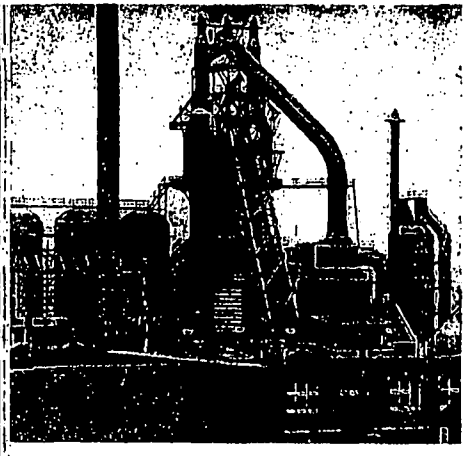
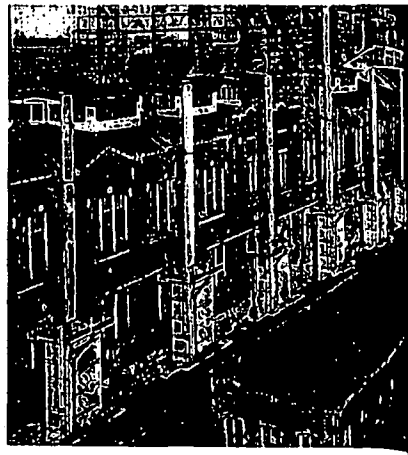
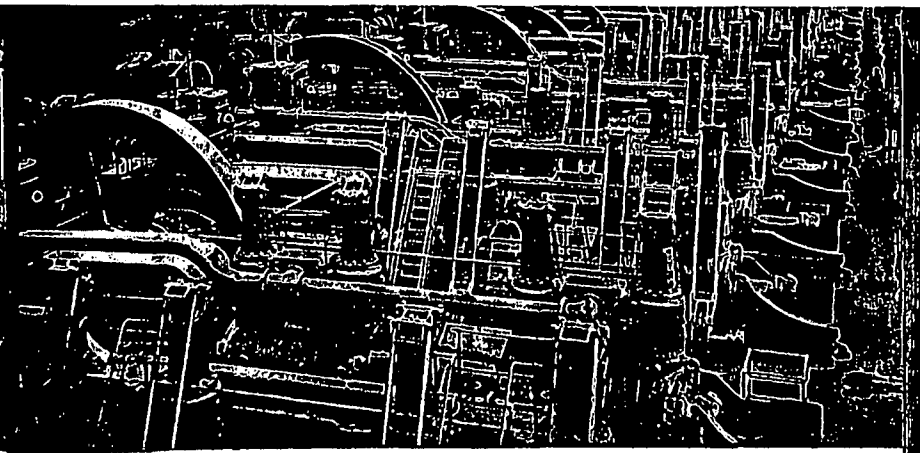


BLAST-FURNACE GAS leaves furnace (center) at top by downcomer, large-diameter pipe, to dust catcher (below)

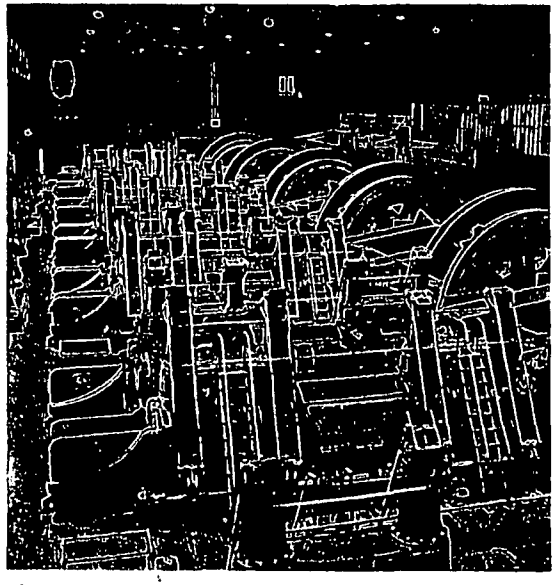


WASTE-HEAT BOILERS, outside the engine house, receive exhaust from engines fired by blast-furnace gas



