generation, compression or use of free (undissolved) acetylene at pressures higher than 15 lbs. per sq. in. The reason for this is that acetylene may, under certain conditions at pressures greater than 15 lb. per sq. in., break down explosively into its constituents, carbon and hydrogen. Testing laboratories have established standards which closely control the manufacture of acetylene generators. The Re-examination Service marker of the Underwriters' Laboratories, Inc. on the OXWELD NA-7 Acetylene Generator shows that this generator meets the standards set by this testing organization.

It is essential that all persons who operate or work on NA-7 generators thoroughly understand and carefully follow the recommendations in the NBPU Pamphlet No. 51, "Standards of the National Board of Fire Underwriters for the Installation and Operation of Gas Systems for Welding and Cutting."

* Acetylene is commonly stored and shipped in specially-constructed cylinders, in which it is dissolved in acetone at pressures above 15 psi. Under these conditions and strictly in accordance with the Interstate Commerce Commission specifications, acetylene may be safely stored and shipped.

Section II. Generator Description & Operating Principles

Sect. II-A. Description of Generator

The OXWELD NA-7 is a stationary generator for the production of medium-pressure acetylene. It can be operated to generate acetylene at rates of up to 9000 cu.ft. per hr., at any pressure between 8 and 13 psi.

The NA-7 consists of two main assemblies, the generating-chamber assembly and the 2000-lb. carbide-handling assembly (Fig. 1). The generating-chamber assembly, which contains approximately 250 gallons of water, provides the space in which acetylene generation takes place. It is provided with controls for regulating the supply of water and draining of residue, and for activating the carbide feed screw control unit. The 2000-lb. carbide-handling assembly consists of two carbide hoppers, one above the other, which can be isolated from each other by a connecting valve.

In this way, the upper hopper can be charged with carbide while the generator continues to operate on carbide supplied from the lower hopper. The two main assemblies are connected by an inclined carbide screw which extends from the bottom of the carbide-handling assembly into the upper side of the generating chamber.

An inclined-screw carbide elevator is generally used to charge the upper hopper of the carbide-handling assembly. The discharge end of this carbide screw elevator is attached to the top of the upper carbide hopper and the loading end is located near floor level in the carbide storage room. In an NA-7 installation, the carbide hopper is the most convenient method of carbide charging. See Page 12 for a more detailed description of this companion equipment.
Automatic features of the NA-7 generator reduce manual duties to those associated with the recharging of carbide, observation of generator-condition indicating devices, draining of residue at 2-hr. intervals, and occasional cleaning and adjustment of water supply and pneumatic control equipment. Safe operation is assured by the control and signal systems which warn of approaching dangerous conditions, and which automatically stop generator operation if steps are not taken to offset those conditions.

Sect. II-B. Principles of Operation
(Refer to Figures 1 and 2)
NA-7 operation consists essentially of the feeding of calcium carbide into water contained in the generating chamber, to produce acetylene gas. A whitish residue of slaked lime remains in the water which is drained automatically to waste. Acetylene enters the service line to supply consuming equipment.

As shown in Figure 2, carbide is fed from the base
of the lower carbide hopper by an inclined feed screw which discharges into the generating chamber. Here the carbide is thoroughly doused by four fresh water sprays which cover all of the surface of the water in the generating chamber. Carbide not completely reacted by the sprays is prevented from accumulating or settling to the bottom of the generator by a tandem propeller agitator which maintains the entire carbide-lime-water mass in the generating chamber in constant turbulence.

Acetylene leaves the top of the generator by way of a centrally located scrubbing tower provided with three fresh water sprays in series. These sprays cool the acetylene, lower its moisture content and wash out entrained lime. The acetylene then passes through a hydraulic back-pressure valve which prevents back flow of gas into the generator from the service line.

Sect. II-C. Operating Features
Water Shell

The water shell is a welded-steel pressure vessel. It forms the generating chamber in which the carbide and water are reacted. Carbide is fed into the generating chamber by an inclined feed screw which discharges above the surface of the water in the generating chamber. Water enters the chamber through sprays located in the roof of the water shell, and through sprays in the scrubbing tower located at the top of the shell.

Constant circulation of water within the generating chamber is maintained by a propeller-type agitator. The agitator is driven by a motor which is externally mounted at the back of the water shell (Fig. 3). The back of the water shell also contains a manhole for convenient access to the generator interior for inspection and maintenance operations.
The manual residue drain line is connected to the lowest point on the water shell. Most of the generator control devices are mounted directly on the water shell. These include the microswitch and float assembly, generator pressure gauge, thermometer, high-temperature switch connection, and water-temperature control valve.

The water shell rests on four welded pipe legs which are bolted to the generator base assembly.

**Variable-Speed Feed Screw Drive**

The variable-speed system for driving the feed screw is located at the base of the lower carbide hopper (Fig. 4). The drive system consists of a 1 H.P. electric motor, input worm gear reducer, variable-speed P.I.V. unit, output worm gear reducer, air relay operator and roller chain and sprocket assembly.

When the generator is in operation, the electric motor rotates at a constant speed of 1750 rpm, and is connected to the input shaft of the input worm gear reducer. The output shaft of this reducer rotates at 483 rpm, and is connected to the input shaft of the P.I.V. unit. The rotational speed of the P.I.V. output shaft is controlled by the operating lever of the air relay. (For an explanation of how this lever is actuated, refer to the Pressure Control System, Page 7.)

The controlled speed of the P.I.V. output shaft is transmitted to the output worm gear reducer, where it is further reduced. The output shaft of this reducer is connected to the feed screw shaft by a roller chain and sprocket assembly. The only variable in this drive system is the output speed of the P.I.V. unit. Since this speed is determined by the generator pressure which activates the P.I.V. air relay operator, we have a variable carbide feed system which is responsive to the demands of the consumption equipment or processes.

The drive motor is connected to the electrical control system in such a way that any abnormal generator operating condition will automatically open the motor circuit. (See Electrical Control System, Page 10.) This stops the drive motor and prevents further feeding of carbide into the generating chamber.
Agitator

The agitator assembly consists of two propeller-type blades arranged in tandem on a shaft and driven by an electric motor mounted directly on the outside of the generating chamber. The agitator keeps the water-lime-carbide mixture in the generating chamber in constant turbulence to prevent excessive settling of the heavier particles. The agitator starts simultaneously with the feed screw and, through a time-delay control, operates for about one minute after the feed screw stops.

