

## CHAPTER 26.

# Operating

Before starting the burner, a complete understanding of the principle of operation, burner construction, oil supply system and control system is necessary.

**Ques.** How should the installation be regarded?

**Ans.** Do not assume that the installation is perfect. Oil leaks or air leaks may occur.

**Ques.** What precautions should be taken?

**Ans.** Make certain that the control system has been correctly wired with polarity correct and with hot wire through the safety limit control, all wiring connections soldered, correct fuses used and firmly in place.

**Ques.** What check should be made?

**Ans.** Check oil supply and control systems, and the complete installation before starting the burner.

Many errors have been made by putting the burner into operation too quickly and without careful observation, that is, starting the burner with no water in the boiler — radiators shut off — chimney filled with soot which partially or completely covered the stack inlet

to chimney — or starting burner in a new furnace without first explaining to owner that smoke and odor from registers cannot be prevented because of the new furnace cement and new iron that has not been previously heated.

**Ques.** What is necessary for an efficient, dependable, overall performance of burner and heating plant?

**Ans.** A modern type of draught control.

**Ques.** Why?

**Ans.** The burner may be adjusted during spring or fall or with a cold chimney and satisfactory CO<sub>2</sub> and results obtained at that time. During cold or windy weather and with chimney heated, draught becomes excessive; stack temperature goes up; burner goes on safety due to drop in stack temperature with changeable draught; fuel consumption is excessive, all of which result in service calls.

Dependable automatic control of the draught in fire box is important. An oil burner should have automatic draught control. Use draught gauge in adjusting for desired minimum draught in fire box. Use stack temperature thermometer frequently and get after any condition that causes an increase in stack temperature — it may be taken for granted, in most cases, that the stack temperature is too high to begin with.

If safety switch shut off burner by “warping out” wait five minutes for it to cool, then reset safety to restart burner.

**Ques.** What should be done if after starting the burner, vapors in quantity show up in fire box without first being ignited?

**Ans.** Open the main switch and wait until the vapors disappear, then start and stop the burner, operating only a few minutes with delay between starts to obtain desired oil spray and ignition.

**Ques.** What about the appearance of the burner flame?

**Ans.** When adjusted it may appear to one experienced, as efficient, yet be far from equal to the degree or percentage of CO<sub>2</sub>, that can be obtained when using a CO<sub>2</sub> indicator.

Only a nondescript or second-rate oil burner man will be guilty of not having a CO<sub>2</sub> test kit. The complete kit consists of CO<sub>2</sub> analyzer, draught gauge and stack thermometer.

**Ques.** Mention some preliminary duties to be performed?

**Ans.** Open all oil line valves. If oil be fed to burner by gravity, vent the pump by loosening top plug until oil appears, then tighten. If top of oil tank be below oil inlet to burner, remove vent plug and fill with fuel oil to prime pump. Replace plug. Open main line switch and see that the correct amperage fuse is installed for the load.

Remove cover plate from primary control. Check wiring with diagram in the covers of the control.

With test light, make sure that the hot wire is through the limit control and to the proper terminal on the stack control.

See that control safety is in starting position. Remove control and turn helix anti-clockwise and then release slowly to put contacts in starting position.

Place control back in smoke pipe and tighten, holding same. Set thermostat in running position higher than room temperature.

Open fire door.

Fasten draught control in full open position to obtain maximum draught when starting burner. Close the main switch.

**Ques.** What should be done after closing main switch?

**Ans.** Watch for oil spray from nozzle, also observe pressure on gauge. Air in system may delay oil delivery to nozzle. Vent by loosening vent plug if gravity oil feed, and with burner running.



**Ques.** How do you know if electrode setting be correct?

**Ans.** If oil spray contact electrode tips, the electrode setting may not be correct.

**Ques.** How about the draught?

**Ans.** Put draught control in operation. Set control to provide not less than .02 in. and not more than .05 in. draught in fire box with fire door closed. Readjust air inlet on burner, observing flame through drill hole or by opening the fire door quickly.

**Ques.** What other items should be checked?

**Ans.** Check CO<sub>2</sub>, using analyzer. Check stack temperature, if excessive, recommend replacement with a real boiler with adequate heating surface (25 to 1). A stack temperature of 300° Fahr. should be obtained on full load.

