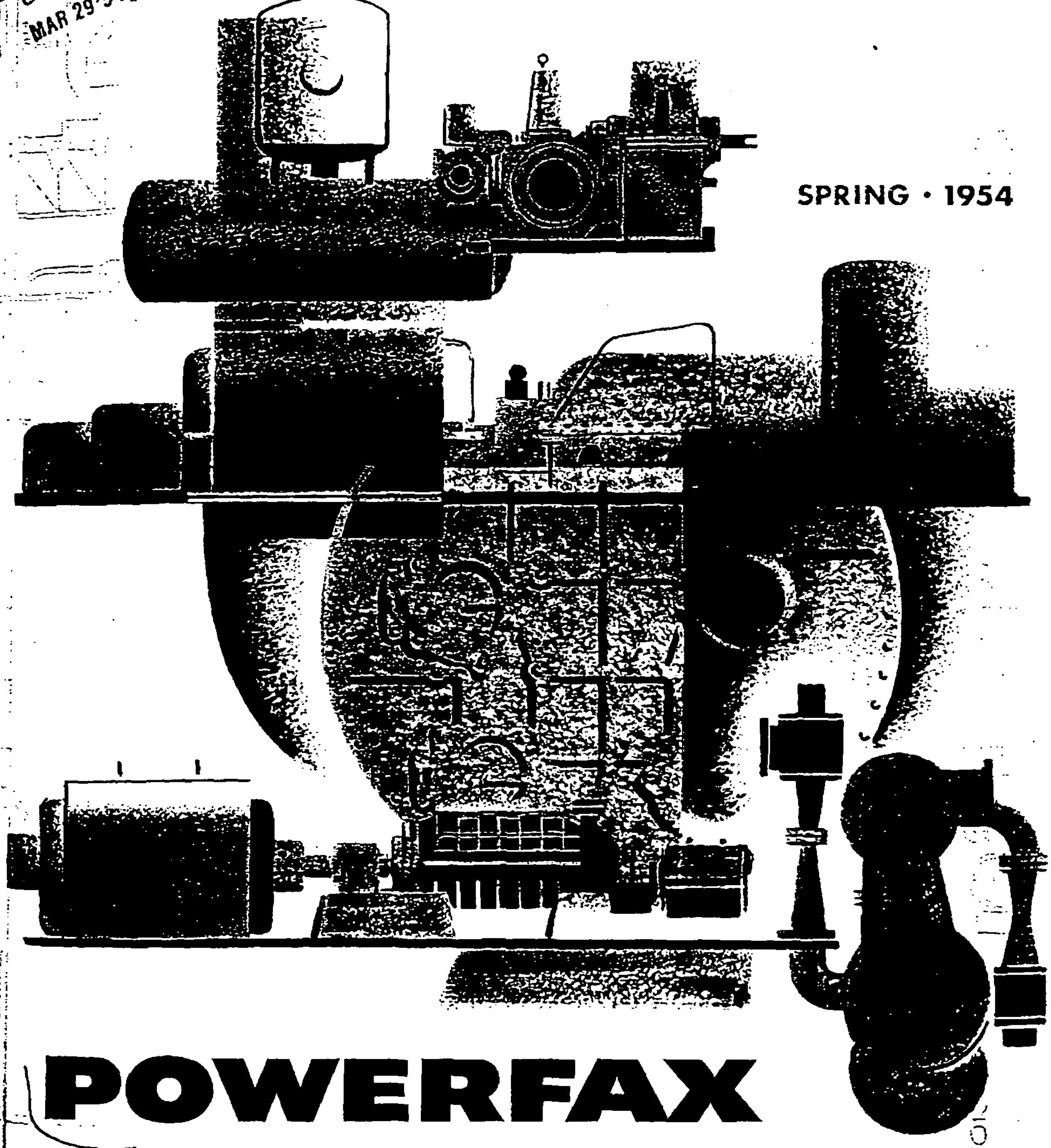
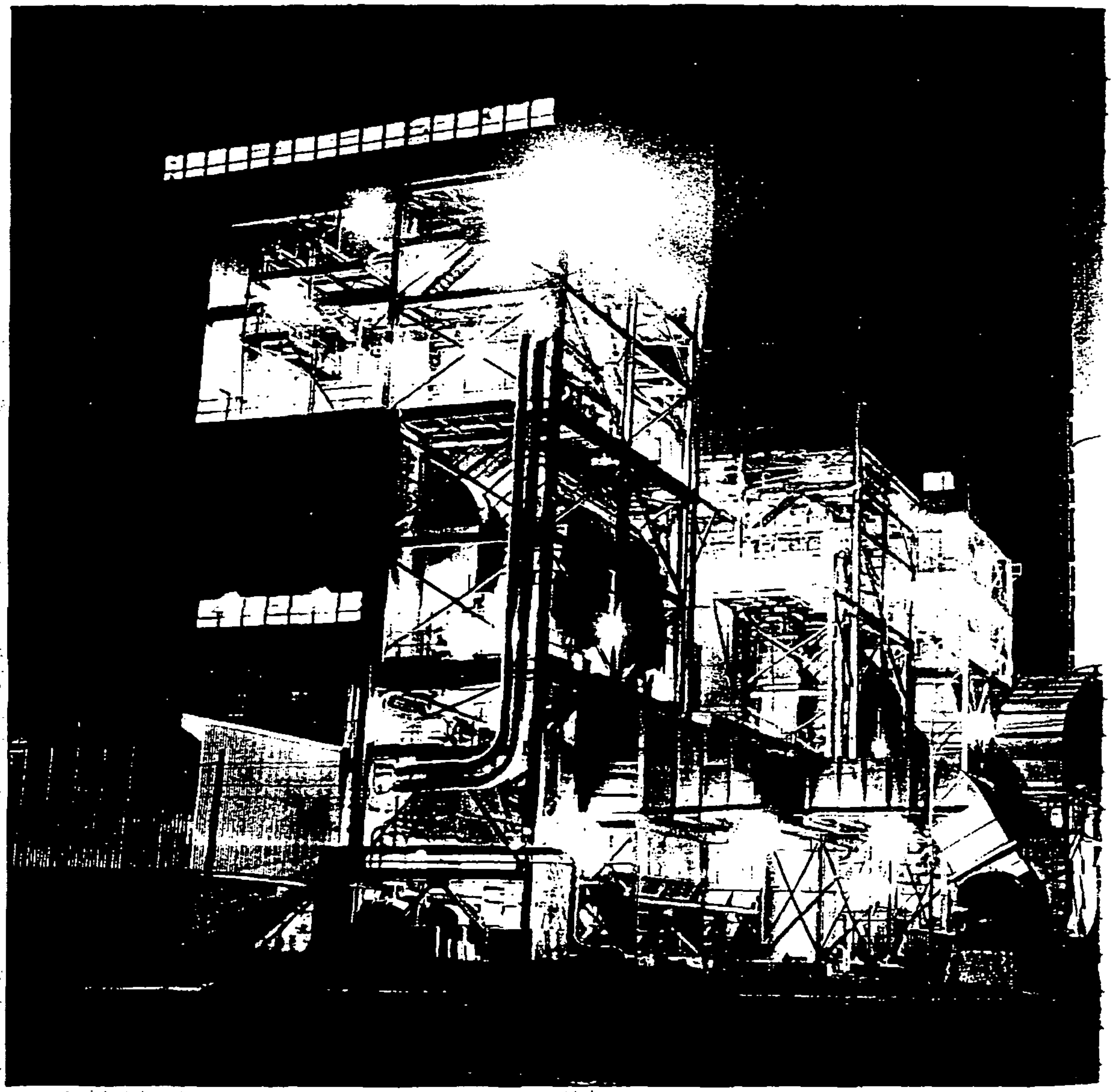
SPRING · 1954



POWERFAX

published by Elliott Company



WE are intrigued with this night photograph of the semi-outdoor Hawthorn Station of Kansas City Power & Light Company. All the more do we like it because it shows a couple of Elliott outdoor splashproof (weather-protected) motors driving forced- and induced-draft fans. The 250-hp motor driving the forced-draft fan is not too easy to make out at the left, but plainly shown at the right is the 600-hp motor on the induced-draft fan. This station was written up in the Summer 1952 issue of *Powerfax*. When the fourth unit is completed in 1955, the $50,000,000 Hawthorn Station, named after Missouri's state flower, will represent one of the largest single private investments in the history of Kansas City.

Published by Elliott Company . . . . POWERFAX is a magazine of information for engineers and operators of steam and electric power plants or in charge of industrial processes. More than 37,000 copies are distributed quarterly with the compliments of Elliott Company to its customers and friends. Address correspondence to C. W. Kalbfus, Editor, Elliott Company, Jeannette, Pa.

POWERFAX

VOLUME THIRTY-TWO NUMBER 1

CONTENTS FOR SPRING 1954

New Publications

Bulletin N-18, Deaeration by Elliott. A new 24-page bulletin that covers fully the principles of deaeration.

Bulletins N-19, 8 pages, and N-20, 4 pages, cover respectively Elliott Tray-type, and Elliott Spray-type Deaerating Heaters.

Bulletin PB11000-1. Elliott Crocker-Wheeler Flexible Couplings—4 pages. Includes coupling dimensions and table for easy selection of proper size.

Bulletin H-21. "Fundamentals of Turbine Speed Control." A generously illustrated educational booklet on theory and operation of various types of speed control systems.

Bulletin PB6000-4, 2 pages, Elliott C-W *Sealedpower* Type TP taconite-dustproof Motors.

Bulletin Q-14A. Elliott Equipment for Power Plant and Industry—16 pages.

Powerfax Index

A new *Powerfax* index covering articles that have appeared in issues of the last three years is now available and will gladly be sent to you upon request.

Speakers

On January 6, R. N. Williams, manager of the centrifugal compressor department of Elliott Company, addressed the regular monthly meeting of the Pittsburgh Section of the American Institute of Chemical Engineers on the subject "Compressor Applications in the Chemical Industry."

Philip Scarola, Pittsburgh office, and C. C. Brandt, electrical department superintendent, Bethlehem Pacific Coast Steel Corp., Los Angeles, jointly presented a paper before the Western meeting of the AISE in Los Angeles during February. The subject was Bethlehem Pacific's combination bar and rod mill at Los Angeles.

H. Steen-Johnsen, chief turbine engineer of Elliott Company, spoke before the ASME Johnstown section, January 26.

J. A. Cameron, Elliott Company chief metallurgist, was on the program of the tenth annual conference of the National Association of Corrosion Engineers at Kansas City, Missouri on March 19.

C-W General Manager

S. K. Hostetter, Jr., sales manager of the Crocker-Wheeler Division for the past year is now general manager of the division. Mr. Hostetter joined Elliott Company in 1934. Before going to the Crocker-Wheeler Division he had been in the Washington office, first as a field engineer and then as district manager for ten years.

Assistant District Manager

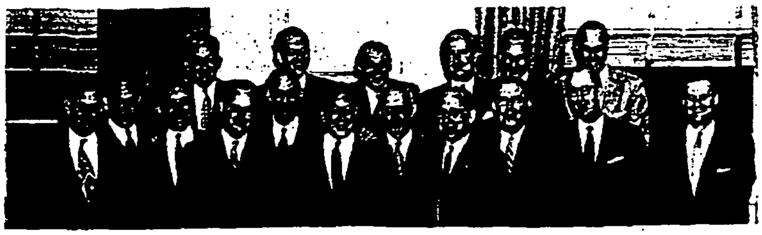
F. L. Humphrey, Jr., has been named assistant district manager in the Atlanta territory. Mr. Humphrey joined the company in 1938 after graduation from Georgia Tech as an electrical engineer. After training, he was assigned to the Atlanta office as a field engineer. In 1942 he entered the army and served four years, returning in 1946 to the Atlanta office.