The agitator requires a water-tight running seal between the generating chamber and the shaft bearings. This is provided by a precision-finished carbon-to-brass mechanical seal. Successful operation of this seal requires that it never run dry. Furthermore, the seal liquid supplied must be clean. In order that these conditions can be maintained, the mechanical seal is provided with an auxiliary seal to act as a barrier against generator lime, and a fresh-water supply for lubrication. The water supply line for this seal is provided with a strainer having a much finer mesh than the strainer in the main water supply line to the generator.

It is not unusual for the mechanical seal to leak slightly when it is idle, or during initial operation when new. Leakage will be noted at the water outlet on the bottom of the mounting flange (Fig. 3). Leakage should stop when the agitator is placed in operation; however, a slight amount of dripping may continue for a few minutes because of water remaining in the drain line. Make sure the drain line is open. An obstructed drain line may permit leakage to enter the bearings, causing them to wear prematurely. If continued leakage is noted at the water outlet on the bottom of the agitator mounting flange when the generator is in operation, the agitator should be repaired in accordance with instructions in the Maintenance Book.

Fresh Water Supply

Fresh water is supplied to the generator through seven sprays. Pour sprays in the generating chamber and the two lower sprays in the scrubbing tower (Fig. 2) operate in conjunction with the feed screw. Through suitable electrical controls, these six sprays start when the feed screw is placed in operation. Thereafter, the sprays remain on unless the demand for acetylene ceases and the feed screw does not operate again within about one minute. Upon resumption of the demand for acetylene, the pressure controls start the sprays and the feed screw simultaneously.

The bulk of the water for generation is supplied by the large secondary spray at the top of the scrubber tower. This spray is subject to the same on-off control system as the other six. However, the rate at which water is supplied through this spray is controlled by a valve which reacts to the water temperature in the generating chamber. When the valve is set to maintain 160°F. (operating temperature) in the generating chamber, it starts to open at approximately 140°F. to provide efficient scrubbing over a wide range of operation. With the generation temperature so controlled, the water requirement of the generator is dependent on the initial temperature of the water supply as well as on the rate of operation.

If the water supply to the generator should become inadequate, the heat of reaction from continued operation will cause a high temperature limiting control to light a red warning light and simultaneously stop the feed screw. A separate indicating thermometer shows the temperature within the generating chamber.

The water supply system is directly connected to the generator, which operates at medium pressure. For these reasons, special precautions have been taken to prevent acetylene from backing into the water supply system if the water pressure should fail. The generator is equipped with a check valve in the lowest part of the water supply piping to prevent a back flow into the water system. Furthermore, the 3-way valve in the water supply line to the generator is manually closed on shutdown, draining any leakage either from the generator or from the water supply to the open port.

Carbide Charging

During operation, the generator must be recharged periodically with carbide. Two carbide hoppers in series and arranged one above the other permit continuous operation of the NA-7 generator by making it possible to isolate and recharge the upper hopper while the lower hopper continues to supply carbide for generation. The amount of carbide left in the upper hopper is easily determined by the operation of a feeler-type carbide indicator mounted on one side of the hopper. See Section III, Page 12 for a description of the carbide screw elevator used for recharging the NA-7.

After the upper carbide hopper has been recharged and the upper carbide valve has been closed, the acetylene pressure in the upper hopper is equalized with the pressure in the generating chamber by opening the equalizing valve for a few seconds. This prevents a sudden surge of moist acetylene through the feed screw and lower hopper and into the upper hopper when the lower carbide valve is opened.

An automatic interference mechanism is provided to prevent any errors in the sequence of recharging operations. The upper carbide valve cannot be opened until the lower carbide valve is closed and the pressure in the upper hopper is vented; the equalizing line cannot be opened while the upper hopper is being recharged; and the lower carbide valve cannot be opened until the upper carbide valve is closed. A detailed description of this interference system is given in Section II-D, Page 9.

Liquid Level Control

The water level in the generator is maintained by a liquid level control. When the level reaches the high operating level, the float-actuated control pneumatically opens the automatic residue drain valve. When the residue has been drained to the low operating
level, the control closes the residue valve. Thus, in
operation the generator water level fluctuates be-
 tween the high and low operating limits. The average
volume of water in the generator is approximately 250
gallons.

The float on the liquid level control also actuates
safety and signal devices. If the water level, for any
reason, should go appreciably above or below the op-
erating range, the control turns on a red signal light
and simultaneously stops the feed screw. See Page
7 for a more detailed description of the liquid-level
control system.

Residue Disposal
The manually-operated residue drain valve is attach-
ed to the lowermost part of the generating chamber.
At regularly prescribed intervals this valve must be
opened to remove the heavier residue. After the valve
is opened and the generator water level recedes to
the desired level, the float on the liquid level control
lights a white signal light, notifying the operator to
close the valve. If the valve is not then closed, the
water level will continue to drop and the feed screw
will stop, as stated above.

Carbide Feed Control
When the generator is operating to produce ap-
proximately 2000 to 9000 cubic feet of acetylene per hour,
the carbide feed rate is controlled by a pneumatic
pilot control which increases or decreases the speed
of the carbide feed screw through an air-operated
diaphragm motor and a variable speed unit. If the
acetylene consumption usage should drop below ap-
proximately 2000 cfm, the pressure control is taken
over by a mercury contact switch sensitive to gen-
erator pressure. The feed screw motor will then
stop and start as required to maintain the desired
generating pressure. (If the air supply to the gener-
at or control system should become inadequate, the
decreased pressure will activate a pressure switch
and stop the feed screw. This pressure switch is lo-
cated in the air-line downstream of the generator air
supply regulator.) See Page 7 for a more detailed
description of the pressure control system.

Hydraulic Back-Pressure Valve
The NA-7 is equipped with a hydraulic back-pressure
valve (or "hydraulic", as it is usually called) to pre-
vent a back flow of gas into the generator from the
service line.