**Ques.** What other test should be made?

**Ans.** Test the limit control.

Do not approve an installation without the correct limit control being installed on the heating plant as shown on wiring diagram. There will be an adequate amount of heating surface for economy if they be not too "Scotch" on the number of tubes and provide enough for a 25 to 1 ratio. House heating boilers should have adequate heating surface as well as fancy painted shiny cases.

**To Start Burner.**—1. Place protectorelay contacts in starting position. 2. Depress and release reset button. (See fig. 3.) 3. Open the hand valve in the oil supply line. 4. Move the indicator on the high limit control and room thermostat to the high end of the scale. 5. Close the line switch. Burner should immediately start.

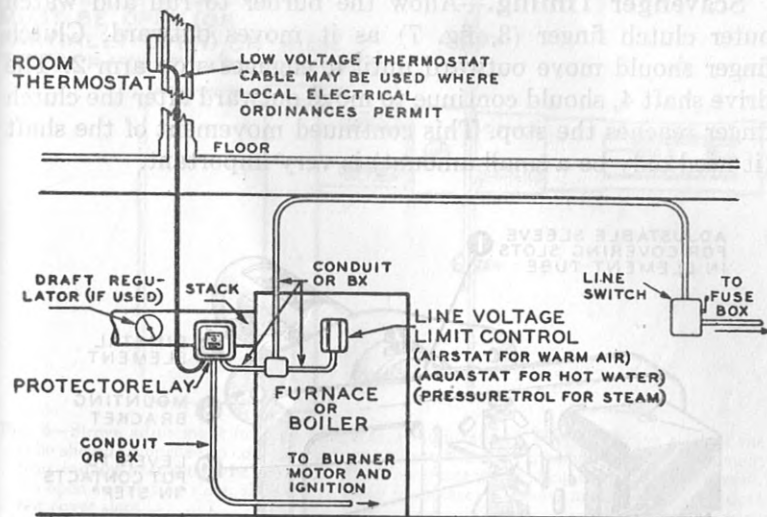


Fig. 1—Typical installation diagram.

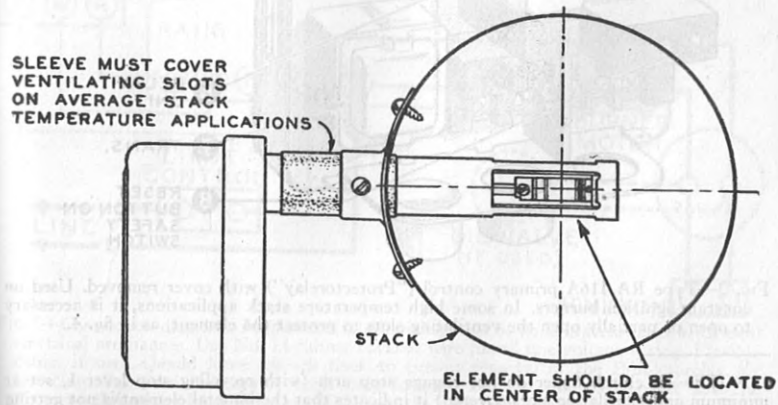


Fig. 2—Sleeve adjustment for average stack temperatures (ventilating slots completely covered).

**Scavenger Timing.**—Allow the burner to run and watch outer clutch finger (3, fig. 7) as it moves outward. Clutch finger should move outward until it engages stop arm 2. The drive shaft 4, should continue to move outward after the clutch finger reaches the stop. This continued movement of the shaft (it need only be a small amount) is very important.