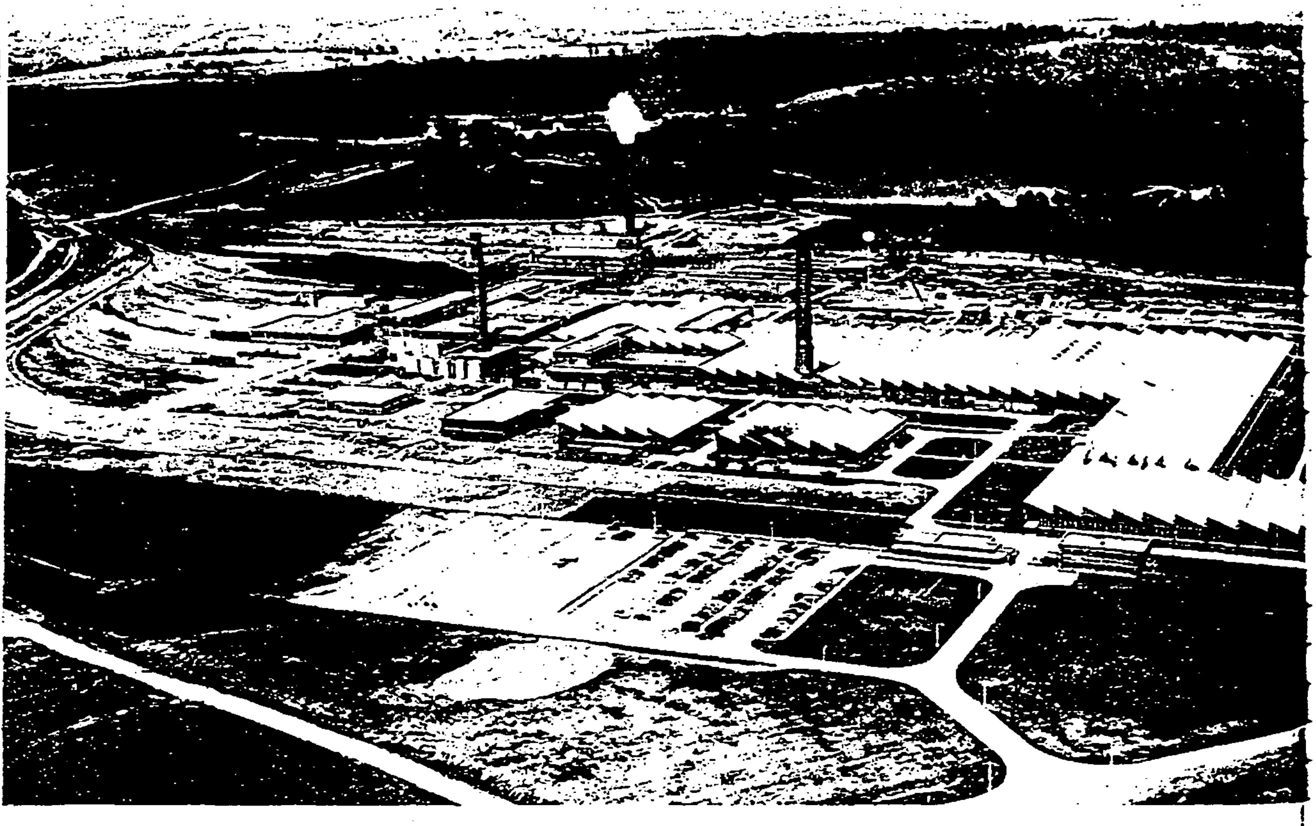
New Orleans Office

A New Orleans office is now located at 256 Lee Circle Building, telephone Raymond 2662, to service southern Mississippi and Louisiana. It is staffed by G. C. Bayles as manager and C. W. Britt, Jr., both formerly in the company's Atlanta office.

District Office Men Meet

Powerfax readers might be interested in this group of Elliott Company district office men assembled at a recent meeting in Pittsburgh. Back row: Honefenger, St. Louis; Thayer, Cincinnati; Fox, Cleveland; Williams, Detroit; Crisman, Pittsburgh; Willcox, Houston. Front row: Hiller, Washington; Kinsel, Boston; McClure, Tulsa; Widau, Chicago; Dunn, San Francisco; Pahren, New York; Hoffman, Atlanta; Strickler, Pittsburgh; Lemmon, Philadelphia; Wilson, New York; Sievert, Kansas City.



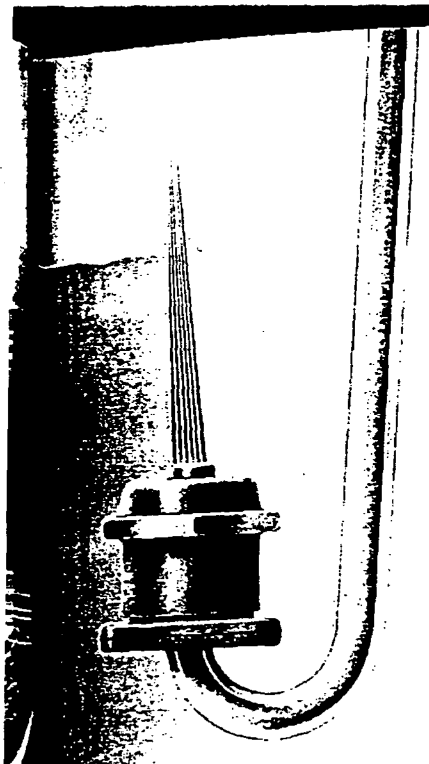


The Lowland, Tennessee, plant of American Enka Corporation makes an impressive aerial view. Beginning operation in 1948, it is equipped with the most modern machinery. The power plant is seen in the background. The other stacks handle process waste gas.

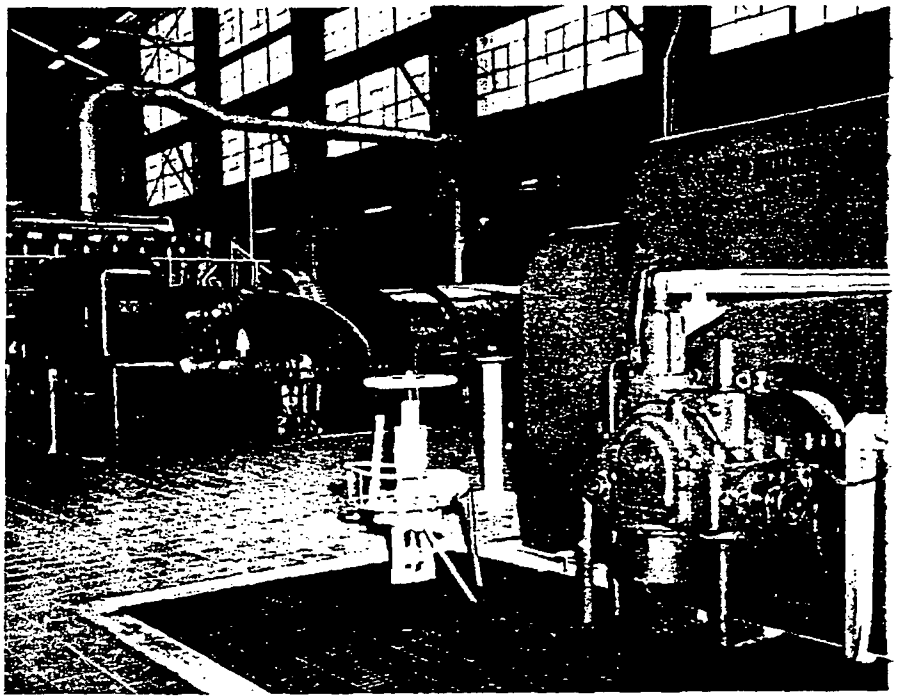
IN AMERICAN ENKA CORPORATION'S LOWLAND PLANT

PERHAPS ever since the Chinese started using silk, about 2640 B.C., scientific and curious people have been intrigued with the prospect of making "artificial silk." It is recorded that in 1664 an English naturalist and research scientist suggested that a way might be found to make an artificial composition resembling the substance spun by silkworms. A Frenchman, de Chardonnet, in 1878 began an extensive study of the life and habits of silkworms. After many failures, he chemically "digested" mulberry leaves to produce nitrocellulose. He forced a syruplike solution through tiny holes in the end of a nozzle and patented his process in 1884. His "artificial silk" was a sensation at the Paris World Exposition in 1889.

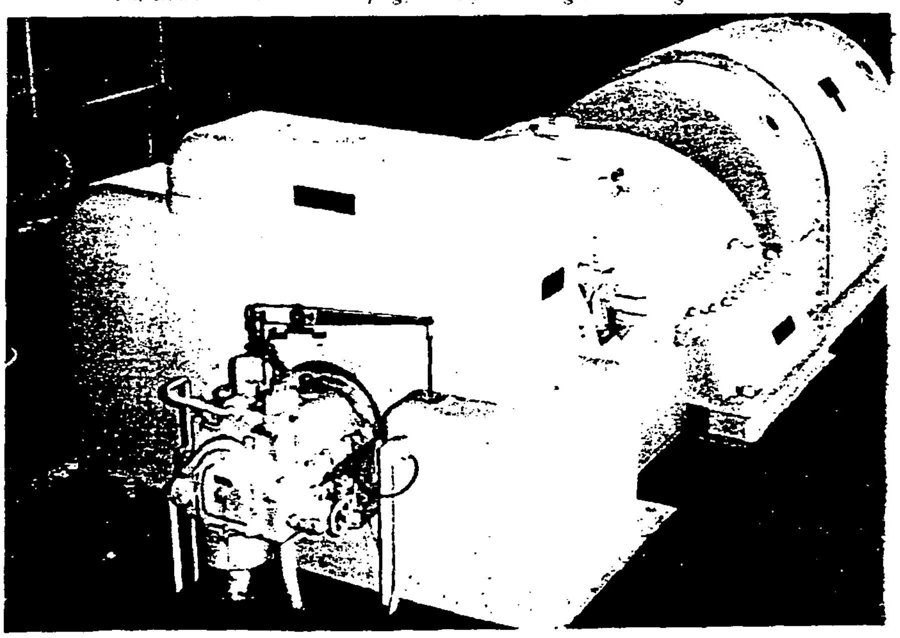
Various other discoveries and developments came along rather rapidly. In 1911 at Marcus Hook, Pa., Courtaulds and Company started the first viscose plant in the United States. In 1924 the term "artificial silk" was discarded in favor of "rayon." In a comparatively short time rayon has advanced from a laboratory curiosity to a vast industry employing



The gold and platinum spinneret might be called the heart of the process of spinning or converting viscose into rayon filament. The viscose is pumped into a glass tube and the other end through this thimble-like cup, which is perforated with any- from 18 to 720 microscopically small of from two- to three-thousandths of inch in diameter. The spinneret, in operation, is immersed in a spinning bath dilute sulphuric acid and various salts.