The hydraulic back-pressure valve is so designed
that acetylene enters the hydraulic through a check
valve, with a tangential flow that minimizes the en-
trainment of water as the gas moves through it. This
method of entrance, together with the baffle arrange-
ment, enables operation at high rates without loss of
water from the hydraulic.

As shown in Figure 5, the hydraulic is provided with
a standpipe inside the baffle tube. This allows the
water level to be checked while gas flows through the
hydraulic. Checking is accomplished by opening the
hydraulic drain valve and inserting the test plug in
the self-closing, quick-disconnect valve. Surplus
water above the top of the standpipe will drain out
through this valve. If the water level is below the top
of the standpipe, this condition will be indicated by a
discharge of gas. The quick-disconnect valve will re-
main open only as long as the test plug is held in it;
it closes automatically as soon as the test plug is re-
leased. With these provisions, the water level can
be checked and adjusted without interrupting gener-
or operation.

During generator operation, the level of water in the
hydraulic is usually increased by condensation of
some of the moisture in the acetylene. To assure sat-
sactory operation of the hydraulic, the water level
should be checked and adjusted after every two hours
of generator operation (see Page 17).

A relief valve is installed in the acetylene outlet line
of the hydraulic. In the event that service operations
develop a back pressure in the service line, the water
seal at the bottom of the hydraulic will prevent the gas from being pushed back into the generator. The excess pressure will then be vented to the atmosphere by the relief valve. It is important that the hydraulic always be filled to the correct level. See also "Cold Weather Care", Page 13.

Sect. II-D. Generator Control Systems

Liquid-Level Control System

The water level in the generating chamber is kept within the operating range by the action of the liquid-level control system. This system consists of a ball float, pilot valve, diaphragm valve and microswitch assembly (Fig. 6).

The pilot valve operates to control the flow of compressed air to the diaphragm-operated residue drain valve. When the water level in the generator rises to the upper operating limit, the float arm trips the pilot valve to its open position to admit air to open the drain valve. When a sufficient amount of residue has been drained, the float arm trips the pilot to release the air from the drain valve to cause it to close. The pilot valve has no point of intermediate action which will cause a throttling of residue flow through the drain valve.

The liquid-level pointer operates with the float rod and indicates the water level in the generating chamber. The liquid-level indicator is provided only as a means of checking the water level; it should never be used as an accurate index for adjusting the water-level control. If the water level varies excessively from the operating limits marked on the water-level indicator, provisions must be made to stop the generator and check the water-level control system as instructed in the Maintenance Book.

The microswitches are operated by cams which are rotated by the float rod through the movement of the ball float. Minute adjustment of the switches is accomplished by the use of adjustable cams. The microswitches (F-1, F-2, F-3) operate the white and red signal lights and also open the electrical circuit to stop the generator if high or low water level or high water temperature conditions should occur. If excessive variation is found between the operation of signal lights and the water-level indicator, provisions must be made to stop the generator and check the water-level control system as instructed in the Maintenance Book.

The microswitch cover must never be removed while the generator is in operation. To do so will expose electrical switches which are not explosion proof. The generator is approved for operation only with the microswitch housing cover in place.

In the NA-7 generator, the operating pressure is maintained at the desired value by automatically adjusting the rate of carbide feed to the rate at which acetylene is required by consumption uses. This is accomplished by means of a Wizard Pilot which is actuated by the generator pressure. The Pilot, in turn, acts to control the pressure of the compressed air which operates the speed selector lever of the variable speed drive for the carbide feed screw. This arrangement is shown in Figure 7.

Pressure Control System

The generator pressure is piped to the control-pressure inlet block of the Pilot and into the Bourdon tube; thus the Bourdon tube will move in response to any change in the generator pressure. An increase in the generator pressure will cause the Bourdon tube to expand, moving the free end to the right. This moves the flapper away from the nozzle and increases the nozzle opening. Thus, the operating air is bled through the nozzle to the atmosphere, with a resultant loss in the pressure on the diaphragm of the air-relay regulator. Conversely, a decrease in generator pressure will cause the Bourdon tube to contract, moving the flapper closer to the nozzle. The operating air then completes its passage through the Pilot and increases the pressure on the diaphragm of the air-relay regulator.

The pressure of the operating air supplied to the diaphragm of the air-relay regulator is always directly proportional to changes in generator pressure. This pressure actuates the air relay regulator to control the pressure of the air which acts against the piston of the diaphragm motor. The position of the piston of the diaphragm motor controls the output speed of the P.I.V. variable-speed unit, which in turn controls the speed of the generator feed screw.

continued on page 9
Fig. 7 Schematic Diagram of Pressure Control System
Automatic Interference System

The automatic interference system prevents errors in the sequence of recharging operations that could lead to gas losses and safety hazards. The automatic interference mechanism accomplishes this in the following manner:

1. It eliminates the possibility of the upper carbide valve being open while the upper carbide hopper is under pressure.

2. It eliminates the possibility of the pressure equalizing line (generator to upper hopper) being opened while the upper carbide valve is open.

The automatic interference system consists of the parts indicated in Figure 8. During operation of the generator at any time other than during the recharging process, the following conditions exist:

1. The upper carbide valve is closed and the upper carbide hopper is pressurized.

2. The hopper pressure holds the contacts of the mercury pressure switch (P-3) closed. This energizes the solenoid valve (V-2) which keeps the air line open to the air cylinder. The air pressure holds the locking pin in position against the locking cam so that the upper carbide valve cannot be opened (Fig. 9a).

3. The operating air supply valve is held open by the locking cam. The resulting air pressure on the diaphragm valve in the equalizing line keeps this valve open.

4. The self-closing manually operated valves in the upper-hopper vent line are in the normally closed position.

During the recharging period, the interference mechanism operates in the following manner:

1. When the upper carbide hopper becomes empty of carbide, the generator attendant closes the lower carbide valve manually. He then holds the self-
c. Locked (Normal Operating) Position  b. Unlocked (Recharging) Position

Fig. 9 Automatic Interference System

closing valve in the upper hopper vent line in the open position until the hopper pressure drops to 1/2 psi. At this pressure the mercury pressure switch de-energizes the solenoid valve, which operates to shut off the air supply line and exhaust the air from the air cylinder. This causes the piston in the air cylinder to move back and releases the locking pin from the locking cam (Fig. 9b). The upper carbide valve can then be opened manually after moving the interference rod down to lock the lower carbide valve closed.

