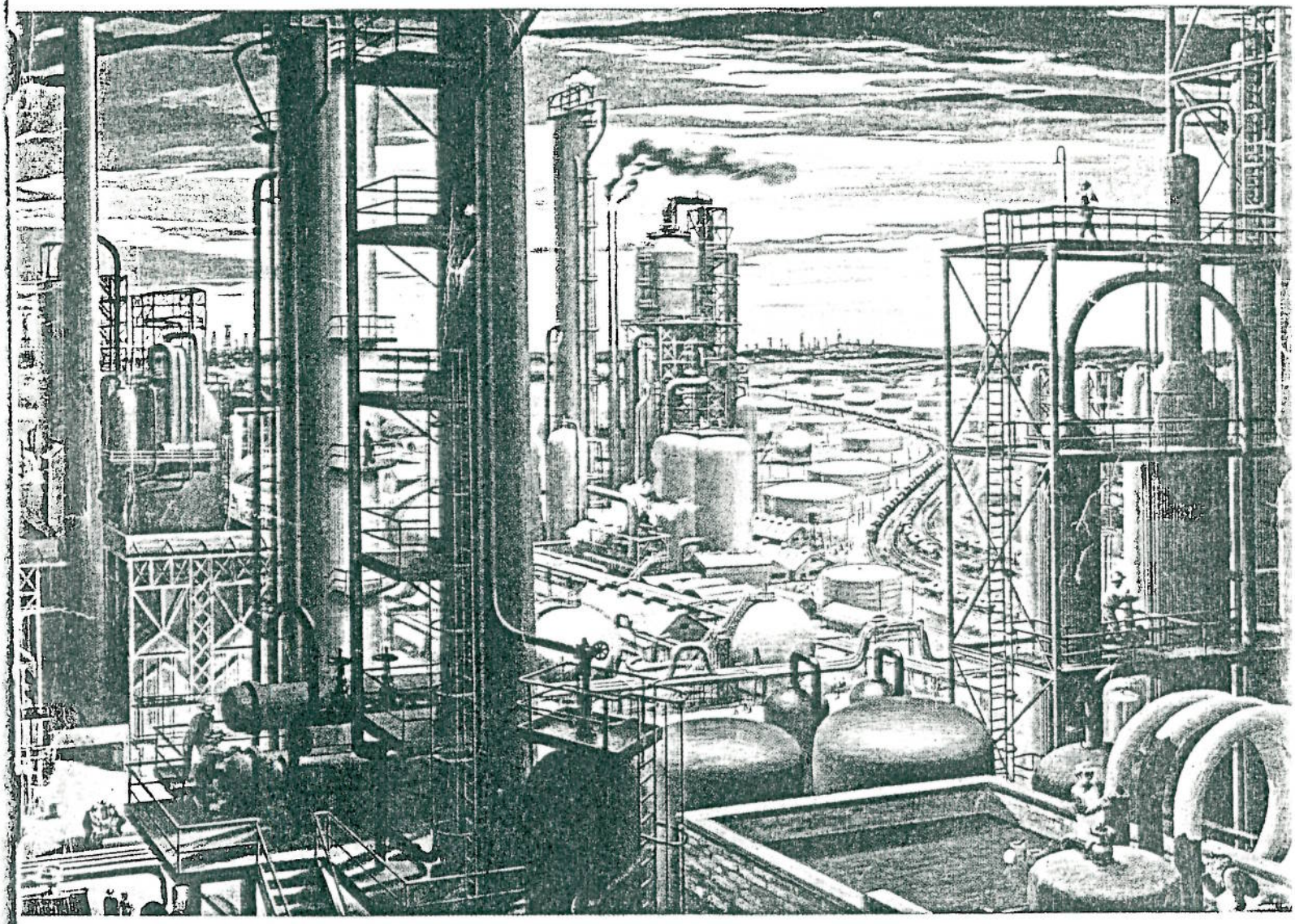
THE PLANT

DEVOTED TO PLANT ENGINEERING — POWER, PLANT FACILITIES, AND MAINTENANCE



(Cover illustration Courtesy of Armstrong Cork Company)