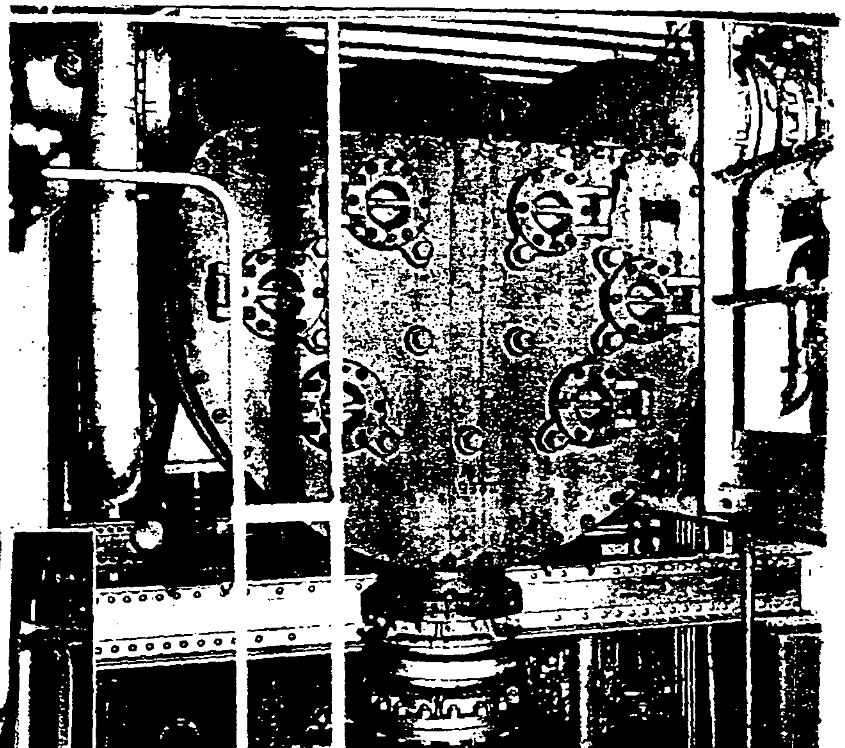
Above and below are the three Elliott 5000-kw turbine-generator units which can operate straight condensing or condensing extraction at 20 psig to process. The steam conditions are 400 psig, 720 F, exhausting to 2 in. Hg absolute.

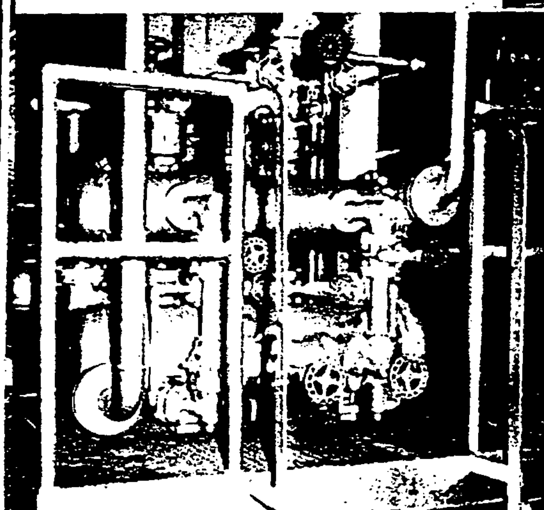


thousands of people. In America, the annual production of rayon has rocketed from 97 million pounds in 1928 to one-and-a-quarter billion pounds in 1950.

In 1928 a group of far-visioned ders founded the American Corporation with an eye to ing their Dutch process for artificial silk." The name was derived from the initial the mother Dutch company, ndsche Kunstzijdefabriek, pronounced "Ka" in Dutch). investigating more than 50 sites, these industrial

One of the three Elliott 6500-sq ft horizontal two-pass non-divided water-box surface condensers, each of which is served by an Elliott twin two-stage air ejector. (Seen at right and below.)

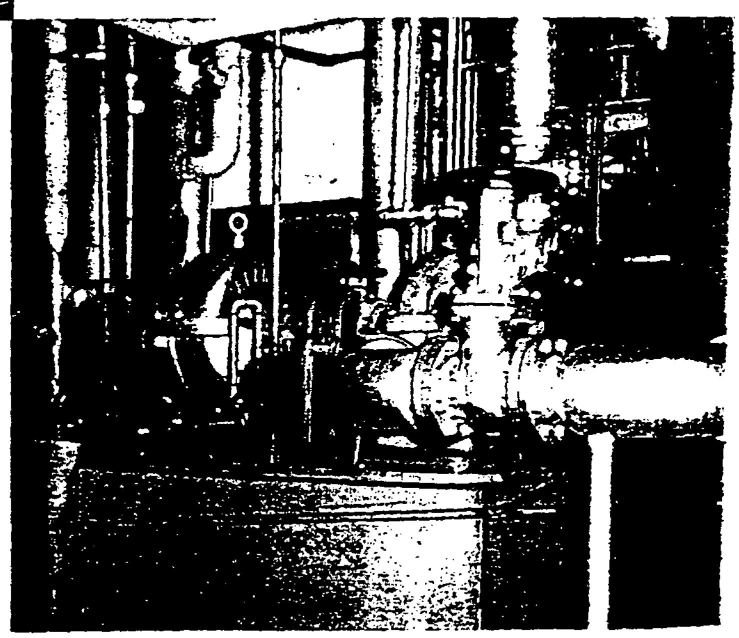




Close-up of one of the twin two-stage ejectors.

There are turbine-driven and motor-driven condensate pumps u condensers. Motor-driven pumps serve Unit 3. At right is a of one of the motor-driven condensate pumps, the motor rate

This photograph is a close-up of one of the 7½-hp steam turbines driving condensate pumps. Both turbine-driven and motor-driven pumps are used on two condensers.

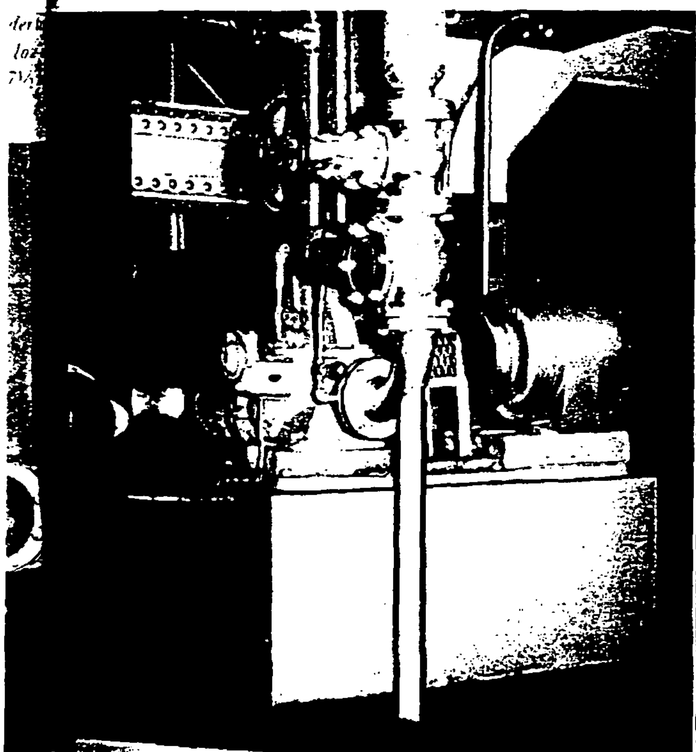


pioneers decided to build their first production plant in western North Carolina, near Asheville. Several factors prompted this decision—accessibility to raw materials and markets, ideal climate, abundance of pure water, and an ample supply of capable labor. By 1940 Enka was providing jobs for nearly 3000 people, and its annual production of 23,000,000 lb was four times the first year's output.

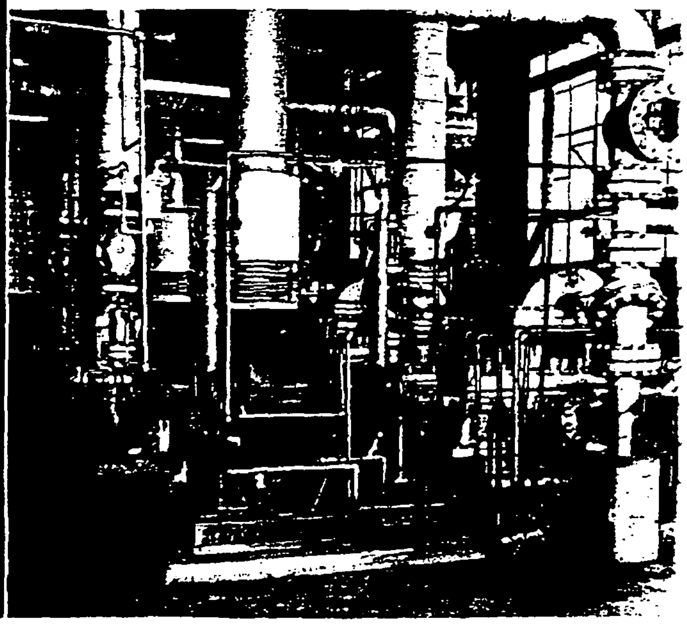
At the outbreak of World War II, Enka quickly geared itself to production of high-tenacity yarns requested by the United States Government. Enka rayon was used in airplane and truck tires, self-sealing tanks and hose, cargo parachutes, and other essential wartime items.

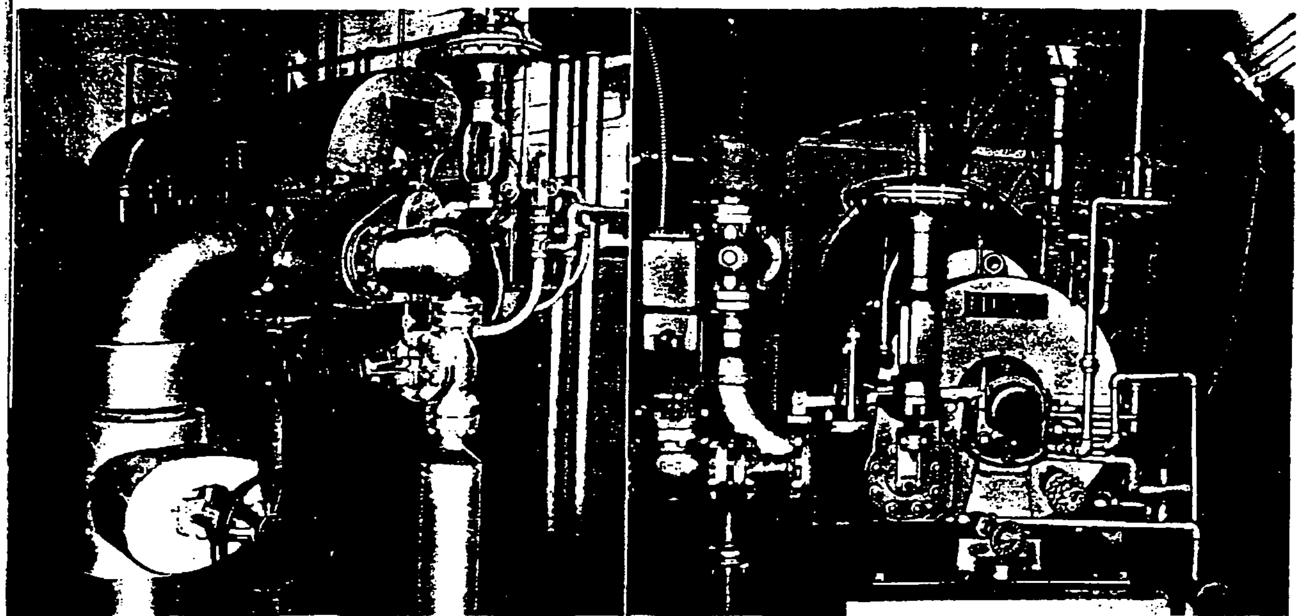
After the war, the company expanded even more. Since the Enka (Asheville) plant had grown to its full capacity, plans were drawn in 1946 for a second plant eight miles south of Morristown, Tennessee, in a community called Lowland. Equipped with the industry's most modern machinery, the Lowland plant began operations early in 1948. This plant specializes in the high-tenacity yarns which are used not only in automobile tires, but in high-pressure hose, fan and conveyor belts, compressor diaphragms, and other miscellaneous items which must endure rough treatment. Superior fabrics are also woven from Enka rayon by America's foremost weaving and knitting mills.