2. When the upper carbide valve is opened, the locking cam moves to close the air valve and exhaust the air from the diaphragm of the valve in the equalizing line. This causes the diaphragm valve in the equalizing line to close, thereby eliminating any possibility of the acetylene flowing into the hopper through the equalizing line while the hopper is being recharged.

3. After the upper carbide hopper is refilled with carbide, the upper carbide valve is closed. Closing this valve causes the locking cam to open the valve which admits air to the diaphragm of the valve in the equalizing line. This opens the diaphragm valve, and the upper carbide hopper can then be pressurized by opening the manual valve in the equalizing line.

4. When the pressure in the upper hopper reaches 2 psi, the mercury pressure switch energizes the solenoid valve, which admits air to the air cylinder. This positions the locking pin under the locking cam to lock the upper carbide valve in the closed position.

5. After the upper carbide valve is thus locked in the closed position, the generator attendant can raise the interference rod to the up position, and open the lower carbide valve.

The recharging operation is now completed, and the interference system is in its normal operating condition.

**Electrical Control System**

The electrical control system for the NA-7 generator is illustrated in Figure 10. Two sources of electrical power are required: 220 volt, 60 cycle, 3 phase for the motors; 110 volt, 60 cycle, single phase for the control circuits.

**STARTING.** CB-1, S-1 and CB-2, S-2 are combination magnetic starters and circuit breakers which give short-circuit protection individually for the 220 volt and 110 volt sources. Push button PB-1 is used for

*All motors and control housings mounted on the generator or mounted in the generator room have been specifically approved by Underwriters' Laboratories for use in these locations. The signal lights are vapor-proof and are installed in a manner prescribed in NFPA Pamphlet No. 51 for acetylene-generator houses. A duplicate set of signal lights is located in the control room.*
FIG. 10 - Schematic Diagram of Generator Electrical System

Legend

- Manually operated circuit breaker
- Contactor or motor starter coil
- Main contactor—normally open
- Thermal overload element
- Thermal overload contact
- Green signal light
- Red signal light
- White signal light
- Maintained contact push button
- Temperature switch
- Cam operated switch—normally open
- Cam operated switch—normally closed
- Pressure switch

To start the generator agitator and feedscrew motors to place the generator in service. When this is done, the green lights (L-5 and L-6) go on. This indicates that the generator is in service, but does not necessarily mean that the feed screw is turning.

Low Generating-Rate Operation. Generator pressure is run from the generating chamber to pressure switch P-1 in the control room. Once the generator is in service, P-1 controls the starting and stopping of the feed screw if the demand for acetylene drops below approximately 2000 cfm.

Temperature. Temperature limit switch T-1 stops the generator if the generator temperature should rise above the normal operating value. The red lights (L-1 and L-2) also warn the operator of this condition.

Water Level. Double-acting float switch F-1 stops the feed screw if the generator water level should rise above the operating level or drop below the drain level. A similar double-acting float switch, F-2, turns on the red lights (L-1 and L-2) for the same conditions. The indicator on the float-switch housing will indicate which condition is responsible for stopping the generator. Float switch F-3 operates the white lights (L-3 and L-4) to indicate to the operator that the generator water level has been drained to the drain level.

Air Pressure. If, at any time during generator operation, the plant air supply should become inadequate for satisfactory generator operation, mercury pressure switch P-2 will operate to stop the carbide feed screw.

Automatic Restarting. When the feed screw stops through the action of P-1, P-2, F-1 or T-1, time delay TD-1 is also placed in operation. If the feed screw does not start again within 1 minute, the delaying action of TD-1 is completed, permitting solenoid valve V-1 to shut off the air supply and vent the air from the valve in the water line to the sprays, closing that valve. The agitator is also stopped through the action of TD-1. As soon as the feed screw starts through action of P-1, P-2, F-1 or T-1, the time delay switch TD-1 is again energized permitting solenoid valve V-1 to open the valve in the line to the water sprays. The agitator is also started simultaneously.

Interference System. Through the action of mercury pressure switch P-3 and solenoid valve V-2, the automatic interference mechanism locks the upper carbide valve closed when the upper carbide hopper is pressurized. When this pressure is reduced to 1/2 psi, P-3 de-energizes V-2, releasing the valve lock for recharging. After recharging, pressurizing the upper hopper operates P-3 to energize V-2, locking the upper carbide valve in the closed position.
Section III. Carbide Screw Elevator

The carbide screw elevator (Fig. 11) is designed for use as companion equipment with the NA-7 generator. It provides a means for conveying carbide from the carbide storage room to the upper hopper of the generator.

The carbide screw elevator consists of an inclined screw within a cylindrical housing. The screw is driven by a 3 H.P. motor through a silent chain and worm-gear reducer. Carbide is fed into the elevator inlet located near floor level in the carbide storage room. Operation of the elevator carries this carbide to the generator hopper at the rate of approximately 180 pounds per minute.

The electrical control circuit for the elevator motor includes a current limit relay in addition to the equipment usually employed for motor control. The function of this relay is to break the motor circuit whenever the amperage to the motor exceeds a set amount. This is the basis for automatically stopping the carbide charging when the upper hopper is filled.

As the generator hopper fills with carbide, the acetylene displaced from the hopper flows back down the elevator and escapes through the vent pipe connected to the top of the elevator casing. This counterflow of acetylene moving through the carbide in the upper end of the elevator acts to sweep the carbide free of air before it is discharged into the generator hopper.