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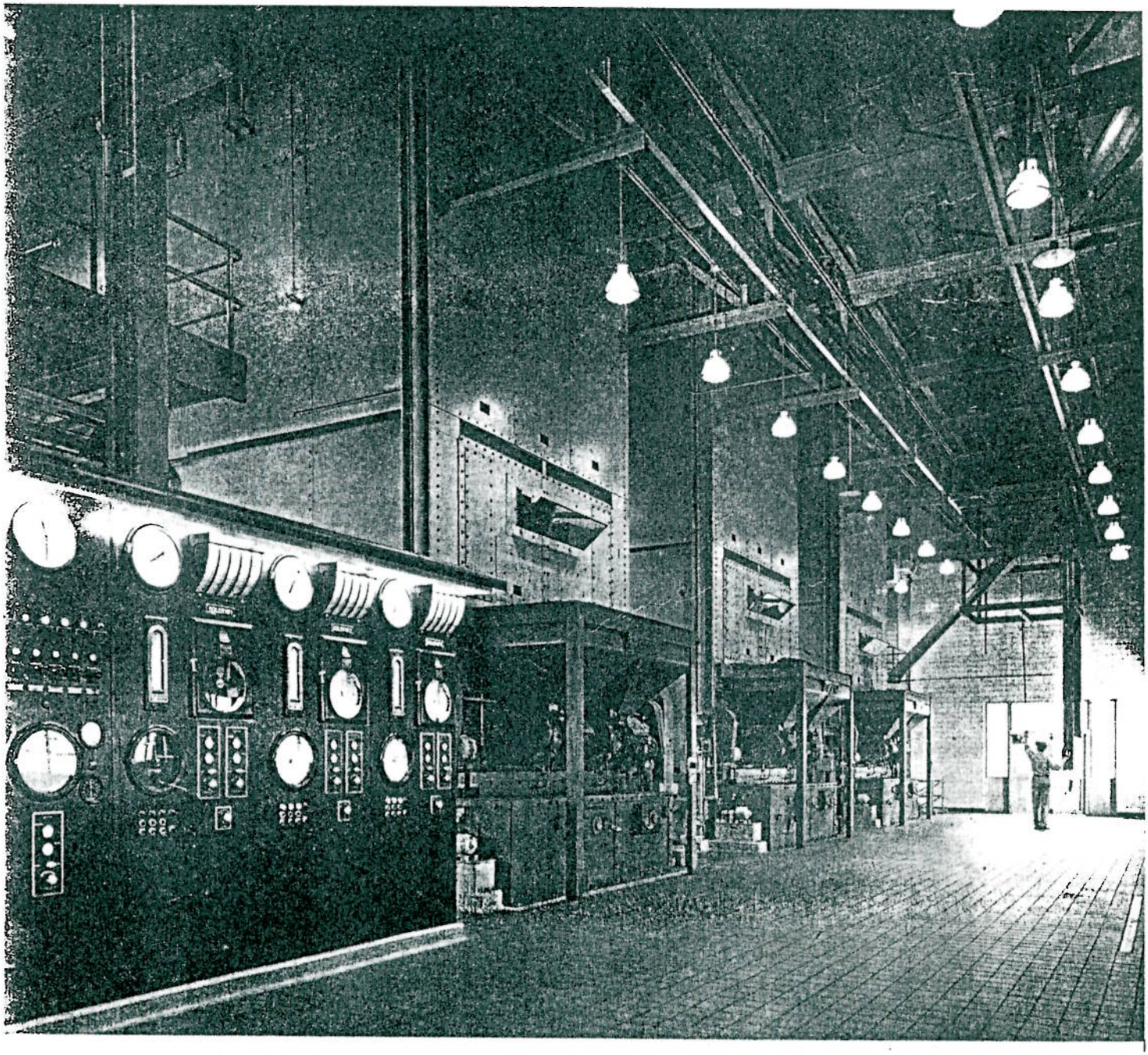
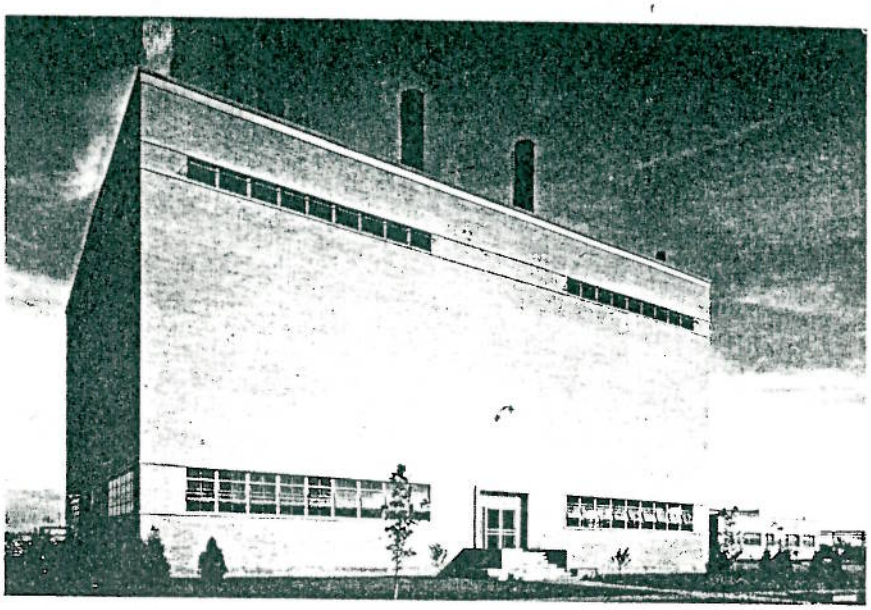
IN THIS ISSUE