Rayon yarn made by the viscose process consists of regenerated cellulose, derived from refined bleached spruce, pine, and hemlock wood pulp, or from cotton linters. The cellulose is delivered to the plant by the pulp manufacturer in rectangular white sheets resembling large desk blotters. Caustic soda is used in a soaking press. Now called alkali cellulose, the material is dropped through a chute to a shredder where cellulose fibers are turned into a mass of small fluffy particles. These "white crumbs" are aged for about two days and are then placed in a churn and treated with liquid carbon disulfide. The white crumbs are thus changed to orange crumbs and the latter are dissolved in dilute caustic soda. The resultant solution is viscose, a golden-brown sticky viscous liquid with the consistency of honey or lubricating oil. After the viscose is filtered and aged, it is spun through a gold and platinum spinneret which is perforated with anywhere from 18 to 720 microscopically small holes of from two- to three-thousandths of an inch



One of three Elliott 300-hp turbines which are direct-connected to three boiler-feed pumps serving the five boilers.





Geared turbines, with NEMA "A" variable-speed governors, are used to drive draft fans. At left is seen one of three Elliott 204-hp geared turbines driving the induced-draft fans. At the right is shown one of the three Elliott 90-hp geared turbines which drive the forced-draft fans.

in diameter. The spinneret is immersed in a spinning bath of dilute sulphuric acid and various salts. When the viscose is pumped through the spinneret into the spinning bath, it coagulates because the chemicals in the bath remove from the cellulose the caustic soda and carbon disulfide which heretofore rendered it soluble. Thus the cellulose is again in a solid state in the form of fine filaments. The filaments are twisted and wound on tubes or cones. Between 14,500 and 17,000 yd of thread are wound onto beams approximately 2½ ft in diameter by 5 ft long for shipment.

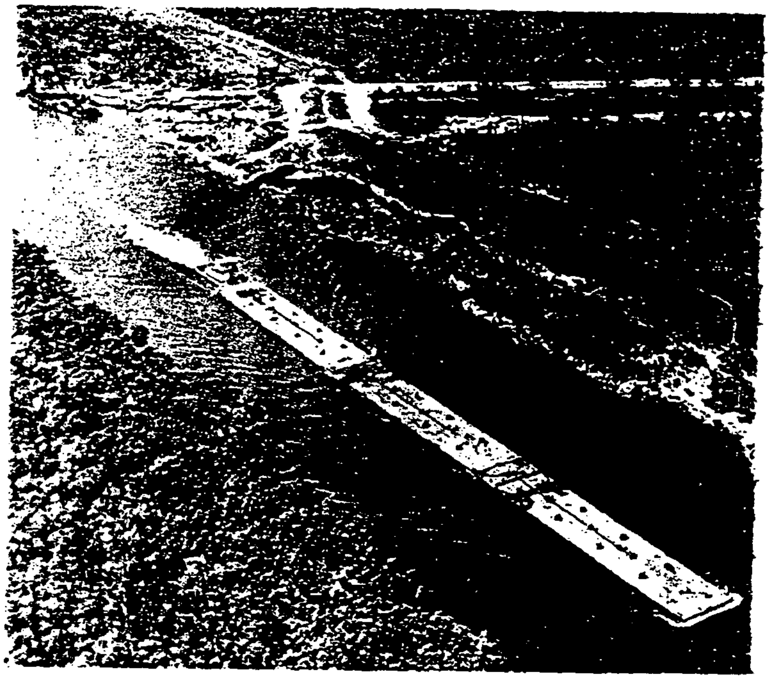
These processes, performed on a huge commercial scale, of course require a large amount of very reliable electric power, process steam, and water 24 hours a day. The electric power consideration assumes critical importance since the Lowland plant has no external source of power. The 60-cycle electric power needed in the manufacturing process is generated by three Elliott turbine-generator units. Four existing boilers (a fifth is now being installed) supply steam for turbine throttle inlet conditions of 400 psig and 720 F and serve, also, pressure-reducing stations for process steam. The turbines may operate straight condensing, or steam may be extracted for manufacturing processes at 20 psig. A rayon plant requires large quantities of steam for process in addition to a nominal steam-heating demand. At Lowland, extraction steam from the turbine units is the largest source of process steam, augmented by pressure-reducing make-up stations. When the Lowland plant went into operation, two Elliott 5000-kw turbine-generator units were installed. By 1951 a third unit of essentially duplicate characteristics was installed. Each of these turbines is served by an Elliott 6500-sq ft surface condenser of the horizontal two-pass nondivided water-box type with fabricated steel shell and cast-iron water boxes. In these condensers, the tubes are rolled in the tube plate at both ends by a special Elliott method, eliminating the necessity of an expansion member in the shell. Each condenser is equipped with a twin two-stage steam jet ejector. The ejectors are so arranged that any stage may be isolated without interference with the operation of the other two-stage element.

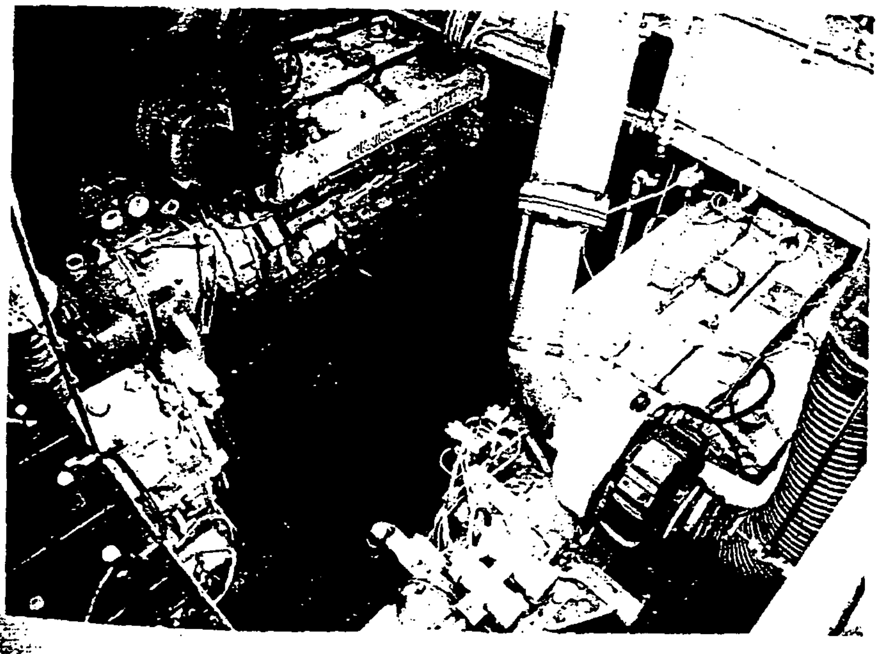
Elliott mechanical drive turbines are driving the boiler-feed pumps, the forced- and induced-draft fans, and condensate pumps on Units 1 and 2 in the power plant. Incidentally at the Asheville plant of American Enka Corporation, 10 Elliott steam turbines are employed to drive boiler auxiliary equipment and Elliott steam jet ejectors serve vacuum equipment.

Elliott Crocker-Wheeler motors drive the condensate pumps on Lowland Unit 3. Seventeen Crocker-Wheeler motors, in sizes from 3 to 40 hp, are used in various plant drives, such as rotary blowers, car shaker, conveyor, and numerous pumps handling viscose, brine, salt slurry, etc. A 250-hp, 1765-rpm motor drives a refrigeration machine.

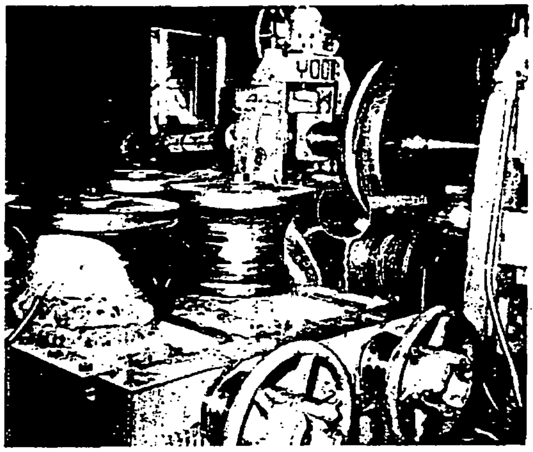
THE REBEL WARRIOR

THE *Rebel Warrior* is a powerful and compact diesel propelled towboat operating in the Intracoastal Waterway between Port Arthur, Texas, and New Orleans, and up the Mississippi to Greenville, Mississippi, pushing her barges loaded with crude oil from producer to market. Owned by the Black Warrior Towing Company of Harvey, Louisiana, she is 58 ft long, 20 ft wide, and draws 7½ ft of water. She is powered by two 600-hp, 2100-rpm Cummins diesels, equipped with Elliott turbochargers. Under full load of three petroleum barges (10,000 bbl each) the *Rebel Warrior* has a cruising speed of five to six knots, making her 1300-mile round trip from Port Arthur to Greenville and return in 12 days. She is one of the most powerful boats of her size out of New Orleans today.





Looking down into the engine room of the Rebel Warrior *we see the two Cummins diesels which are equipped with Elliott turbochargers.*



This photograph shows the leading end of a partially formed pipe as it emerges from the fifth pass of the forming mill.

LONE STAR'S MODERN PIPE MILL

by B. C. DOLPHIN, Chief Research Engineer, Yoder Company
and R. F. KIRCHNER, Elliott Company, Cleveland, Ohio

ON February 1, 1953, production of oil country pipe was begun at the new steel plant of Lone Star Steel Company, Lone Star, Texas.

This completely integrated steel mill, representing a \$150,000,000 investment, includes blast furnaces, open hearths, slab and rolling mills, and two modern electric resistance weld pipe mills. Range of size produced is 1½ in. to 6 in. on the

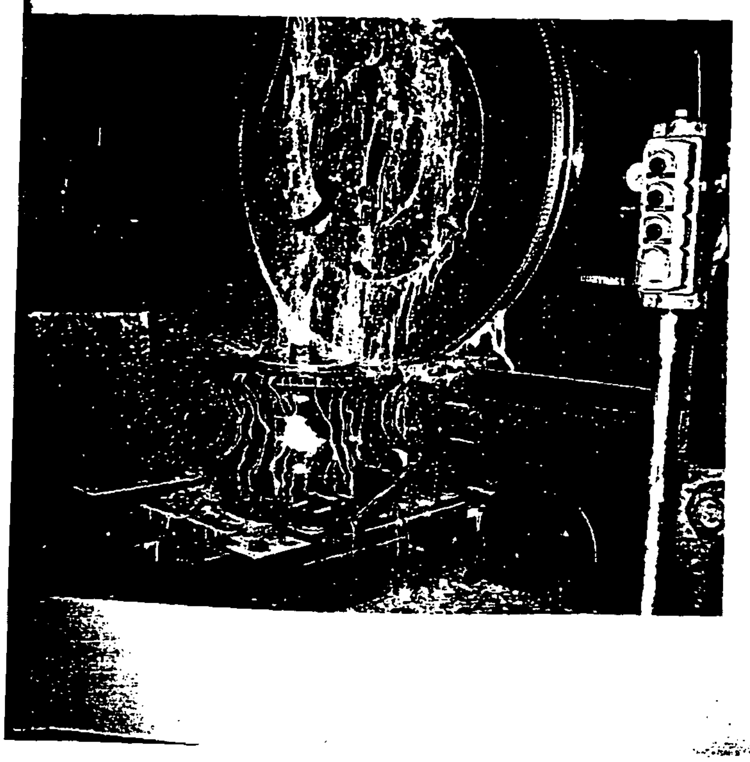
The forming section of the larger mill from the entry end. Drives include eight Elliott Crocker-Wheeler 75-hp, 1150/1400-rpm d-c motors. At right may be seen a 15-hp, 1800-rpm totally-enclosed fan-cooled hydraulic pump driving motor.