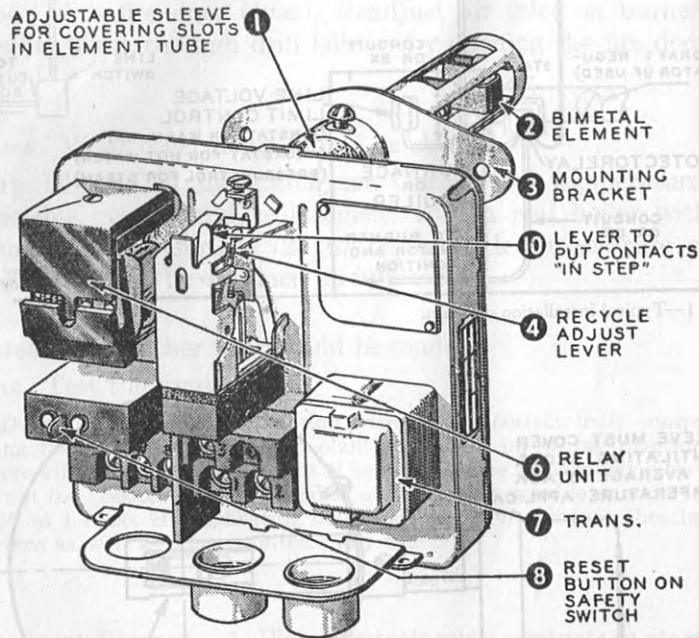


Fig. 3—Type RA 116A primary control ("Protectorelay") with cover removed. Used on constant ignition burners. In some high temperature stack applications, it is necessary to open or partially open the ventilating slots to protect the element, as in fig. 4.

**NOTE.**—If clutch finger do not engage stop arm (with recycling stop lever 1, set at minimum and ventilating slots covered) it indicates that the bimetal element is not getting enough heat to insure proper operation. In this event, the Protectorelay should be moved to a new location where a higher element temperature will be found.

**VENTILATING SLOTS MUST BE OPEN (OR PARTIALLY OPEN) ON HIGH TEMPERATURE APPLICATIONS.**

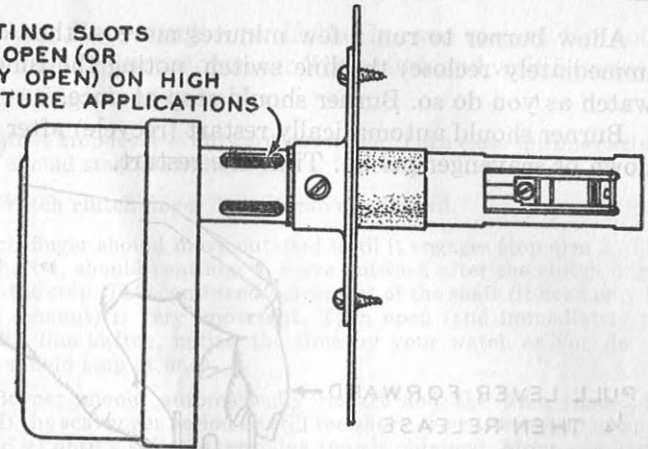


Fig. 4—Sleeve adjustment for high temperature applications. The ventilating slots in the tube should be opened to cool the element and some form of shield to protect the element from radiant heat should be provided. These measures will prolong the life of the element. To open ventilating slots, slide sleeve away from case — be sure mounting bracket does not cover slots.

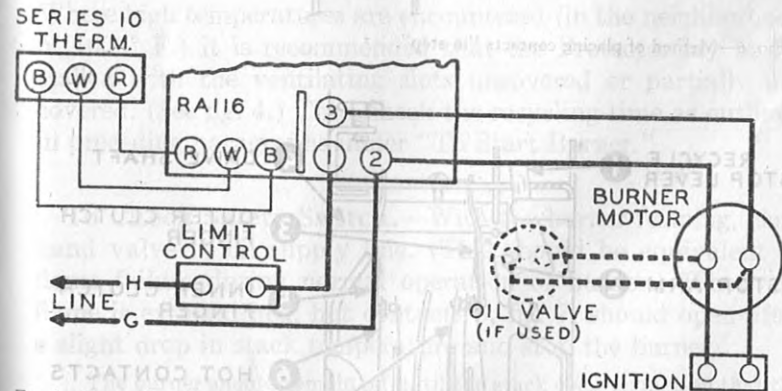


Fig. 5—Connection diagram. **Important:** All wiring must be done in accordance with local electrical ordinances. Use No. 14 rubber covered wire for all line voltage wiring. Flexible cable, if used should have enough slack to permit removal of the Protectorelay for servicing. Standard thermostat cable may be used between the thermostat and the Protectorelay where local codes permit. Place the high limit control in the "hot line" to terminal No. 1 as shown. However, it may be connected in the low voltage white wire to the thermostat.



Allow burner to run a few minutes more — then open (and immediately reclose) the line switch, noting the time by your watch as you do so. Burner should stop at once.

Burner should automatically restart (recycle) after this shut-down or scavenger period. Time the restart.