UPJOHN'S NEW STEAM PLANT ON THE JOB DAY & NIGHT

No prolonged interruption in steam supply is permissible in production of penicillin and other valuable pharmaceutical products. So, in spic and span boiler plant, three 60,000 lb per hr boilers have been installed; spreader stokers with traveling grates have been provided to burn "almost anything"; auxiliary units have dual drives; and a temporary plant with packaged type boilers has been retained for added steam insurance.





The three present boilers, as Evase stacks reveal, are installed in the front half (facing the reader) of the modern brick boiler plant.

TRAYTON TOWNSEND,
Chief Engineer of Steam Plants,
The Upjohn Company,
Kalamazoo, Michigan

MAXIMUM dependability has been built into the Upjohn Company's new boiler house which serves this company's huge, ultra-modern Portage Road plant near Kalamazoo. Three 60,000 lb per hr boilers have been installed and in addition ample space has been provided for three more boilers of the same size — the fourth unit being scheduled for installation early in 1952.

Boilers, 3-drum bent-tube units, have full automatic combustion controls and automatic feedwater regulators. Each is equipped with a cast iron extended surface type economizer and a 2-feeder traveling grate spreader type stoker, which discharges ash continuously at the front and can burn a wide variety of coals. Also dual drives have been provided for the stokers, induced draft fans, and forced draft fans to assure continuous operation as well as a favorable heat balance.

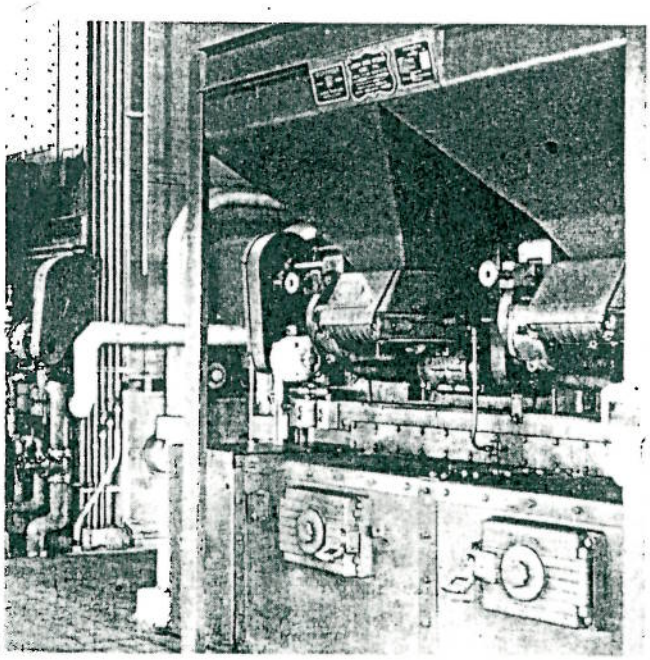
In addition to all this a "temporary" boiler house, which was utilized while the permanent boiler plant was being built, has been retained and made ready for hurry-up service when needed. Originally the temporary boiler house contained three package type, oil-fired boilers, each of 300 hp capacity, but last winter a fourth unit, of 500 hp rating, was installed to provide additional capacity.

Interruption of steam supply, if prolonged to an appreciable extent, could cause heavy losses in the production of such valuable drug products as penicillin. Steam is an absolute necessity here, 24 hours a day, 365 days a year. The new manufacturing plant, which provides 33 acres of floor space on one floor and a basement extending under part of the main structure, is fully air conditioned and in many production areas temperatures and humidities must be controlled within comparatively narrow limits for considerable lengths of time.

Ground was first broken at this Portage Road site in 1946, the penicillin division being the first to be transferred to the new location. To serve this division at the start, since the culture of penicillin requires a steady supply of steam in fairly large quantities, the small, 3-unit boiler house was built and oil employed for fuel.