![Schematic Diagram of Electrical System for Carbide Screw Elevator](image)

**LEGEND**

- **MANUALLY OPERATED CIRCUIT BREAKER.**
- **CONTACTOR OR MOTOR STARTER COIL.**
- **MAIN CONTACTOR—NORMALLY OPEN.**
- **THERMAL OVERLOAD ELEMENT.**
- **THERMAL OVERLOAD CONTACT.**
- **CONTACTOR—NORMALLY CLOSED.**
- **MOMENTARY CONTACT PUSH BUTTON.**

**Fig. 12** Schematic Diagram of Electrical System for Carbide Screw Elevator

Sect. III-A. Electrical Control

Figure 12 is a wiring diagram for the carbide screw elevator. After closing the circuit breaker, CB-4, pushing the momentary-contact push button PB-2 starts the screw motor. To keep the overload current relay OR-1 from being actuated by the starting current, a shunt circuit is provided through SR-1. Push button PB-2 actuates SR-1, closing the shunt circuit around OR-1. When PB-2 is released after the motor starts, SR-1 becomes deenergized and the circuit is completed through OR-1.

If the motor current increases to a predetermined value, contactor OR-1 will open to stop the motor by the action of S-3. Thus, when the upper generator hopper becomes full and further operation of the screw tends to pack the carbide in the screw, the resultant increase in current actuates OR-1 to instantly stop the elevator motor.
Sect. IV - A. General Safety

General Precautions

1. Protect the generator from all smoking around the generator; a lighted cigar, cigarette or pipe, or any other possible source of fire near the generator room or unit. This includes electric flashlights. Acetylene and air in contact (80% acetylene) are flammable and may be ignited.

2. Do not work on or near the generator or other implements that may be in use.

3. If the odor of acetylene is detected, immediately open the doors and locate the source of the odor of leakage at once. Use nothing but a flashlight to locate leaks.

4. Do all charging, cleaning, adjusting of the generator by day.

5. Never allow the generator to operate while there is carbide in the hopper or cylinder.

6. Keep the generator room clean to prevent carbides from accumulating in corners or other places. Keep all passageways clear.

7. Always follow the printed order in the order specified. Shortcuts are unsafe.

Cold Weather Care *

1. Protect the generator from freezing of the generator room. Allow the room to go below 40°F. Where necessary, the heat should be so regulated that the furnace should be so located that it is in or near the generator room heaters should not be employ.

2. If water in any part of the generator is not covered, thaw it with hot water only.

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LEGEND

1. Acetylene Intermediate Valve
2. Acetylene Service Valve
3. Air Regulator (Automatic Interference System)
4. Air Regulator (Pilot Valve)
5. Air-Supply Pressure Gauge (Automatic Interference System)
6. Air-Supply Pressure Gauge (Pilot Valve)
7. Automatic Spray Valve
8. Automatic Interference System
9. Carbide Indicator Handle
10. Carbide Screw Elevator (Accessory)
11. Carbide Valve Interference Rod
12. Feed Screw Housing
13. Generator Pressure Gauge
14. Generator Relief Valve
15. Hopper Relief Valve
16. Hopper Vent Valve
17. Hydraulic Back-Pressure Valve
18. Hydraulic Back-Pressure Valve Relief Valve
19. Lower Carbide Valve
20. Lower Carbide Hopper
21. Main Water Supply Valve
22. Micro Switch Housing
23. Pilot Valve (For Liquid Level Control)
24. Pressure-Equalizing Valve, Automatic
25. Pressure-Equalizing Valve, Manual
26. Residue Drain Valve, Automatic
27. Residue Drain Valve, Manual
28. Scrubber Tower
29. Thermostatic Water Control Valve
30. Upper Carbide Valve
31. Upper Carbide Hopper
32. Variable-Speed Drive Unit
33. Water-Filling and Flush Valve
34. Water Flowmeter
35. Water Shell
36. Water-Spray Pressure Gauge
37. Water Spray Regulator

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*For additional details, refer to For Care of Acetylene Generating and Disposal. This booklet is available through your...
fore such a generator can be put into service, the air
must be purged from it; then it must be filled with
water and charged with carbide. Follow the instruc-
tions in the order presented below, referring to Fig.
13 for the location of operating components.

1. Close the generator acetylene service valve.
2. Open the intermediate acetylene valve between
the generator and the hydraulic.
3. Close the manual residue valve at the bottom of
the generator.
4. Close the generator water-filling and flush valve.
5. Close the plug valve in the automatic residue
drain line.
6. Close the water valve at the bottom of the hy-
draulic.
7. Drain all water from the hydraulic by removing
the double-tapped bushing from the bottom. After
the water is drained, replace the fittings.
8. Close the water valve to the agitator shaft seal.
9. Close the water shutoff valve in the scrubber
spray line.
10. Adjust the pointer on the air-supply mercury
pressure switch (P-2, in the control room) to
12 psi.
11. Open the air-line shutoff valve and adjust the
generator air regulator to provide 20 psi pres-
sure to the generator controls.
12. Adjust the mercury pressure switch (P-3, in the
control room) in the automatic interference sys-
tem. Set the lower pointer to 1/2 psi and the
upper pointer to 2 psi.
13. Adjust the air regulator in the automatic inter-
ference system to provide 20 psi to the inter-
ference mechanism.
14. Move the carbide-valve interference rod to the
down position and close the upper carbide valve.
15. Move the carbide valve interference rod to the
up position and open the lower carbide valve.
16. Temporarily remove the plug in the end of the
equalizing line on the hopper side of the manual
pressure-equalizing valve. Replace the plug
with a line connected to a nitrogen supply mani-
fold which is equipped with a regulator and a
shutoff valve downstream. Back out the regu-
lator pressure-adjusting screw until it no longer
compresses the spring, then slowly open the cy-
linder valves. Adjust the nitrogen supply to 10
psi pressure.
17. Slowly open the nitrogen shutoff valve and per-
mit the pressure in the entire generator to build
up to 10 psi. Then close the shutoff valve.
18. Raise the operating lever of the hydraulic relief
valve and permit the pressure to release to the
outdoor atmosphere.
19. Repeat steps 17 and 18 three additional times.
20. Shut off the source of purge nitrogen. Disconnect
the nitrogen line from the equalizing line, and re-
place the plug.
21. The generator is now adequately purged with
nitrogen to be free of air and ready for purging
with acetylene.
22. Open the plug valve in the automatic residue drain
line.
23. Turn the three generator-control circuit break-
ers ON and make sure that both the white and red
signals light. Turn the carbide screw elevator
control ON.
24. Open the main water supply valve. Then open
the generator water-filling and flush valve and
add water until the red and white lights go out.
25. Close the lower carbide valve. Move the valve
interference rod to the down position and open
the upper carbide valve.
26. Make sure the carbide supply container is posi-
tioned over the inlet of the carbide screw ele-
vator, with the container valve open.
27. Push the carbide screw elevator push button ON
to start the screw motor. The screw motor will
stop after the elevator conveys approximately
1000 lbs. of carbide to the upper generator hop-
per*.

