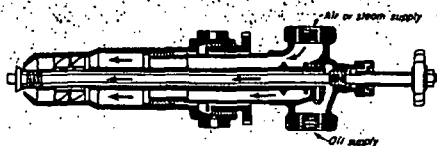
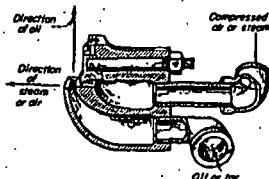
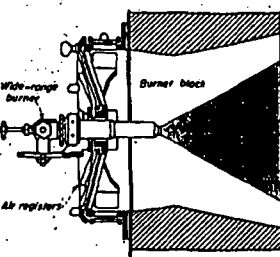


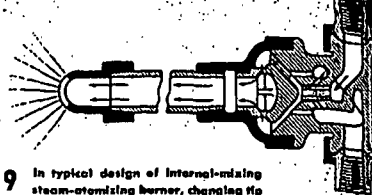
THESE BURNERS ATOMIZE FUEL OIL BY ACTION OF STEAM OR AIR



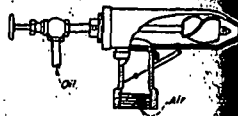
8 Steam-atomizing burner of external-mixing type, above, brings oil and atomizing medium, steam, together at the burner tip. Register, below, has damper vanes to regulate the air supplied



10 In this external-mix oil burner a steam jet hits the emerging oil at right angles as the oil leaves the burner; gives turbulent mixing action

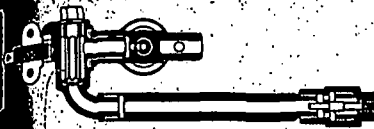


9 In typical design of internal-mixing steam-atomizing burner, changing tip alters the range of capacities handled

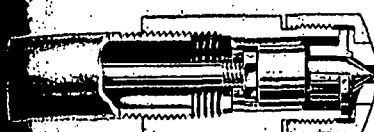


11 Low-pressure air service atomizing medium for burner, meeting all of the air and breaking it up. Air atomization finds relatively little use because cost is often too high

THESE BURNERS ATOMIZE OIL UNDER PRESSURE BY MECHANICAL MEANS

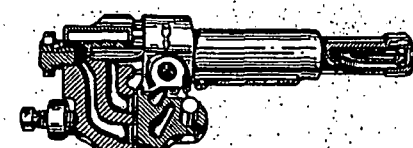
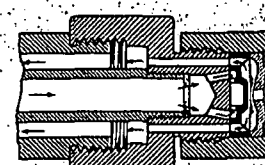


12 Mechanical-atomizing burner receives the oil under pressure, about 225 to 300 psi, and of an optimum viscosity of about 150 ssu. Orifice atomizes the fuel



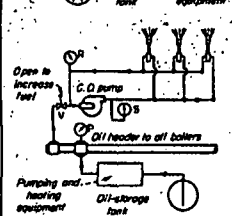
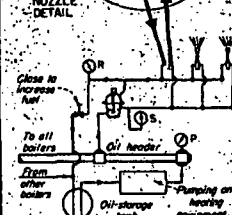
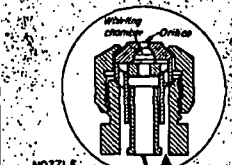
13 Movable control rod, center, through a regulating pin, varies the area of tangential slots in sprayer plate and volume of oil passing through orifice, right. With oil kept at 300 psi and 200 ssu, range is 10 to 1

14 With fixed orifice size, best atomization occurs in narrow flow range. Design, at right obtains wide capacity range by supplying oil to burner tip at a constant rate in excess of demand. Oil burned varies with the load, rest is returned



15 Wide-range burner, or above operates on constant-differential systems shown, Fig. 16

HOW ONE WIDE-RANGE SYSTEM OPERATES



16 Regulation of output from the wide-range burner of Fig. 15, whose atomizing and whirling and shows above, can come from either a constant-differential valve or a constant-differential pump to hold pressure across supply and return

If oil is to be vaporized in the combustion space in the instant of time available, it must be broken up into many small particles to expose as much surface as possible to the heat. This atomization may be effected in three basic ways: (1) using steam or air under pressure to break the oil into droplets (2) forcing oil under pressure through a suitable nozzle, and (3) tearing an oil film into drops by centrifugal force. All three methods find use in practical burners.

Turbulence Necessary. In addition to breaking the oil into small particles for fast vaporization, the burner must provide motion between oil droplets and air, so vapor "coats" are stripped off as fast as they form and fresh surfaces exposed. This calls for penetration of the oil particles in the proper direction and for a high degree of turbulence in the air. Such relative motion of oil and air helps to produce more uniform mixture conditions over the combustion zone.