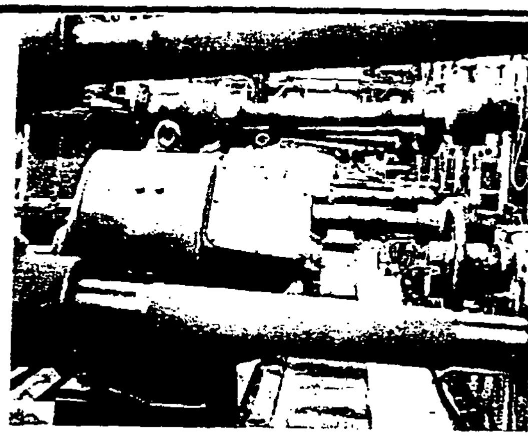
smaller mill, 4 in. to 16 in. on the larger mill. Pipe with wall thickness of 3/8 in. or less is made from coiled stock, and heavier pipe with walls up to 9/16 in. is made from plate.

Line pipe, casing, and drill tubing are manufactured in a continuous line—including uncoiling or depiling, levelling, edgetrimming, shot blasting, forming, welding, cutting to length, normalizing, reducing, and straightening. Subsequent operations are performed in an adjacent building and include threading, trimming, upsetting, hydro-testing, etc.

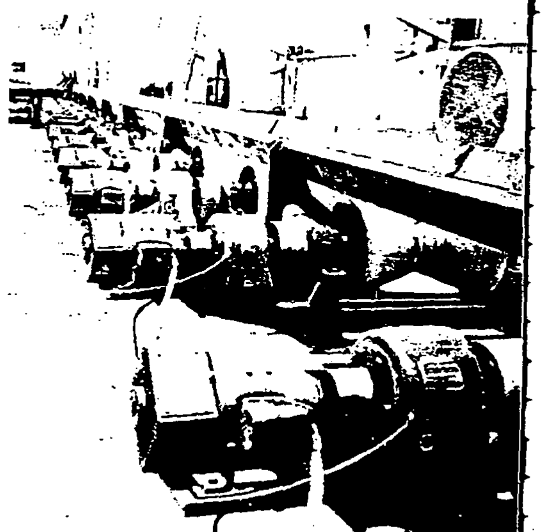
The most vital part of the entire pipe mill operation is performed by the resistance welding machines and associated equipment, which is manufactured by Yoder Company of Cleveland, Ohio. The material is formed by means of rolls into a circular section and passed under a pair of electrodes to effect the weld. After welding, the pipe is cut to length using a flying cutoff machine. The cutoff machine for the large mill, manufactured by Wm. K. Stamets Company, Pittsburgh, is the first of its kind to accommodate diameters as large as produced on this mill. Drive power for the electric weld mill

This photograph shows pipe being welded as it leaves the forming mill (to the extreme right) and travels toward the pullout section. External flash is cut at the extreme left of the photograph and collected on the "bead winder," shown darkly at upper left. The large wheels in the center of the photograph are the copper electrodes which effect the weld by passing a controlled current as high as 275,000 amperes through the seam edges.



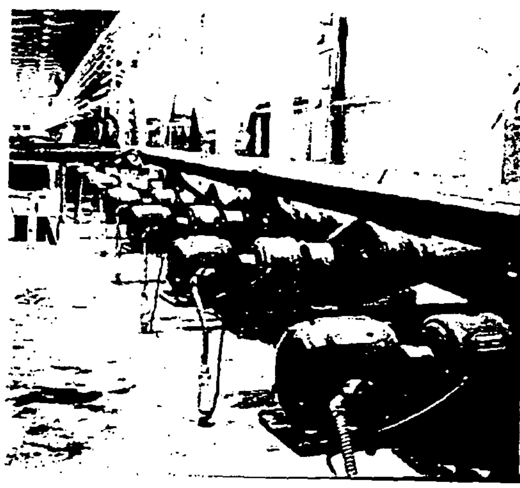


A view showing four 25-hp, 1150/1440-rpm d-c forming section drive motors on the small mill.



The pipe conveyor of the No. 1 mill is driven by a line of Elliott C-W 1-hp, 1750-rpm d-c motors.

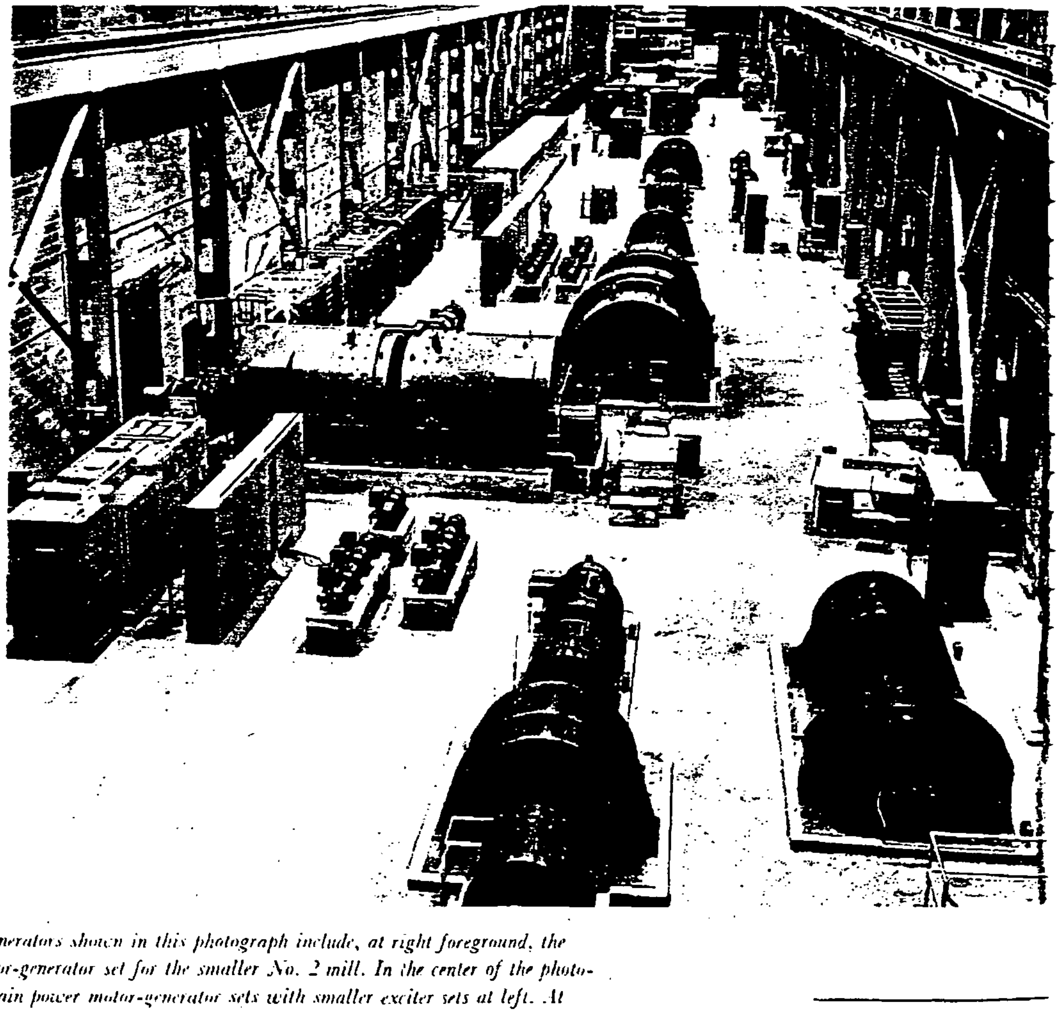
This pipe conveyor is driven by a line of Elliott C-W 1-hp, 1800-rpm enclosed induction motors.



sections is supplied by ten adjustable-voltage d-c generators totalling nearly 3000 kw. Weld power is supplied by two single-phase alternators, the larger one being 4000 kva at 2400 volts, 84 cycles, driven by a synchronous motor rated at 4500 hp, 13,200 volts. A-c motors range in size from this 4500 hp down to 1/6 hp, and have a total horsepower rating of over 11,600. All rotating equipment for the new pipe was supplied by Elliott Company, with Cutler-Hammer control.

Electrical engineering for this project was accomplished by the co-operative efforts of A. J. Boynton Company of Chicago, Yoder Company, Cutler-Hammer, Inc., and Elliott Company.

Looking toward the finish end of the smaller pipe m.



Elliott motor-generators shown in this photograph include, at right foreground, the weld power motor-generator set for the smaller No. 2 mill. In the center of the photograph are the main power motor-generator sets with smaller exciter sets at left. At the far end in the center is the weld power motor-generator set for the No. 1 larger mill.

In this group of motor-generator sets, the 4500-hp weld power set for the No. 1 mill seen in the right foreground. Four m-g sets, exclusive excitation sets, serve this mil

LION CHEMICAL PLANT INSTALLS TURBINE-GENERATORS

by G. A. ROBERTS, Senior Engineer,
Lion Oil Company, El Dorado, Ark.

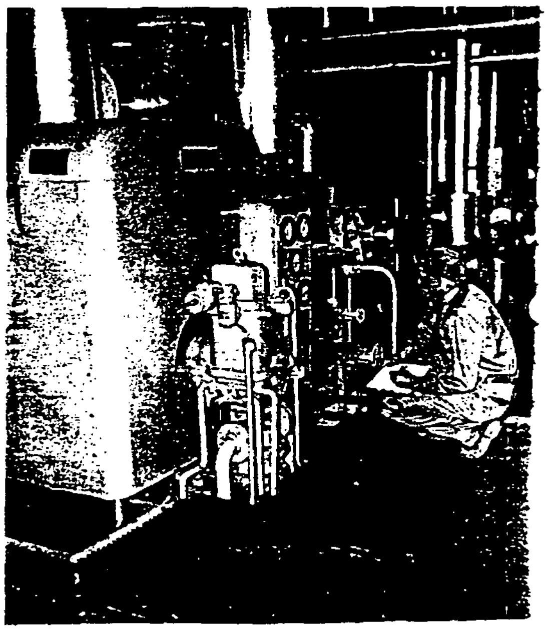
EDITOR'S NOTE: The Autumn 1950 *Powerfax* carried an article on Lion Oil Company's refining and petro-chemical plants located near El Dorado, Arkansas. The company is constantly making additions and improvements designed to diversify, improve processes, or reduce operating costs. This article tells how the installation of two turbine-generators gives needed electric power without increasing boiler load. The installation was under the jurisdiction of A. M. Sprague, chemical superintendent, and F. L. Emert, chief engineer.

EL DORADO, the oil capital of Arkansas, is in the midst of the oil- and gas-producing area of the state. Here Lion Oil Company has two manufacturing installations. One, a refinery, in the southwest portion of the city, produces a wide variety of refined oil products from crude oil. The other, a chemical plant five miles north of the city, uses natural gas, air, and water as the principal raw materials in the manufacture of nitrogen products.

The basic product of the chemical plant is anhydrous ammonia, which is produced by combining atmospheric nitrogen with hydrogen from steam and reformed natural gas. Although some of the anhydrous ammonia is marketed as such, most of the ammonia is processed into ammonium nitrate, ammonium sulfate, and ammoniated solutions. The acids used in the production of these agricultural and industrial chemicals are made at the Lion plant.

Large quantities of steam are required for power and process in the production of these chemicals. At

The view at far right shows the two Elliott noncondensing turbine-generator units. One turbine exhausts into the 65-psi header, the other into the 30-psi header, giving independent control and flexibility. Picture at near right shows governor end of one of the turbines, with operational instruments.



several stages thermal energy is recovered by means of waste-heat boilers, all of which feed into the 275-psig main steam system. However, most of the steam load is carried by four gas-fired integral-furnace boilers under automatic control.

Steam for process is used at several pressure levels. The gas reforming process uses steam at 65 psi and 20 psi, regeneration of purification solutions at 30 psi, while feedwater heating requires 20 psi.

The users of intermediate and low-pressure steam were supplied by back-pressure mechanical drive turbines and the original turbine-generators, as well as by direct pressure reduction.

The original plant was self-sufficient in electricity. The quantity of direct pressure-reduced steam for process was relatively small.