* The carbide handling capacity of the carbide screw elevator
is approximately 180 pounds per minute. Thus, the time
required to fill the generator hopper can be determined. If the
screw should operate for a longer period of time than
estimated to fill the hopper, either the carbide supply
container has become empty of carbide or carbide has
bridged within the container to stop the flow of carbide to
the screw.

If the carbide supply container becomes empty during the
recharging operation, push the screw elevator pushbutton
OFF and complete the generator recharging instructions.
Since the generator hoppers are not completely full of
carbide, it will take less time of generator operation to
empty the hoppers. During this time, the empty carbide
supply container must be replaced with a full one, and the
normal recharging operations resumed when the upper
generator hopper becomes empty of carbide.

If carbide bridges in the container during the recharging
operation, the condition usually can be corrected immediately
by pounding on the outside of the container with a wooden
mallet or other sparkproof tool. If other measures are
required, the screw elevator must be stopped and the
generator recharging instructions completed. After the
bridging condition is remedied, normal recharging opera-
tions can be carried on when the upper carbide hopper again
becomes empty.
28. Close the upper carbide valve and move the interference rod to the up position. Open the lower carbide valve. When the carbide has discharged into the lower hopper, close the lower carbide valve.

29. Move the interference rod to the down position. Open the upper carbide valve and restart the carbide screw elevator. When the upper hopper is filled again, close the upper carbide valve. Move the interference rod to the up position and open the lower carbide valve.

30. Connect the water filling connection to the bottom of the hydraulic, raise the hydraulic relief-valve operating lever, open the hydraulic drain valve and fill the hydraulic to operating level with 6 gallons of water. Drain any excess water from the hydraulic by replacing the water filling connection with the drain connection. Close the hydraulic drain valve and close the relief valve.

31. Open the water valve to the scrubber spray.

32. Open the water supply valve to the generator agitator 1/4 turn.

33. Adjust the generator pressure mercoid switch (P-1, in the control room) so that the lower pointer is 1/2 psi above the desired operating pressure and the upper pointer is 1 psi above the desired operating pressure.

34. Turn the adjusting screw on the water regulator to the sprays all the way down.

35. Turn the generator feed screw push button ON. As soon as the generator is up to the predetermined setting on the pressure mercoid, observe that the feed screw motor will stop.

36. Adjust the water regulator to the sprays to 45 psi pressure. Check the water flowmeters to see that each indicates a flow of 3 gallons per minute or more.

37. Turn the generator feed screw push button OFF.

38. Raise the operating lever on the hydraulic relief valve and release the pressure to the outside atmosphere.

39. Repeat Instructions 35, 37, and 38 three additional times. The generator is now purged and ready for operation. The following operations place the generator in service.

40. Adjust the reducing supply regulator, which is located near the pressure controller, to 15 psi pressure. Refer to Figure 9.

41. Adjust the instrument regulator, which is located at the left of the pressure controller, to 20 psi pressure.

42. Turn the pressure control knob counter-clockwise until the gauge on the upper-right corner of the controller indicates "O".

43. Turn the generator feed screw push button ON.

44. When the generator pressure starts to rise, open the acetylene service valve.

45. Adjust the pressure control knob to the desired operating pressure. The generator is now in service and continual operation must be performed in accordance with the RECHARGING Instructions and GENERAL OPERATION Instructions.

**Sect. IV-C. Recharging**

When a generator is in operation, the supply of carbide in the hoppers must be replenished periodically. The following instructions provide the necessary information to recharge the generator with carbide.

1. Periodically push up on the carbide indicator handle near the base of the upper hopper to determine when the upper carbide hopper is empty of carbide. The pressure on this handle will indicate the relative amount of carbide remaining in the upper hopper.

2. When the upper hopper is empty, close the lower carbide valve.

3. Open the vent valve in the upper hopper vent line. Hold the vent valve open until the interference locking pin retracts. Then release the vent valve handle.

4. Move the interference rod to the down position and open the upper carbide valve. Depress the elevator push button to the ON position. As soon as the upper hopper is charged (when the screw elevator motor stops) close the upper carbide valve.

5. Slowly open the generator-to-upper-hopper pressure equalizing valve and hold it open for about 10 seconds. Check to see that the interference locking pin returns to the locking position. Then release the valve handle.

6. Move the interference rod to the up position. Open the lower carbide valve. The generator is now recharged with carbide and continual operation must be performed in accordance with the GENERAL OPERATION instructions, below.

**Sect. IV-D. General Operation**

In addition to the previous instructions connected directly with the recharging of carbide, certain additional duties must be performed at regular intervals to assure that the generator will continue to operate satisfactorily.

**Once Each Hour:**

1. Check the four sprays in the generating chamber and the two lower sprays in the scrubber tower to see that they are operating. This can be determined from the pressure gauge and the three water flowmeters near the sprays. The pressure gauge must indicate a pressure of 45 psi. If necessary, adjust the water regulator to this pressure. Each flowmeter must indicate a flow...
of three (3) gallons per minute or more. Less flow indicates clogged sprays. This condition must be remedied immediately. The generator must be shut down in accordance with the TEMPORARY SHUT DOWN instructions, page 18. The following procedure is then required to clean the sprays:

a. Raise the hydraulic relief-valve operating lever until the generator pressure drops to "0". Then release the relief-valve operating lever.

b. It is not necessary to purge the generator to clean the sprays. However, extreme caution should be used to eliminate the possibility of producing sparks during the operation. Use sparkproof tools.

c. Carefully loosen the union above the spray and let any residual pressure escape. Break the necessary unions in the water line and the union above the spray. The spray is removed with the half-union. Immediately plug the openings to the generator with plugged half-union. (Fig. 14.) Clean the sprays by chipping away any encrustation from the lower face. Unscrew, dismantle and clean the nozzle, being careful not to mar the metal; to do so may destroy the full cone spray action. Reassemble the spray, grease the surfaces liberally and replace in the generator, using non-hardening thread compound on the threaded joints. The generator is again ready for service and may be started in accordance with the STARTING instructions, page 19.