Hydrocarbons, as we have seen, burn by hydroxylation and by cracking. In practice, both forms are present, although the usual oil-burner flame is predominantly the latter type. This characteristic short yellow flame has good radiating characteristics and fits usual combustion spaces well. It carries, however, solid carbon particles,

which, if their burning is stopped by any chilling action, form soot. Depending on the nature of the chilling, the soot may deposit on heating surfaces or may be carried out the stack as a major constituent of smoke.

Pure hydroxylation burning, while free from soot and smoke possibilities, yields a less radiative flame and can be produced only in certain types of burners. Thus, as in many engineering matters, we compromise and strive to introduce enough hydroxylation into a predominantly cracking process to keep the flame clean and reduce smoking tendencies. Hydroxylation is encouraged by thorough atomization, suitable preheating of both oil and air, and exposing the mixture to a gradually increasing temperature over not too short a time.

Steam-Atomizing Burners. Let's look now at practical oil-burning equipment. Oldest form is the steam- or air-atomizing burner. Installation is relatively inexpensive and simple, especially where no attempt is made to control steam and oil supply simultaneously. Steam-atomizing burners, as a class, possess ability to burn almost any fuel oil, of any viscosity, at almost any temperature. Air is less extensively used as an atomizing medium because its operating cost is apt to be high. These burners can be divided into

two types: (1) internal-mixing or pre-mixing—oil and steam or air mix inside the body or tip of the burner before being sprayed into the furnace; Fig. 9, 11, and (2) external-mixing—oil emerging from the burner is caught by a jet of steam or air, Fig. 8, 10.

Steam consumption for atomizing runs from 1 to 5% of steam produced, usually averaging around 2%. Pressure required varies from about 75 to 150 psi, and steam can be taken from: (1) a low-pressure line (2) a desuperheater with a pressure reducer, or (3) a drum vent, through an orifice and regulating valve. Oil pressure need only be enough (usually 10 to 15 psi) to carry oil to the burner tip.

External Mixing. In the burner of Fig. 8, oil reaches the tip through a central passage, flow being regulated by the screw spindle, right. Oil whirled against a sprayer plate to break up at right angles to the stream of steam, or air, coming out behind it. The atomizing stream surrounds the oil chamber and receives a whirling motion from vanes in its path. When air is used as the atomizing medium in this burner, it should be at 10 psi for lighter oils and 20 psi for heavier. Combustion air enters through a register, shown below in Fig. 8. Vanes or shutters are adjustable to give control of excess air. Fig. 10 shows another external-mix-

ing design. Oil and steam discharge through separate nozzles at right angles to each other, the steam breaking up the oil stream.

Internal Mixing. Fig. 9 and 11 give examples of the premixing principle. In Fig. 9, steam and oil meet and mix well within the burner body. Energy in the steam serves to force the steam-oil mixture through the nozzle for atomization. Burner of Fig. 11 brings oil and air under pressure together at the burner tip for mixing before discharge into the furnace.

Mechanical Atomizing. Now let's look at another major burner class, mechanical atomizers, Fig. 12 to 15. Good atomization results when oil under high pressure (75 to 200 psi or higher) is discharged through a small orifice, often aided by a slotted disk. The disk gives the oil a whirling motion before it passes on through a hole drilled in the nozzle, where atomization occurs. For a given nozzle opening, atomization depends on pressure and, since pressure and flow are related, best atomization occurs over a fairly narrow range of burner capacities (about 40%).

To follow a fluctuating boiler load, a number of burners may be installed and turned on or off as steam demand varies; or burner tips with different nozzle openings can be applied to a single burner body.

Wide-Range Designs. Oil-burner manufacturers have developed many designs to extend the usual 1.4 to 1 capacity range of the mechanical-atomizing nozzle. One, for example, features a plunger that opens additional orifices in the nozzle as oil pressure increases. This gives a 4 to 1 range. Another design, Fig. 13, employs a movable control rod, which, through a regulating pin, varies the area of tangential slots in the sprayer plate and the volume of oil passing through the orifice.

Still another variable-capacity design, Fig. 14, delivers oil at high pressure (350 psi) at a constant rate, but discharges through the nozzle only the quantity needed to meet steam demand. The remainder recirculates.

Fig. 15 shows a wide-range mechanical atomizer which, when combined with either of the pumping systems shown in Fig. 16, will give a capacity range of about 15 to 1, and considerably higher if needed. By use of either a constant-differential valve or pump, as shown, difference in pressure between supply and return is held constant. This maintains a uniform pressure drop across the tangential slots in the burner tip and creates a constant atomizing force. The valve system is simple to install and maintain, but the pump system offers advantages in many plants: (1) No hot oil is returned