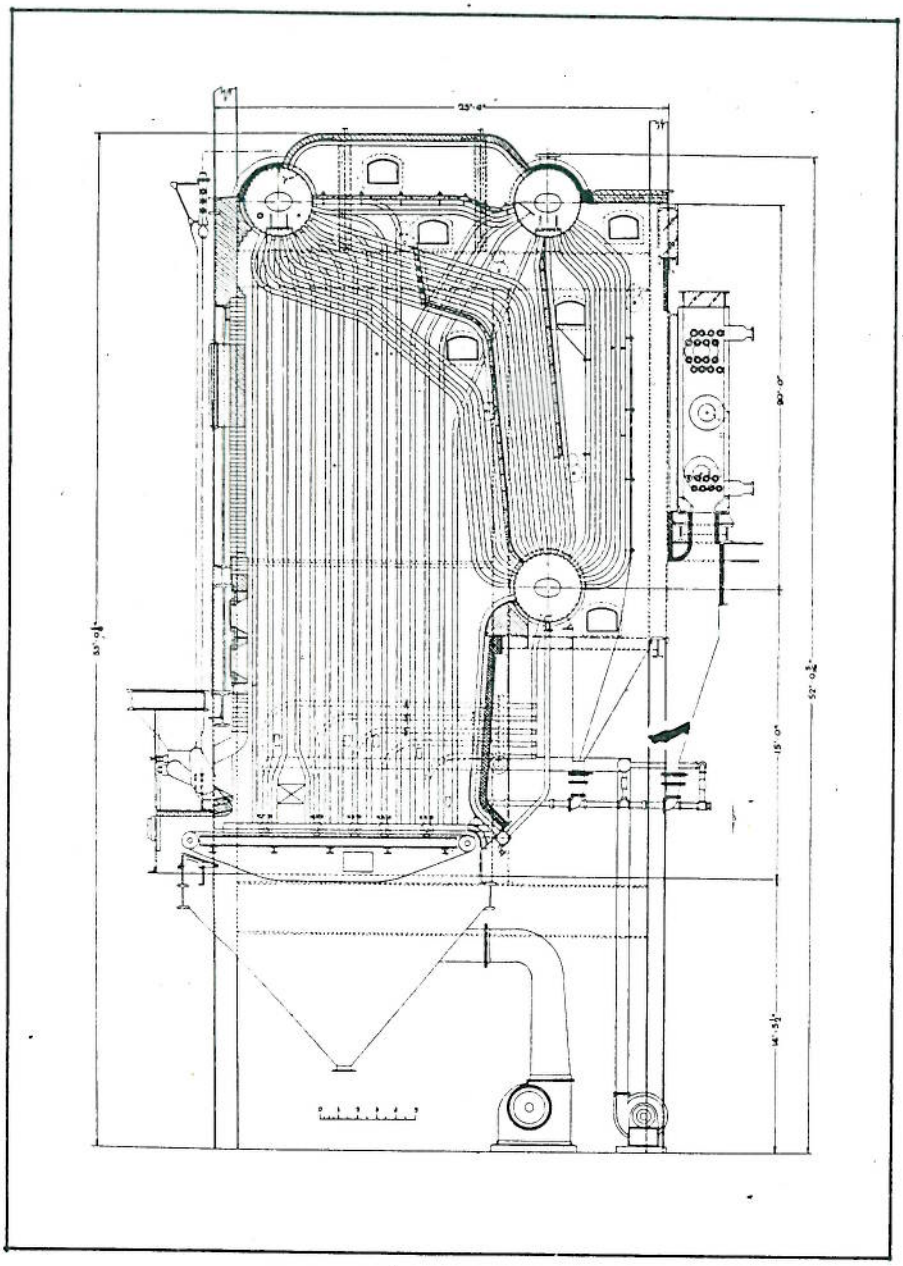
Meanwhile construction of the permanent boiler plant was rushed. As a matter of fact the first of the three larger boilers was erected and was placed in operation before the boiler house has a roof over it or the floor had been finished. The first boiler was started up Dec. 15, 1948, mainly for drying out. It went on the line Jan. 17, 1949, and was operated until the middle of May, 1949. In November it was started up again and has carried its share of the load since that date. The other two boilers were completed and placed in operation early in 1950.

Winter loads at this plant have been running between 65,000 and 95,000 lb of steam per hr, so that only two of the boilers were required and one could always be held in reserve. Summer loads have been running from 53,000



View of the firing aisle indicates attractiveness and cleanliness of entire plant. Fourth boiler will be installed at right in space not shown.

Stokers are 2-feeder units; equipped with dual drives and hydraulically driven traveling grates which discharge ash continuously at the front.