Once Each Two Hours:
2. Open wide the water-filling and flush valve for 10 seconds. Then close the valve. This will loosen any lime which may have packed in the bottom of the generator. Then open the manual residue drain valve wide until the generator water level drops to the DRAIN LEVEL, which will be indicated by the white signal light. Immediately close the manual residue drain valve and add fresh water through the water-filling and flush valve until the white light goes out.

3. Drain the condensate collected in the hydraulic back-pressure valve by attaching the water-drain connection and opening the hydraulic water-level valve. As soon as the first bubbles of gas appear, close the valve and remove the water drain connection.

4. See that water is being supplied to the agitator shaft seal. The shaft-seal water valve should be open about 1/4 turn, and the surface on the agitator mounting flange immediately below the water inlet should be relatively cool.

Once Each Shift:
5. After Step 2, above, has been completed at the start of each shift, open the main residue line flush valve slowly and all the way. After about 15 seconds, close the flush valve slowly. This will clean the residue line of any accumulated residue.

6. Inspect the drain outlet hole on the underside of the agitator mounting flange. If water drips from this hole while the generator is in operation, preparations should be made for withdrawing the impaired generator from service. It is not unusual to have a slight amount of leakage at this point on an idle generator. The leakage should stop when the agitator is placed in operation, however, although a slight amount of dripping may continue for a few minutes because of the water remaining in the drain line.

7. Check the pressure at the generator air regulator to see that it is maintained at 20 psi. Adjust the regulator if necessary. Temporary deviations are permissible at times when the automatic residue valve or the automatic spray valve are in the process of opening or closing.
8. Loosen the condensate-blowdown thumbscrew at the bottom of the generator air regulator to drain any condensate or loose dirt which may have accumulated. Close the thumbscrew as soon as drainage stops.

9. Check the pressure at the interference air regulator to see that it is maintained at 20 psi. Adjust the regulator if necessary.

10. Loosen the condensate-blowdown thumbscrew at the bottom of the interference air regulator to drain any condensate or loose dirt which may have accumulated. Close the thumbscrew as soon as drainage stops.

11. Check the pressure at the reducing supply regulator to see that it is maintained at 15 psi. Adjust the regulator if necessary (Refer to Fig. 9).

12. Loosen the condensate-blowdown thumbscrew at the bottom of the reducing supply regulator to drain any condensate or loose dirt which may be accumulated. Close the thumbscrew as soon as drainage stops.

13. Check the pressure at the instrument regulator near the pressure controller and see that it is maintained at 20 psi. Adjust the regulator if necessary.

14. Loosen the condensate-blowdown thumbscrew at the bottom of the instrument regulator to drain any condensate or loose dirt which may have accumulated. Close the thumbscrew when drainage stops.

**Once Each Week:**

15. Replace the strainer in the automatic residue drain line. (This operation requires the generator to be out of service for about 15 minutes; arrangements and scheduling should be made accordingly.)

Turn the feed screw motor push button **OFF**. Then close the generator service valve. Open wide the water-filling and flush valve for 10 seconds. Then close this valve. Drain the residue from the generator until both the white and red lights turn on and then drain for an additional 10 seconds before closing the valve. Then lift the hydraulic relief valve operating lever until the generator pressure drops to "0".

Lightly grease the outside of a spare clean strainer with cup grease. **Loosen** the plug in the tee connection at the top of the automatic drain line. Let any residual acetylene pressure slowly escape through the loosened plug. Remove the plug and carefully pull the old strainer out and insert the clean one (Fig. 15). Quickly replace the plug using non-hardening thread compound to make a gas-tight seal.

Add water through the water-filling and flush valve until the red and white lights go out. Then turn the feed screw push button **ON**. As soon as the generator pressure starts to rise, open the service valve to return the generator to service.

**Sect. IV-E. Temporary Shutdown**

These instructions will apply if the generator is to be shut down and unattended for a period of time.

1. Turn the feed screw motor push button **OFF**.

2. Close the acetylene service valve.

3. Do nothing further until the agitator stops.

4. After the agitator stops, open wide the water-filling and flush valve for 10 seconds; then close this valve. Then open the manual residue drain valve wide until the white and red lights go on. Close the residue drain valve.

5. Close the lower carbide valve.

6. Close the valve in the water line to the large spray.

7. Close the main water supply valve at the generator.

8. Close the plug valve in the automatic residue drain line.

9. Turn the three generator circuit breakers **OFF**.

Thereafter, if the generator is to be kept fully charged and in a standby condition, operate the generator every other day with the service valve closed until the mercury pressure switch stops the screw. This assures that the generator will remain ready to operate at a moment's notice.
**Sect. IV-F. Starting From Stand-by Condition**

Follow these instructions for starting a generator which is in stand-by condition.

1. Turn the three generator circuit breakers **ON**.
2. Check the pressure at the generator air regulator to see that it is maintained at 20 psi. Adjust the regulator, if necessary.
3. Check the pressure at the interference air regulator to see that it is maintained at 20 psi. Adjust the regulator, if necessary.
4. Open the plug valve in the automatic residue drain line.
5. Open the main water-supply valve at the generator.
6. Open the generator water-filling and flush valve and fill the generator until the red and white lights are out. Then close this valve.
7. See that the agitator shaft-seal water valve is open 1/4 turn.
8. Open the valve in the water line to the large spray.
9. See that the acetylene intermediate valve is open.
10. Turn the feed screw motor push button **ON**.
11. When generator pressure starts to rise, open the acetylene service valve.
12. Check the pressure gauge in the water line to the sprays. 45 psi pressure is required for operation. Adjust the regulator, if necessary.
13. Check the three water flowmeters in the line to the sprays. A minimum of 3 gallons per minute each is required.
14. Pull down on the handle of the upper-hopper pressure-equalizing valve for 10 seconds. Then release the valve handle.
15. Open the lower carbide valve.
16. Check the instrument-regulator pressure on the pressure controller to see that it is maintained at 20 psi. Adjust the regulator if necessary.
17. Check the reducing-supply regulator pressure to see that it is maintained at 15 psi. Adjust the regulator if necessary.
18. Check the generator pressure to see that it is maintained at the desired operating pressure. Adjust the pressure control knob if necessary. The generator is in service and continual operation must be performed in accordance with the RECHARGING and GENERAL OPERATION, page 16.