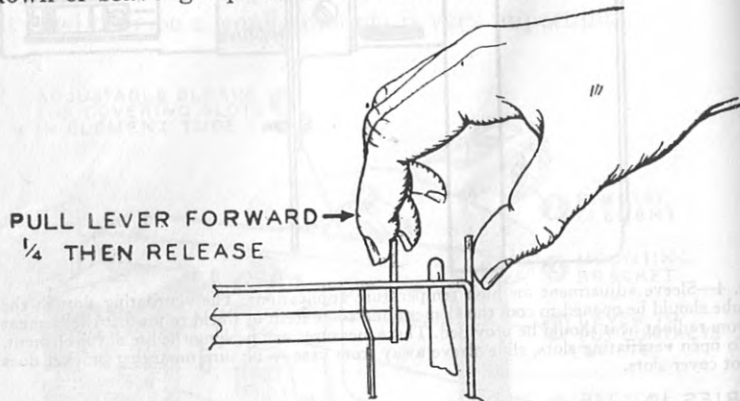


FIG. 6—Method of placing contacts "in step".

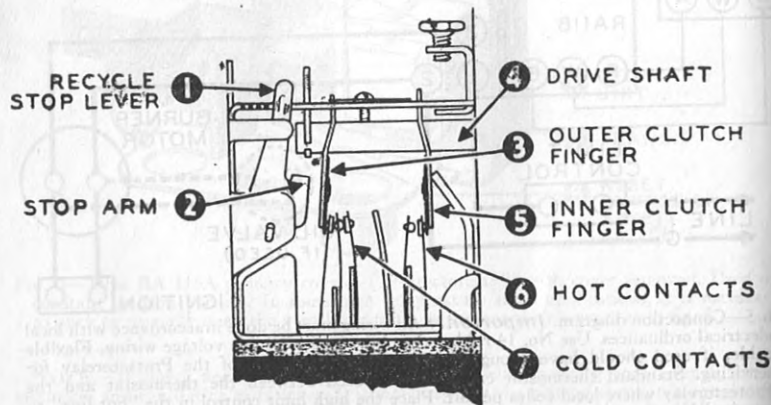


FIG. 7—Recycling time adjustment.

**Too Fast Recycling.**—(w) If the burner restart too soon (not less than 1 minute) open the line switch and wait 5 minutes for the heating plant to cool.

(x) Move stop lever 1, outward one notch. Then close the line switch. Burner should start immediately.

(y) Watch clutch finger 3, as it moves outward.

Clutch finger should move outward until it engages stop arm 2. The drive shaft 4, should continue to move outward after the clutch finger reaches the stop. This continued movement of the shaft (it need only be a small amount) is very important. Then open (and immediately reclose) the line switch, noting the time by your watch as you do so. Burner should stop at once.

(z) Burner should automatically restart and the time should be noted. If the scavenger period be still too short, repeat tests (paragraphs w, x and y) until a suitable recycling time is obtained. Move stop lever only one notch at a time.

**Adjustments for High Temperature Conditions.**—

Where high temperatures are encountered (in the neighborhood of 1000° F.) it is recommended that the Protectorelay be installed with the ventilating slots uncovered or partially uncovered. (See fig. 4.) Then check the recycling time as outlined in preceding paragraphs under "To Start Burner."

**To Check Safety Switch.**—With the burner running, close hand valve in oil supply line. (This should be equivalent to flame failure during normal operation of burner.) When the flame is extinguished, hot contacts 6, fig. 7, should open after a slight drop in stack temperature and stop the burner.

The burner should remain off until the stack cools enough so that the "cold contacts" 7, fig. 7 make.

When the "cold contacts" make, and the burner motor starts up with the oil supply valve closed, check the timing of the safety switch. The safety switch should trip and stop the burner motor in approximately 90 seconds at the rated voltage.



**Operation.**—Refer to fig. 8. When burner is idle, cold contacts 6 and 7 are closed, hot contact 8 is open, safety switch contact 5 is closed, and the relay is out.