Boiler cross-section indicates elements of 3 identical units. F. D. fans and overfire air fans are located in basement.

to 67,000 lb per hr and many times only one boiler has been needed. However, loads are increasing. Boilers are kept on the line 3 or 4 months and, when taken off, are thoroughly inspected and checked. So far no scale, pitting, or other major boiler water troubles have shown up.

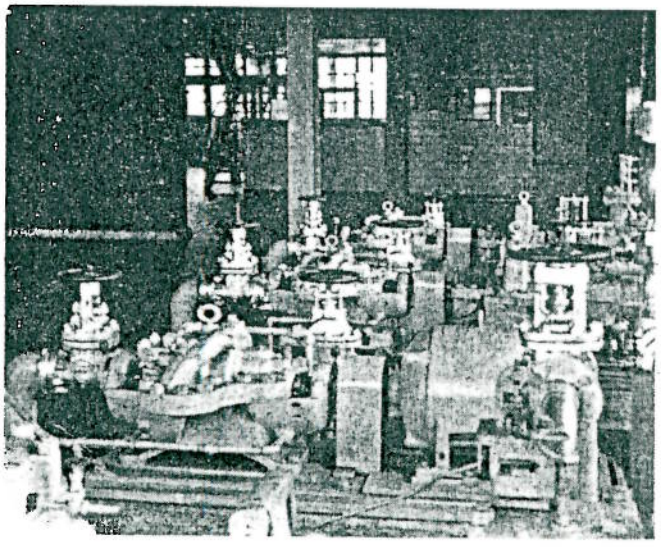
Boiler Efficiency

Efficiency of the boilers, which are identical units, has been consistently 83.5% at 60,000 lb of steam per hour. Steam is generated at 175 lb saturated and is delivered for process and heating purposes (all electrical energy is purchased) through three well insulated lines—two to the main manufacturing areas and one to the penicillin division. Despite rising coal prices, steam costs have averaged only $.39 per 1000 lb. CO_2 has been averaging 13.2%.

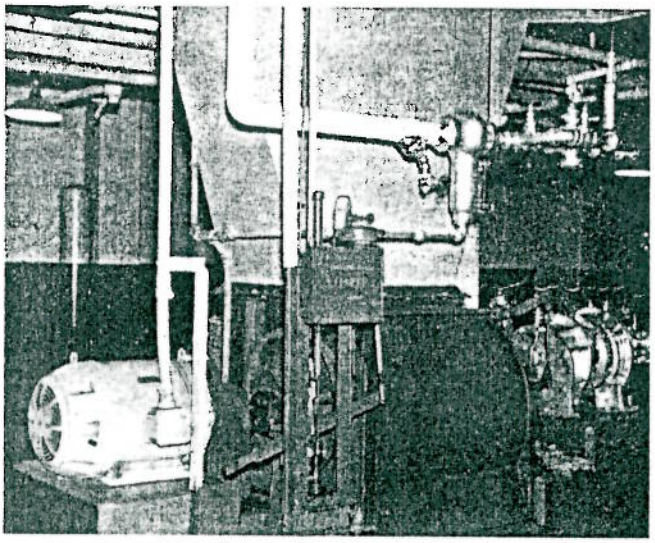
At present washed Indiana screenings (1 in. to 10 mesh) are burned. This coal is easily handled and gives off very little dust. The coal is delivered on a spur track and dumped into a track hopper provided at one end of the boiler house. An enclosure, or car-port, has been built alongside the boiler house and over the track hopper to facilitate coal deliveries in bad weather.

Another feature is a covered gas-fired thawing station, some distance from the boiler plant, for thawing frozen coal cars. This station thaws but one car at a time but it can accommodate cars with up to 4 unloading pockets. Most recent addition for speeding up the unloading of cars is a

Feedwater pumps are installed along sidewall at operating floor level. Two are turbine driven and one motor driven. Office shown at rear, center.



Dual drives and control system elements are shown in this view of one of the forced draft fans. Basement, too, is well painted and maintained clean.



simple car shaker which attaches to the under frame of a hopper car and vibrates the entire car by means of a motor-operated cam machanism. With this equipment one man can unload a car of coal in two hours or less—a job that formerly took 3 or 4 men all day, the length of time depending upon the particular conditions.

From the track hopper, the coal is belt conveyed over a magnet to a crusher (which can be by-passed if the coal is fine) and then to a chain bucket elevator. The latter delivers the coal to another belt conveyor, which extends from one end of the overhead bunker to the other and is equipped with trips to permit proper distribution of the coal. The bunker is constructed of steel plate with an interior coating of gunnite cement. It has a capacity of 700 tons and is equipped with 13 discharge gates to minimize the chances of spontaneous ignition by having coal lying undisturbed for any great length of time. A 2-ton weigh larry serves all boilers.