Revisions and additions to the ammonia plant increased the ammonia production rate by 30 per cent. Fertilizer solutions, pelleted ammonium nitrate, and ammonium sulfate were added to the product list. The consumption of process steam and electricity increased accordingly.

The electric load exceeded the reliable capacity of the plant system. Part of the load was transferred to purchased power. Even with this relief, the plant system was loaded to capacity.

Lion's chemical plant engineers showed that additional back-pressure turbine-generator capacity to pass most of the process steam being supplied by direct pressure reduction would add at least 2700 kw to the plant generating system, and at the same time serve to desuperheat the process steam.

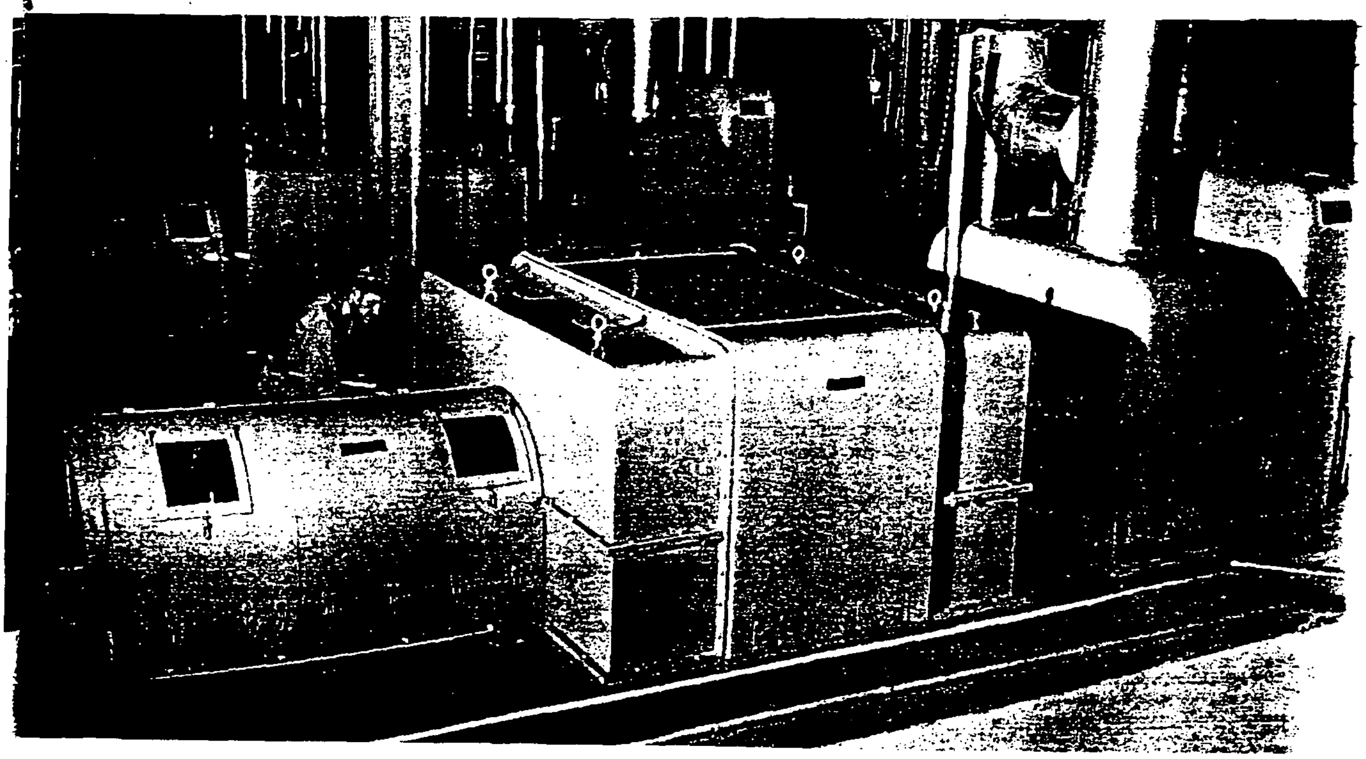
A combination extraction and back-pressure unit was first considered for supplying the various pressure-levels. Analysis of the steam load at the various pressures indicated that the energy recoverable from pressure reduction to 65 psi or to the lower pressure was nearly equal. Two Elliott 1500-kw back-pressure turbine-generators were installed. Both turbines operate with 275-psi 540 F steam at the throttle. One exhausts into the 65-psi header, and the other exhausts into the 30-psi header. A pressure regulator station was installed between the 30-psi header and the 20-psi header.

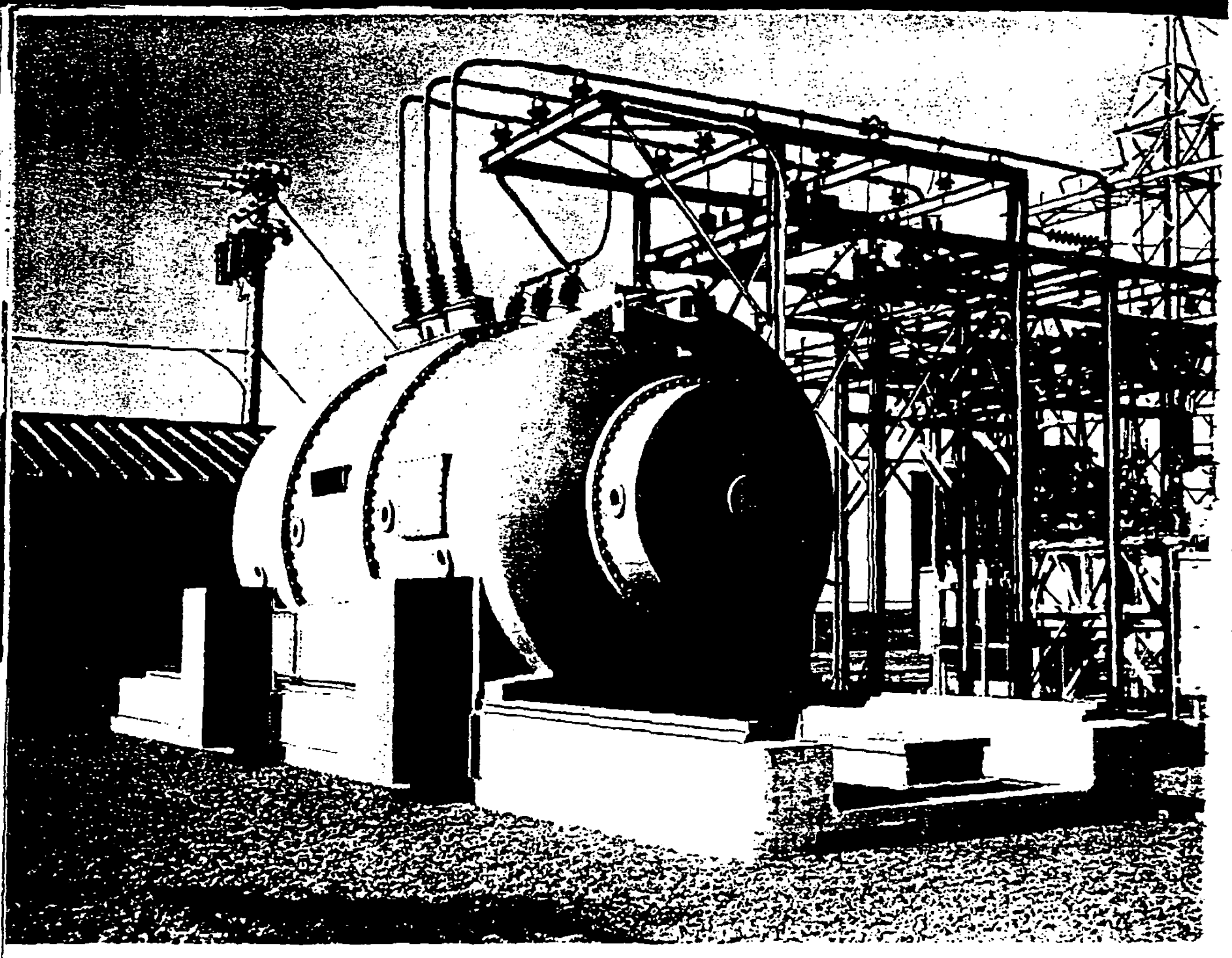
The installation of the two units provided independent supply and control of the two process steam pressures, affording operating flexibility and maintenance availability.

The 30-psi unit was put in service in December, 1952. It has operated at nameplate rating and on test has demonstrated a capability beyond 2000 kw. The 65-psi unit went into service the following month. It has operated at about three-fourths load.

The El Dorado Chemical Plant's engineering staff of Lion Oil Company performed the load analysis, designed footings, piping, and the electrical layout, erected the turbine-generators, and installed all accessories pertaining thereto.

Since these turbine-generators operate without increasing boiler load, their energy cost is really low, below the incremental cost on gas-engine generators running on the system.





The Elliott 40,000-kva synchronous condenser at the Beaver Creek substation, showing bus connections from transformer bank to condenser. Starting is by means of reduced voltage from the autotransformer bank in the switchyard.

BEAVER CREEK SUBSTATION—KEY LINK IN NORTHEASTERN COLORADO TRANSMISSION SYSTEM

by J. L. LANGFORD, Engineer, Design and Construction Division, Bureau of Reclamation, Denver, Colorado

BEAVER CREEK substation on the Bureau of Reclamation's Colorado-Big Thompson Project is the main switching station of the Bureau's high-voltage system now serving a widespread area in northeastern Colorado. Located near Brush, Colorado, the substation was placed in operation in March 1953, the first of its kind to be installed on this transmountain diversion project

All lines radiating from the Beaver Creek installation are operated at 115 kv except one, a 46-kv line, now being connected to the substation. Power is delivered over this network to several stepdown substations supplying REA and other distribution systems which serve more than 14,000 customers in rural areas and in small communities.

The importance of switching operations, particularly after system troubles or outages, influenced the decision to make this station attended. However, operators have no control over system frequencies, and some synchronizing operations must be cleared through the power plant operator

In addition to its importance as a switching station, the substation maintains optimum bus voltage to provide the best possible service to customers. A synchronous condenser, manufactured by Elliott Company, maintains a suitable voltage on the 115-kv system. However, the station bus voltage is not the controlling factor since loads are not served directly from the Beaver Creek installation. Rather, the distribution substations on the network are the points at which approximately constant voltage is needed. The over-all system voltage can be adjusted over a considerable range by the operator at the substation.

Power generated in the Colorado-Big Thompson Project's hydro-electric power plants on the eastern slope of the Rocky Mountains is delivered to the Beaver Creek substation over Bureau transmission lines extending through Greeley and Brighton, Colorado. From the substation, the power continues over a network of 115-kv lines radiating out to Sterling, Colorado (where interconnection is made with the Missouri River Basin transmission system) and Holyoke, to Akron, Yuma, Wray, and Limon, all in northeastern Colorado. These lines supply energy for distribution systems operated by REA co-ops and municipalities.

Three of the 115-kv lines may either supply power or represent loads, depending on system operating conditions. These lines emanate from the Beaver Creek installation and extend respectively to Greeley, the Colorado-Big Thompson Project substation at the Flatiron Power and Pumping Plant, and a Missouri River Basin Project substation at Sidney, Nebraska. The remaining lines supply distribution substations only.

The Beaver Creek installation's 115-kv bus structure is designed to supply seven 115-kv transmission lines, one 46-kv line, and the substation's 40,000-kva, 13.8-kv synchronous condenser. Two of these 115-kv line positions are spares for future expansion of the Colorado-Big Thompson Project power system. In addition to the main bus, the substation is equipped with a 115-kv transfer bus. With the exception of the bay serving the transformer for the 46-kv line, there is one 115-kv oil circuit breaker for each line position. The 46-kv line is protected by a 46-kv oil circuit breaker and the 3-phase transformer is protected by 115-kv fuses. An additional 115-kv breaker is installed between the 115-kv bus supplying the transformer bank and the transfer bus, serving as a transfer breaker if any 115-kv breaker is taken out of service.