When thermostat calls for heat, relay pulls in, closing contact 12, starting the burner motor, and bringing on the ignition. Contacts 9, 10 and 11 are also closed, thereby establishing a holding circuit

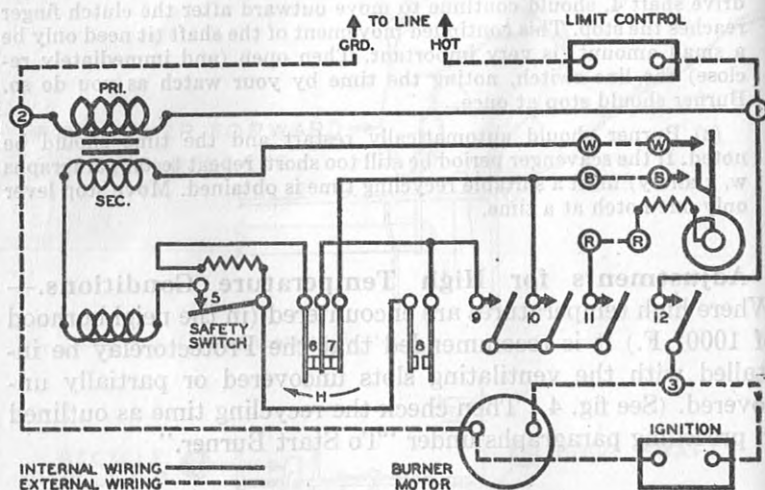


FIG. 8—Schematic circuit of type RA116A primary control ("Protectorelay").

On the initial rise in stack temperature hot contact 8 makes shunting out the safety switch heater. A further rise in stack temperature causes cold contacts 6 and 7 to break. The burner is now in normal operation.

The initial rise in room temperature will open thermostat contact B. The relay will remain in, through a holding circuit established through R and W thermostat contacts and contacts 9 and 11 of the relay.

Opening of contact B sends all of the current through the thermostat heater, thereby causing an accelerated shut down.

When the thermostat is satisfied, contact W will open, causing the relay to drop out, stopping the burner.

**Ignition Failure.**—If combustion fail to take place on start-up, hot contact 8 will not make, thus current continues to flow to the safety switch heater and in approximately 90 seconds the safety switch contact 5, will open, stopping burner. The reset button 8, fig. 3, must then be manually depressed before restart is permitted.

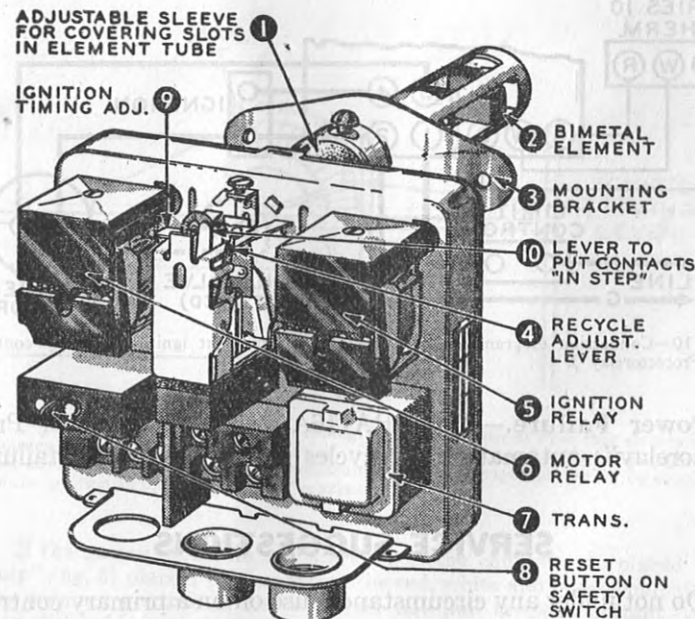


FIG. 9—Type RA117A primary control ("Protectorelay") with cover removed. Used on intermittent ignition burners.

**Flame Failure.**—If a flame failure occur when burner is running normally, hot contact 8, will open on the initial drop



in stack temperature. The relay will immediately drop out, stopping the burner.

At the expiration of the scavenger period (normally about one minute) cold contacts 6 and 7, will make, restarting the burner. If combustion take place, burner will continue to run, but if oil fail to ignite, a safety shutdown will occur in approximately 90 seconds. The reset button 8, fig. 3, must then be manually depressed before burner can restart.