Stoker hoppers are of ample size to feed two rotors. The traveling grates, which are 14 ft 3 in. long, are built in 3-ft wide sections to provide a total width of 9 ft. Total area of each grate is 128.25 sq ft. Furnace heat release is 20,200 Btu per cu ft per hr at a steaming rate of 45,000 lb per hr and 27,000 Btu at 60,000 lb per hr. Water walls are provided on the side and rear of the furnaces, and the settings are of suspended wall construction, insulated, and completely steel encased.

An interesting test was made some time ago to determine how much load could be carried with only one stoker feeder operating. This test revealed that temporarily approximately full load could be carried with the one feeder.

Ash falls off the front of the stokers into ash hoppers below the operating floor. Periodically it is withdrawn by means of a steam jet actuated vacuum conveyor system to a 30 ton ash silo, constructed of vitrified blocks, located at the back of the boiler house. An unloader, equipped with scraper and water spray, unloads the ash without dust. The silo is at a convenient height so that the ash can be chuted into trucks and hauled away.

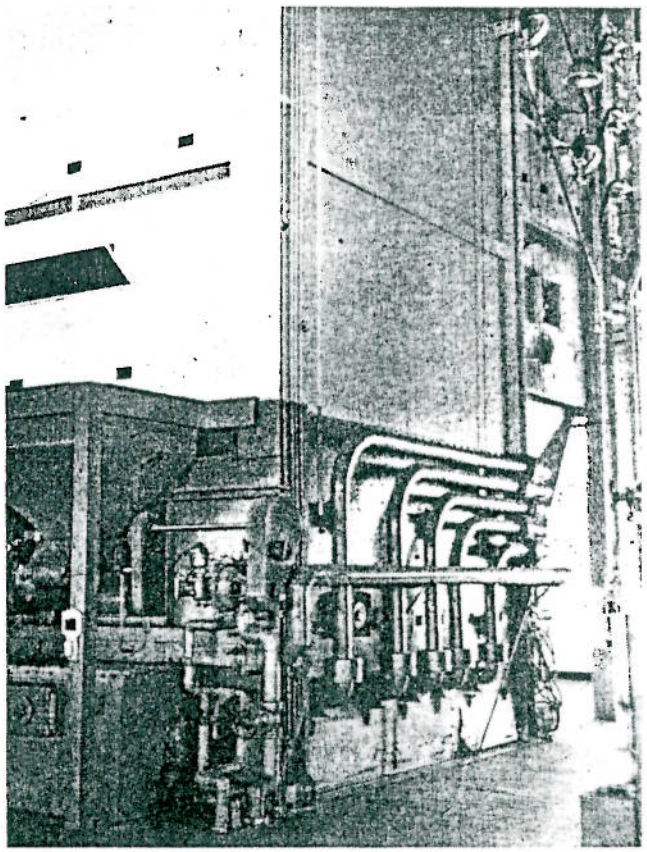
Early in the operation of the boiler plant, when only part of its capacity was being utilized and consequently coal was not moving out of the bunker very fast, fire was discovered in the bunker. To handle the fire, a special chute, leading to the ash hopper of the nearest idle boiler, was hastily constructed and the burning coal was discharged by means of the weigh larry and special chute into the ash hopper. From there it was conveyed by the vacuum system to the silo and finally dumped on the ground. After the fire has been extinguished and the coal cooled, the charred remains were put back into the fuel system and burned.

Spontaneous ignition of stored coal was also encountered while the boiler plant was getting underway. An outdoor storage pile of 5000 tons is maintained in an area some distance from the boiler plant. From necessity several different coals were first stored and the mixture soon developed hot spots. These have been cleared out and now only an eastern coal with a sulphur content of less than .5% is stored in the outdoor pile. Fuel for outside storage is unloaded by crane and compacted with a bull-dozer. When needed, coal from the pile can be loaded onto trucks—with the aid of portable, inclined, end-loading conveyors—and delivered to the track hopper and the boiler plant's coal handling system.