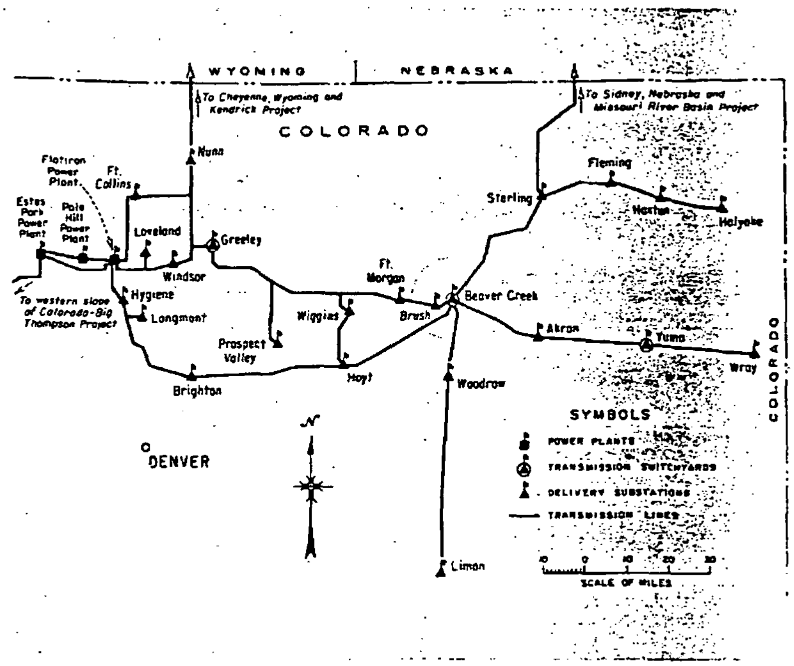


Diagram of northeastern Colorado 115-kv transmission system on which the Beaver Creek substation is located near the load centers. The system is supplied by several hydro stations. An Elliott 35,000-kva, 450-rpm generator serves the Pole Hill Power Plant. Three Elliott 13,333-kva, 240-rpm generators are installed in the Kortes power plant in the Kendrick Project, mentioned at top of diagram, and two Elliott 18,950-kva, 164-rpm generators will soon be in operation at the Alcova power plant, also part of the Kendrick Project.

Three single-phase, 115-kv, grounded wye to 13,800-volt transformers are installed in the switchyard to supply the synchronous condenser. Each transformer has a self-cooled rating of 12,800 kva, which can be increased to 16,000 kva by the addition of cooling fans.

Initially, network analyzer studies indicated that the bus at the substation should be maintained at about 107 kv during periods of light loads. These studies also showed that the voltage should be increased to about 115 kv during periods of heavy system loads. During periods of light loads, the capacity of the transmission lines tied into the substation causes the voltage to rise at distant points on the system. During periods of heavy loads, the lagging power factor of the loads will cause an appreciable drop along the transmission lines. Accordingly, varying these bus voltages between 107 kv and 115 kv should provide satisfactory voltage at system load points. The transformers are provided with taps above and below 115 kv to meet changing conditions in the systems.

The transformer bank taps now are set on the normal voltage (115 kv) tap, and the synchronous condenser is expected to operate satisfactorily with this setting for several years. The estimated corresponding range of voltages at the condenser terminals is from 12.6 kv to 14.5 kv. When 14.5 kv at the condenser terminals will not maintain the bus at about 115 kv during heavy loads, the transformers can be changed to the 117.875-kv tap. Network analyzer studies show that, during periods of light system loads, the condenser should absorb about 8500 kvar from the system. At heavy system loads, the condenser will be required to supply about 40,000 kvar to the system. Over a period of several years the loadings are expected to fluctuate over the full range of capacity of the condenser. The bus voltage is adjusted at intervals as the system load conditions change.

The Elliott Company's synchronous condenser is a 3-phase, 60-cycle, horizontal, hydrogen-cooled, outdoor type of machine, rotating at 720 rpm. It is designed for automatic starting from a master control switch. This switch, the voltage level, and other controls are mounted on the main control board in the switchyard control building. The machine is equipped with an automatic voltage regulating circuit and an amplidyne exciter for a pilot exciter. A motor-operated field rheostat permits manual regulation of the voltage in emergencies. The main exciter is direct connected at one end of the condenser, but can be sealed off from the hydrogen system of the condenser. The generation of reactive power is controlled by adjusting the voltage regulating control switch for the regulator, which changes the excitation current of the condenser field by adjusting the exciter field current.

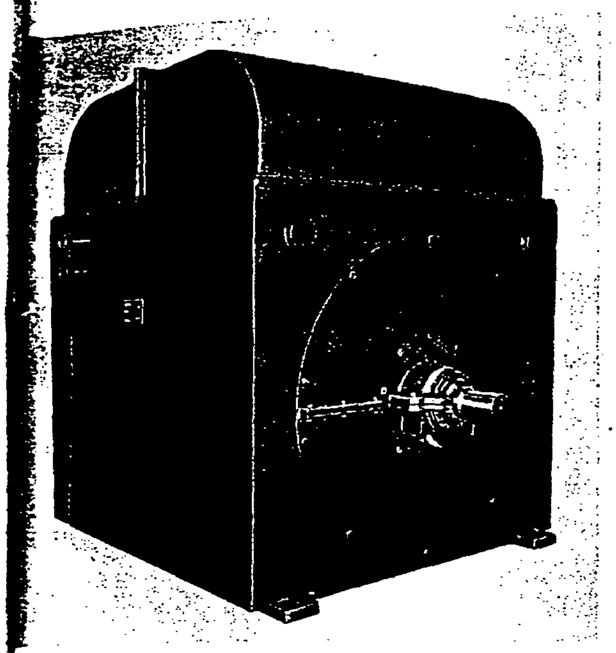
Although the synchronous condenser was installed primarily to regulate the 115-kv bus voltage, the automatic regulating network is actually connected to the 13.8-kv bus. Accordingly, a current transformer is connected to a compensating network to correct for the voltage drop through the transformer bank.

The condenser is rated at 40,000 kva at leading power factor when overexcited, and at 16,800 kva at lagging power factor when underexcited. Hydrogen cooling requires ½ psi pressure (above atmospheric) for this rated output. The 40,000-kva rating can be increased to 48,000 kva by increasing the hydrogen pressure to 15 psi. An upper limit control circuit is included in the voltage regulating equipment. This permits setting the maximum load that the machine will carry when overexcited. When this loading is exceeded, the circuit automatically lowers the reactive output of the machine. Accordingly, the bus voltage will be reduced if the condenser is unable to maintain the desired voltage.

Short intervals of system overfrequency, following faults or other system disturbances, are not expected to cause any disturbance at the substation. However, protective relays are provided to shut down the condenser if, during system disturbances, the condenser loses synchronism with the generating plants. Otherwise, the condenser will return to normal operation when the system is restored to 60-cycle operation. The automatic regulating equipment is compensated for frequencies consistently above and below 60 cycles. Without these special compensated regulating circuits, the alternating-current terminal voltage rise would be approximately proportional to any increase in frequency. The amplidyne set, consisting of an electric motor direct-connected to the amplidyne exciter, also has an overspeed switch that causes the automatic regulation to be cut out at dangerous overspeeds.

To supply cooling water for the present synchronous condenser and for a second condenser planned for future installation, two wells were constructed about a mile from the substation. The supply system consists of the two wells having a tested producing rate of about 800 gpm, two 8-in., 5-stage, turbine-type pumps, installed in a concrete pump house, an 8-in. supply line to the substation, and an 8-in. return line to Beaver Creek. Each pump is rated 360 gpm at a total dynamic head of 135 ft. Since the water pumped is extremely hard and analysis has indicated that it is scale-forming, a treating system was installed to keep the salts in solution. No attempt is actually made to remove the salt content of the water, and some trouble was experienced during the first few months of operation. The treating system consists of a 500-gal. concrete dosing tank, a flow-controlled feed tank, a plastic feed line to each well, and the necessary control valves. Power to operate the pumping plant is obtained from the 3-phase, 460-volt station service system at the substation's switchyard. This power is stepped up to 2300 volts and transmitted to the pumping plant site on a single-pole transmission line. A control cable is installed on the same poles beneath the power conductors.

Now being installed is a 7500-kva transformer bank and a 115-kv switching bay for connection with the Colorado-Big Thompson Project's substation at Yuma, Colorado. The substation designs provide for the possible addition of a second transformer bank and synchronous condenser. The present installation should be adequate for 10 to 15 years. However, if the present rate of load growth continues, additional facilities will ultimately be required.



Elliott totally-enclosed inert-gas or instrument-air-cooled motor with top-mounted water cooler design.

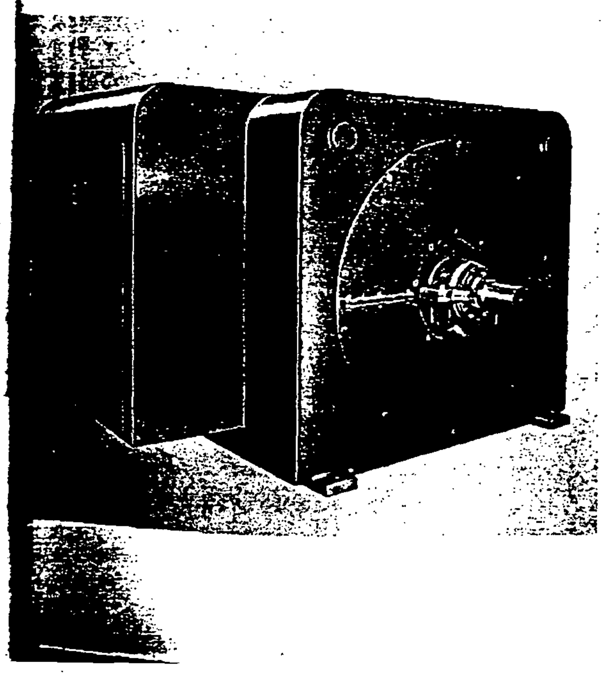
THE petroleum and chemical industries have been faced with the high cost of initial motor installations and have been looking for means to cut down this cost. One method of cutting down the cost is by using inert-gas or instrument-air-cooled motors on ratings 900 hp and above in hazardous areas instead of explosion-proof motors.

The inert-gas or instrument-air-cooled motor is basically what is known as "a totally-enclosed water-cooled motor," but instead of circulating ambient air it uses a closed system to circulate inert gas or instrument air, with water circulating in a tubular heat exchanger unit to cool the gas or air with inert gas or instrument air introduced as a cooling medium at approximately .15 psig or 4.2 inches of water with special seals on the shaft and gas-tight construction throughout to prevent leakage of gas. Thus, only a small supply of non-explosive "make-up" gas is required.

Since the inert-gas or instrument-air-cooled motor is available in larger horsepower sizes than the explosion-proof motor, it can be applied to meet the demand for "greater capacity" and when properly installed and maintained is acceptable to the insurance and other inspection authorities.

TOTALLY-ENCLOSED INERT-GAS OR INSTRUMENT-AIR-COOLED MOTORS

This new motor for hazardous areas can also be furnished with side-mounted water cooler as shown here:



The inert-gas or instrument-air-cooled motor is designed for operation in Class I, Division II "hazardous" areas. The Class I, Division II areas are defined in the National Electrical Code as locations (1) in which flammable volatile liquids or flammable gases are handled, processed where used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment, (2) in which hazardous concentration of gases or vapors are normally prevented by positive mechanical ventilation, but which might become hazardous through failure or abnormal operation of the ventilating equipment, or (3) which are adjacent to Class I, Division I locations, and to which hazardous concentrations of gases or vapors might occasionally be communicated.