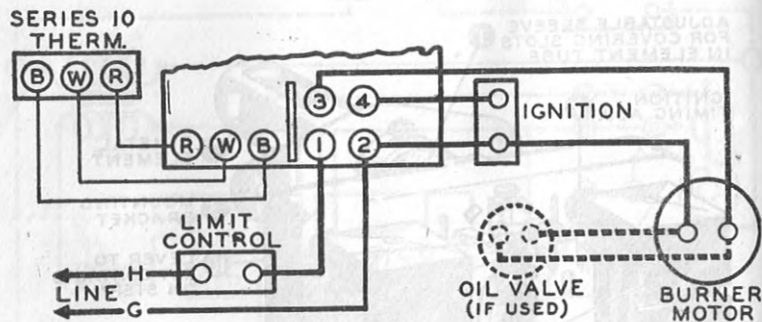


Fig. 10—Connection diagram for type RA117A intermittent ignition primary control "Protectorelay").

**Power Failure.**—Type RA116A primary control ("Protectorelay") automatically recycles in event of power failure.

## SERVICE SUGGESTIONS

Do not under any circumstances use oil on a primary control. It is important that the cover be left on the primary control to protect it from dust and mechanical injury.

If the primary control fail to operate after the line switch is closed, and with the high limit control and thermostat calling for heat, depress and release reset button (8, fig. 3).

Burner motor should start immediately. If burner do not start, place the primary control contacts in the starting position (see fig. 6). Burner motor should immediately start.

If combustion do not take place, open the line switch. Check power supply, wiring, ignition and oil supply.

If it be necessary to place the contacts "in step" (fig. 6) in order to start the burner, see accompanying instructions and carefully check the complete operating cycle as outlined.

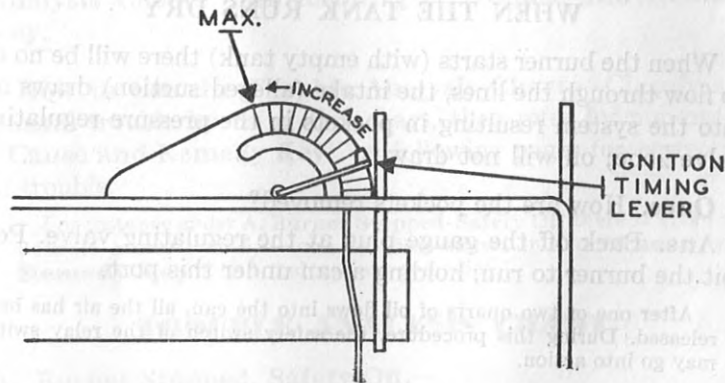


Fig. 11—Method of increasing ignition timing. Note the length of time that elapses after the burner starts, until the right hand relay, (5, fig. 9), drops out, cutting off the ignition. This adjustment is factory set at "minimum." If a longer ignition period be required, move the ignition timing level toward "maximum."

If the burner motor do not start when the contacts are placed "in step" (fig. 6) place a jumper across the red, white and blue terminals of the primary control. If the relay do not pull in (with current "on" and with cold contacts (7, fig. 7) closed, the primary control is defective and should be replaced.

If the relay do pull in, remove the jumper and check all connections between the thermostat and primary control and examine the contacts of the thermostat (and low voltage limit control if used) to make sure they are closed. Finally, check the low voltage cable if necessary.

Chattering operation (rapid opening and closing) of the relay indicates an open red wire circuit or interchanging of the blue with either the red or white wire somewhere in the low voltage circuit.

If the primary control goes on safety, after the burner has started up normally, the trouble may be due to any one or more of the following: Down draughts or air leaks in the smoke pipe, slow temperature rise of the flue gas where the primary control element is located, plugged oil line, ignition failure, or accumulation of soot on the bimetal element.

### WHEN THE TANK RUNS DRY

When the burner starts (with empty tank) there will be no oil to flow through the lines, the intake (alleged suction) draws air into the system resulting in pockets in the pressure regulating valve zone; oil will not draw.

**Ques.** How are the pockets removed?

**Ans.** Back off the gauge plug at the regulating valve. Permit the burner to run, holding a can under this port.

After one or two quarts of oil flows into the can, all the air has been released. During this procedure, the safety switch of the relay switch may go into action.

**Ques.** What should be done?

**Ans.** Wait about 2 minutes and reset the safety button.

**Ques.** What is important?

**Ans.** The intake (alleged suction) line should be absolutely tight and if the contractor wasn't too Scotch, there would be a good check valve at the tank end of the intake pipe, which by the way should be several inches above the bottom of the tank to prevent drawing in foreign matter.

On an A-1 job, there will be provided a vacuum gauge at the pump to indicate if there be alleged suction — that is to say, to indicate if there be any vacuum.