Cinder Re-injection

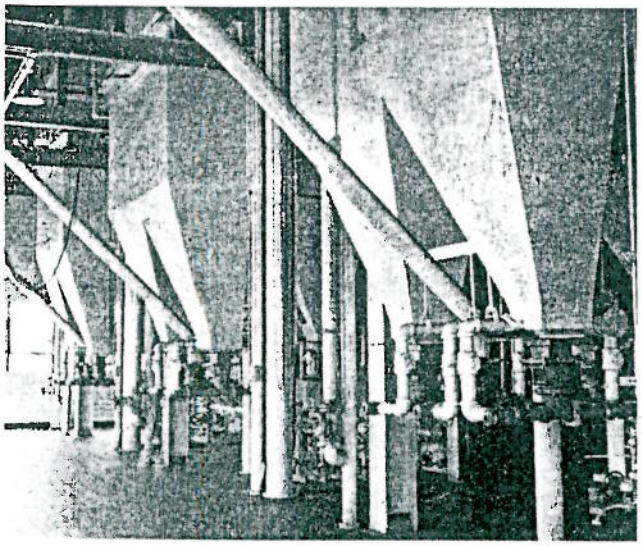
Boilers are equipped with individually adjustable over-fire air jets and cinder re-injection nozzles—4 air jets under each rotor and 4 nozzles in each back wall—for promoting combustion, minimizing smoke, and avoiding waste of Btu's in the cinder. Cinder is collected in hoppers at the furnace outlets, in divided hoppers at the bases of the economizers (with which each boiler is equipped), and in dust collectors that remove fly ash and cinder from the exit gases. (Incidentally, the stub or Evase stacks extend only 19 ft above the boiler house roof.) Separate pipe lines—two from hoppers at the furnace outlets, two from the hoppers at the economizer, and one from the hopper of the dust collector—conduct the cinder and fly ash to the reinjected systems at the back of the boilers. Individual high velocity fans, installed in the basement near the forced draft fans, supply air for the overfire jets and the cinder reinjection nozzles.

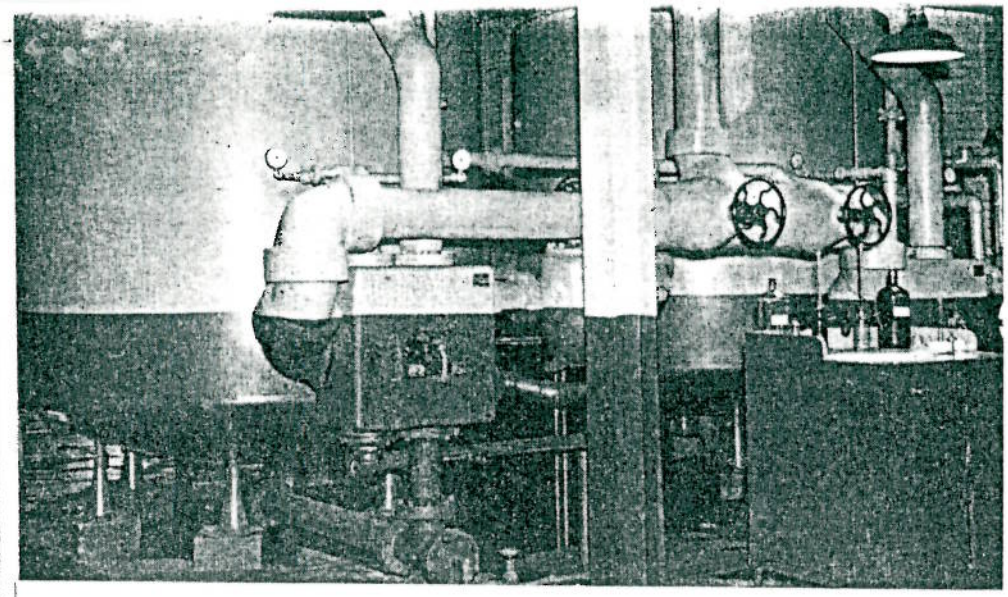
Forced draft fans, in the basement,



Corner view of one boiler shows stoker turbine drive, headers, and (upper right) soot blowers.

Separate pipe lines serve cinder return systems at rear of the boilers—two from economizer, two from furnace outlet, and one from dust collector.





Compact water treatment laboratory is provided in basement corner housing water treating equipment.

have dual drives: 25 hp motors and 25 hp steam turbines. They are rated 20,400 cfm, operate at constant speed and are equipped with adjustable vortices. The induced draft fans have been placed on a platform of steel grating above and slightly to the rear of the boilers. They too have dual drives—75 hp motors and 100 hp turbines. They are equipped with fluid couplings, speed of the fans being varied in accordance with demands of the automatic combustion control systems.

Of special note is an air intake, located in the basement. Incoming air is drawn through the intake which resembles an over-size engine radiator or unit heater. This equipment is valuable in maintaining temperature of the air and is especially useful in winter when cold air (sometimes sub-zero air) can be warmed to 72 F. This avoids many possible difficulties and promotes overall boiler efficiency.