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**Sect. IV-G. Withdrawing From Service**

Before the generator is opened for inspection or maintenance (other than cleaning of the four sprays in the generating chamber or replacement of the screen in the automatic residue drain line), the generator must be withdrawn from service and purged free of acetylene. Follow the procedure outlined below:

1. Operate the generator until the upper and lower carbide hoppers are completely empty of carbide.
2. Turn the feed screw motor pushbutton **OFF** and wait until the agitator motor stops.
3. Close the agitator shaft-seal water valve.
4. Close the acetylene service valve.
5. Close the valve in the water line to the large spray.
6. Open wide the water-filling and flush valve for 10 seconds to loosen any accumulation of lime in the bottom of the generator. Then close the valve and drain all of the residue from the generator. Raise the hydraulic relief-valve operating lever until the generator pressure is "0".
7. Close the main water-supply valve at the generator.
8. Close the plug valve in the automatic residue drain line.
9. Close the acetylene intermediate valve.
10. Open and tag disconnecting switches in the electrical room.
11. Drain all of the water from the hydraulic by removing the double-tapped bushing and fittings at the bottom. Then replace the bushing and fittings.
12. Open the acetylene intermediate valve.
13. Temporarily remove the plug in the end of the equalizing line, on the hopper side of the manual pressure-equalizing valve. Replace the plug with a line connected to the nitrogen supply manifold equipped with a regulator and a downstream shutoff valve. Back out the regulator pressure-adjusting screw until it no longer compresses the spring; then slowly open the cylinder valves. Adjust the nitrogen supply to 10 psi pressure.
14. Slowly open the nitrogen shutoff valve and permit the pressure in the entire generator to build up to 10 psi pressure. Then close the shutoff valve.
15. Raise the hydraulic relief-valve operating lever and let the generator pressure blow down to "0".
16. Repeat steps 14 and 15 four additional times.
17. Replace the nitrogen supply with an air supply and repeat steps 14 and 15 two additional times.
18. Remove the carbide from the feed screw housing. First provide a metal trough to fit under the cleanout at the side of the lateral under the lower carbide hopper. Also, provide a metal pan to fit between the frame members under the lateral. Remove the cleanout cover plate and drain the carbide, placing it in an empty, dry carbide drum. Rap the feed screw housing with a Monel, rubber or wood mallet to knock down additional carbide which may be lodged between the flights of the conveyor screw. If necessary, remove the chain guard and chain from the feed screw drive, and turn the feed screw clockwise by hand. **DO NOT**

**TURN COUNTER-CLOCKWISE.** Remove all carbide which can be removed through the cleanout. Then place a lid on the carbide drum.

19. Open all windows and doors to provide room ventilation.

20. Remove the manhole cover.

The generator is now completely purged of acetylene and ready for cleaning, repair or maintenance. While a man is inside the generator, it is recommended that additional air be bled into the generator.

### Section V. Generator Lubrication

#### Sect. V-A. Plug Valves

The following are plug valves which depend upon a stick-type lubricant to assure easy operation of the valves and to maintain them tight against leakage.

- Acetylene Service Valve
- Intermediate Acetylene Valve
- Manual Residue Drain Valve

To ensure the proper working of these valves, they should be supplied with adequate lubrication at all times (see Lubrication Schedule, below). Lubricant is fed to the valve cock by occasionally turning the lubricant screw several turns. Rotate the valve handle while turning in the lubricant screw, and stop when the valve turns easily. Further addition of lubricant at this time will **NOT** improve valve operation; the additional lubricant will be wasted, and might clog the lines. When the lubricant screw has been turned in all the way, remove the screw and add a fresh stick of lubricant.

#### Sect. V-B. Carbide Charging Valves

The upper and lower carbide charging valves are grease-lubricated valves. They must be lubricated frequently (see Lubrication Schedule, below) through the grease fittings located at the front of the carbide-system support assembly. These valves must be cleaned annually to remove the grease-carbide dust accumulations in the valve grooves.

#### Sect. V-C. Lubrication Schedule

<table>
<thead>
<tr>
<th>Part</th>
<th>Lubricant</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Carbide Valve</td>
<td>Shell Oil Co., Alvania #2</td>
<td>After each operation of valve</td>
</tr>
<tr>
<td></td>
<td>Grease or equivalent</td>
<td></td>
</tr>
<tr>
<td>Lower Carbide Valve</td>
<td>Shell Oil Co., Alvania #2</td>
<td>After each operation of valve</td>
</tr>
<tr>
<td></td>
<td>Grease or equivalent</td>
<td></td>
</tr>
<tr>
<td>Acetylene Service Valve</td>
<td>Merco-Nordstrom #721-C</td>
<td>Turn in lubricant screw a few turns as required, insert new lubricant stick when screw shoulders.</td>
</tr>
<tr>
<td>Acetylene Intermediate Valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual Residue Drain Valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed Screw Upper Bearing</td>
<td>Bearing Grease</td>
<td>Weekly</td>
</tr>
<tr>
<td>Feed Screw Bearing Housing</td>
<td>Bearing Grease</td>
<td>Weekly</td>
</tr>
<tr>
<td>Variable-Speed Input Worm Gear</td>
<td>In accordance with recommendations of original equipment manufacturer, on nameplate of each unit.</td>
<td></td>
</tr>
<tr>
<td>Variable-Speed Output Worm Gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable-Speed PIV Unit</td>
<td>Powdered Graphite</td>
<td>Monthly (Sparingly)</td>
</tr>
<tr>
<td>Water-Level Control Pilot-Valve Piston</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>