BATTERY OF GAS-POWERED BLOWING ENGINES furnish heated air in volumes up to 100,000 cfm at 20 psi. Air requirements for blast furnaces are shared by some steam turbine-driven blowers to give a flexible supply source

How Gas Engines Serve Today's Steel Mills



ROUGHLY 20% OF PLANT ELECTRICAL LOAD comes from gas-electric 25-cycle engines at 25% thermal efficiency including pickup from waste-heat boilers

A one-time major source of steel mill power now shares the kw load. W M Cline Jr, combustion engineer, Bethlehem Steel Co, tells how typical steel mill uses gas engines to advantage, gives operating and heat-balance details

▶ STEEL MILLS, with gas-electric engines installed, find their continued use an operating advantage. A combination of gas engine with a waste-heat boiler, working from the engine exhaust, produces power at a rate of 9400 Btu per kwhr. This includes a credit of about 2 to 4 lb of steam per kwhr developed in the waste-heat boiler. Without this recovery thermal efficiency runs about 25%, or 13,600 Btu per kwhr.

A typical steel plant today requires about 65,000,000 kwhr per month. Gas engines already on the line supply about 20% of this load, with the remainder split roughly between purchased power and steam-generated energy. This division of load has come about from changes within the steel industry.

For instance, in the early days the gas engine enjoyed the favored spot as prime mover in the steel mill. This was so because (1) plant electric loads were small, individual steam drives common for most equipment (2) blast-furnace gas-fired boilers suffered from using raw gas without cleaning (3) smaller quantity demand of the individual gas engine permitted cleaning gas without too heavy a capital outlay (4) efficiency of the current gas engine ran 1½ to 2 times that of the contemporary steam engine and boiler installation (5) capital costs for gas engine and equivalent steam boiler and turbine were about even.

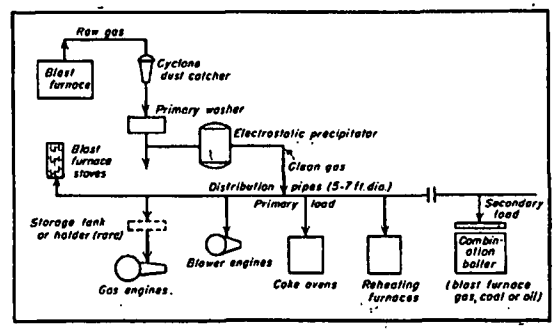
Today's Gas Engine. Since 1930 the picture has changed. Gas-electric engines have lost ground to newer condensing and noncondensing steam turbine-generators. The reasons are (1) enormous electrical load growth within the plant making large-capacity turbines justifiable (2) increase in reliability and efficiency of blast-furnace gas-fired boilers at higher operating pressures (3) decrease in capital investment for steam stations to the point where they run about half that of an equivalent engine installation (4) transition to 60-cycle power, which rules out the gas engine because of size requirements (number of poles in generator) and speed (present speed runs about 88 rpm) (5) advent of the topping turbine that permits use of higher-pressure higher-temperature steam in this unit and its exhaust to existing lower-pressure condensing machines, or direct to process.

Operating Characteristics. Now let's look at a typical gas engine. Speed is based on frequency of the electric current produced and number of poles in the generator field. With a current requirement of 25 cycles and a machine with 34 field poles, engines must operate at 25 × 60 ÷ 34/2, or 88.24 rpm. This speed is critical because the gas engines are synchronized with other units and purchased power supply from utilities.

Governing for speed control consists of a pilot-operated hydraulic cylinder mechanically tied into the gas-regulating valve. A centrifugal or flyball governor operates the pilot valve, which admits oil under 45 to 50 psi to the cylinder. A pump driven off the engine camshaft develops the hydraulic pressure.

A spring-loaded overspeed trip attached to the flywheel cuts off ignition if flywheel exceeds a preset speed.

Starting up and putting an engine under load involves a somewhat stand-



DISTRIBUTION OF BLAST-FURNACE GAS within the mill follows chart with certain loads given first call, and blast-furnace gas boilers as "flywheels"