Water Treatment

Water for the entire plant is obtained from 9 wells (120 to 220 ft deep) on company property. As much as 8 million gal per day can be provided for processes, air conditioning, and other purposes. The water is first put through a large filter tank in the basement to remove gravel and similar material. For softening and treating the water, zeolite softeners and a hydrogen ion exchange system are employed, the treated water being passed through a degassifier before going to a clear well.

Boiler make-up is roughly 20%, the zeolite softened water (to which a phosphate treatment is added) being utilized for this purpose. No pitting from oxygen has been noted or other boiler water difficulties encountered.

Three centrifugal feedwater pumps have been installed, two are turbine driven and one is motor driven. Nominally one pump is sufficient although some winter loads call for the operation of two units. They pump from a deaerating feedwater heater, which uses 5 lb steam to heat the feed to 230 F. Final feedwater temperature leaving the economizers is around 300 F. Flue gas leaves the economizers between 360 and 420 F. All boiler units are equipped with continuous blowdowns and heat exchangers. Three soot blowers are provided for each economizer and 5 soot blowers for the boiler passes.

Numerous catwalks and stairways of metal grating have been built for easy servicing of the boilers. However, much use is made of a portable railed platform that can be extended to reach 25 ft above the floor. This equipment avoids the erection of catwalks that are needed only infrequently and provides, at the level selected, ample space for a worker and his tools.

Main floor of the boiler house is finished with red tile, and is maintained spotless. Walls are of buff color glazed brick. Cleanliness is emphasized and a 30-station house vacuum system has been provided so floor, walls, and equipment can be vacuumed cleaned from a convenient location.

Fire protection is furnished by two fire pumps installed in the basement—one is motor driven and the other is driven by a 188 hp Diesel engine. Two elevated spherical water tanks, each of 100,000 gal capacity, have been erected—one on each side of the boiler house. One tank is reserved for fire purposes only and the other is utilized to maintain domestic water pressure and for emergencies.

Compressed Air

Air at 115 psi is supplied for the combustion controls and for the manufacturing plant by 3 compressors. Two—one rated 675 cfm and one rated 500 cfm—are two-stage units driven by synchronous motors of 125 and 100 hp respectively. The third compressor is a single-stage machine, with a rating of 180 cfm, and is driven by a 40 hp induction motor. The small compressor is utilized for night and week-end loads.

Underground tunnels, of such size as to permit sufficient working space, connect the boiler plant with various areas. The tunnels carry air, water and steam lines. Two sump pumps keep the basement dry.

The Austin Company was general contractor for the entire project and also furnished the consulting engineering service. W. Hawley & Company of Detroit installed the boilers.

LIST OF PRINCIPAL EQUIPMENT

Boilers—Union Iron Works (Type A)
Stokers—American Engineering Co. (Perfect Spread, 2-feeder, traveling grate.)
turbines—Coppus Engineering Co.
Motors—Louis Allis Co.
Hydraulic drives for grates—Gerotor Corp.
Economizers—Foster Wheeler Co.
FD fans—Clarage Fan Co. (20,400 dfm, 1800 rpm)
turbine—Coppus Engineering Co.
motor—Louis Allis Co.
ID fans—American Blower Co.
turbine—DeLaval Steam Turbine Co.
fluid coupling—American Blower Co.
motor—Louis Allis Co.
Dust collectors—Western Precipitation Corp.
Over-fire air fans—Buffalo Forge Co.
Coal handling—W. A. Melchior Co.
Aut. combustion control, flow and boiler meters, draft gages, recorders—Republic Flow Meters Co.
Water column & gage—Reliance Gauge Col. Co.
Furnace walls—M. H. Detrick Co.
Ash conveyor—United Conveyor Co.
Water softeners, deaerating heater—Cochrane Corp.
Feedwater pumps—DeLaval Steam Turbine Co.
Feedwater regulators—Northern Equipment Co. (Copes)
Soot blowers—Diamond Power Spec. Co.
Water filter—Cuno Engineering Co.
Safety valves—Consolidated
Blow-off valves—Okadee Co.
Continuous blowdown—Cochrane Corp.
Switchgear—ITE Circuit Breaker Co.
Motor control center—Allen Bradley Co.
Deepwell pumps—Goulds Pumps
Sump pumps—Yeoman Bros.
Fire pumps—Peerless Pump Co.
motor—Louis Allis Co. (125 hp)
Diesel—General Motors Co. (188 hp)
Air compressors—Ingersoll-Rand
Package boilers—Cleaver-Brooks Co.
Vacuum cleaning system—U. S. Hoffman
Car shaker—National Conveyor & Supply Co.
Traps—Illinois Engineering Co.
Valves—William Powell Co.
Non-return valve—Golden-Anderson Valve Spec. Co.