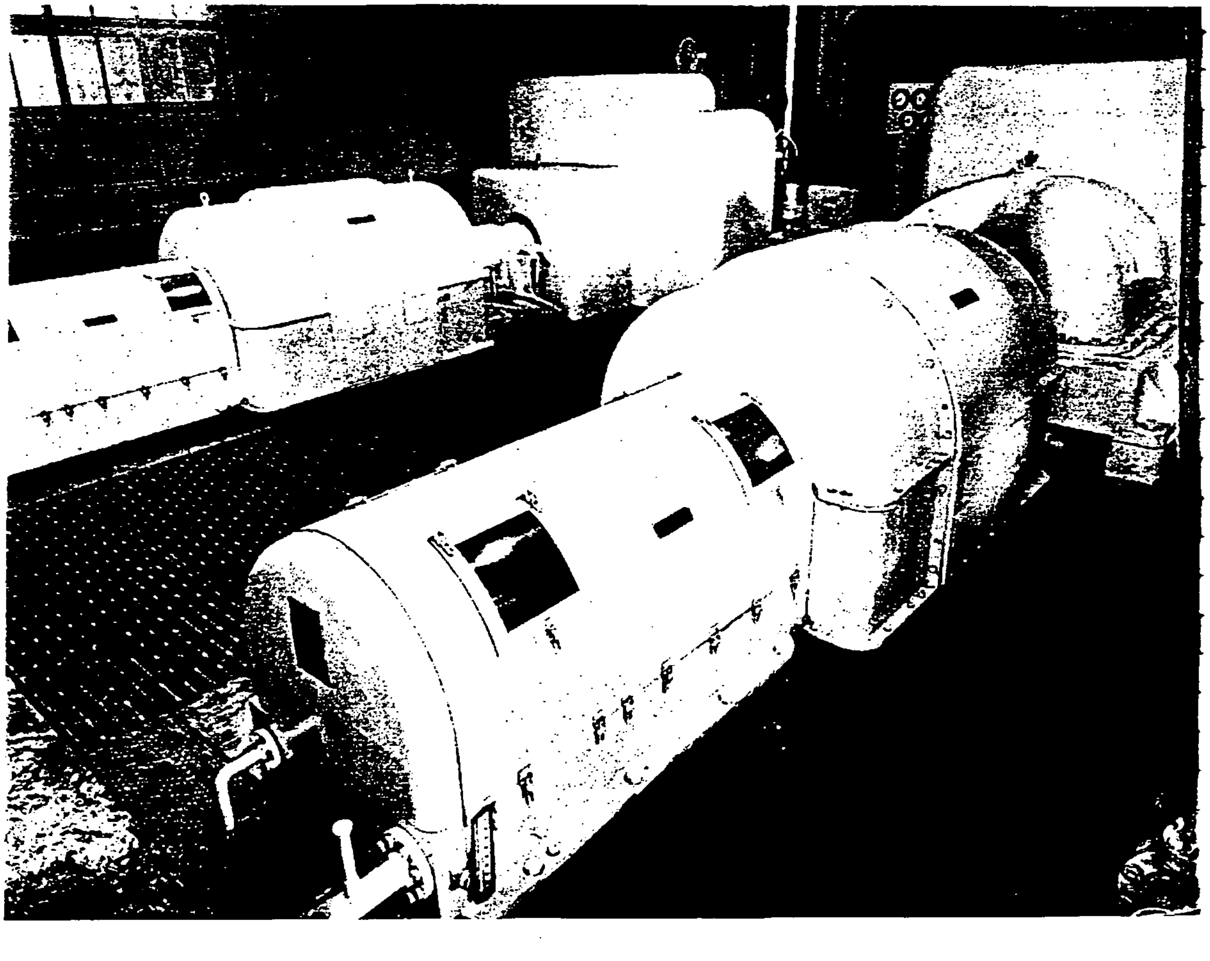
POWER MODERNIZATION AT DOWNINGTOWN PAPER COMPANY

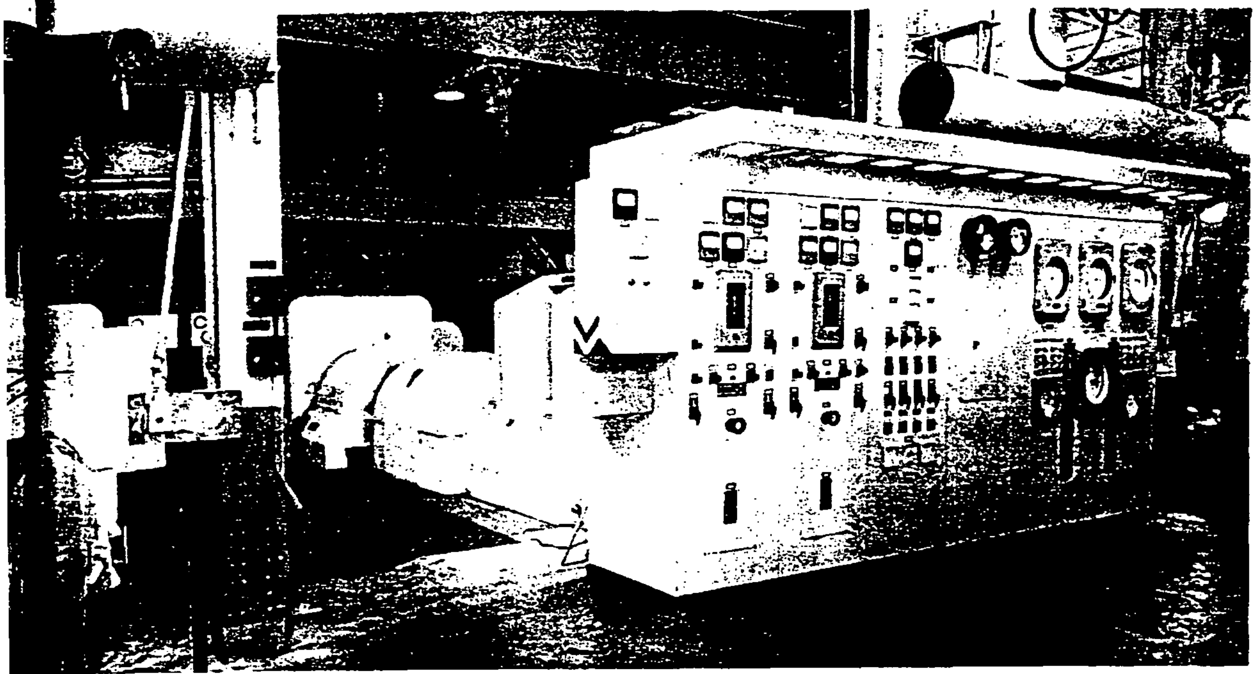
by JAMES M. LAFFERTY, Mechanical Engineer, Albert C. Wood Associates, Consulting Engineers

WITH the recent installation of two 2500-kw turbine-generators and one surface condenser, the Downingtown Paper Company, Downingtown, Pennsylvania, has just completed its program for the modernization of its steam and electric power-generating facilities.

The Downingtown Paper Company, manufacturers of high quality paperboard began this modernization program in 1947. At that time, the steam requirements of the plant were supplied by three boiler plants which generated saturated steam at 150 psig. Purchased power and steam engines furnished the power requirements of the mills.

Following a detailed survey and study, plans were made for the installation of new steam-generating facilities and the construction of a central boiler house to replace the individual steam plants. Two 80,000-lb-per-hr pulverized-coal-fired steam-generating units were installed to generate saturated steam at 150 psig to supply the plant's steam distribution system. These units were designed for future





This view of the two Elliott 2500-kw turbine-generators features the instrument switchboard.

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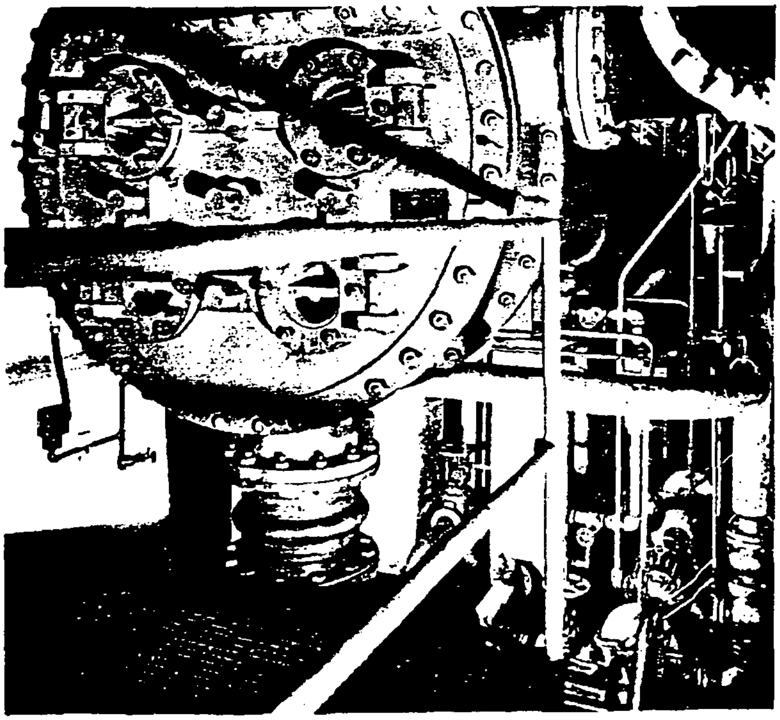
In the picture at left, the condensing extraction turbine-generator unit is shown in the foreground and the noncondensing unit in the background.

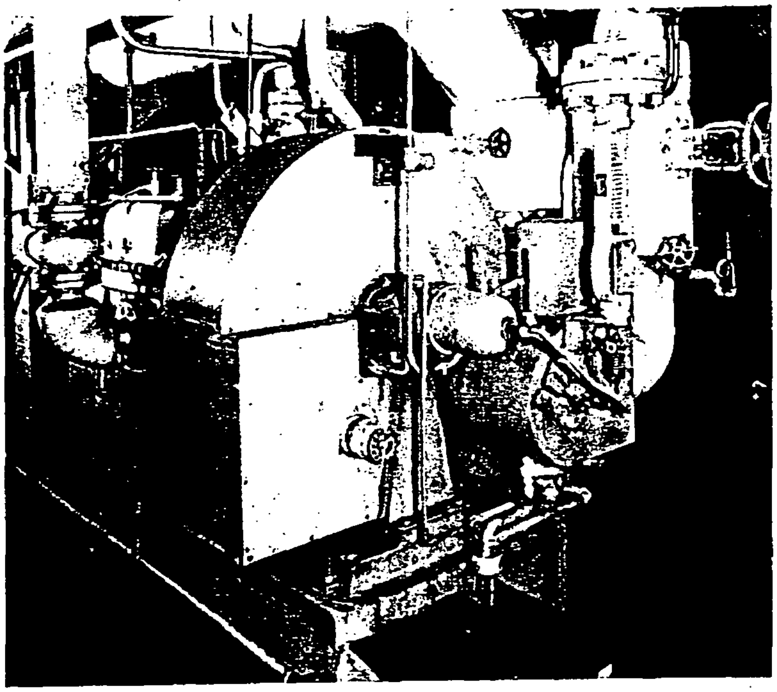
operation at 450 psig, 650 F in order to permit the future installation of turbine-generator equipment.

Two 400-gpm boiler-feed pumps were installed; one with motor drive and the other with an Elliott mechanical drive steam turbine. The forced-draft fan is motor-driven and the induced-draft fan is driven by an Elliott mechanical drive turbine equipped with variable-speed governor control, under the operation of the combustion control system.

A complete coal- and ash-handling



The Elliott 3000-sq ft two-pass non-divided water-box condenser is hung from the turbine exhaust nozzle. At lower right may be seen the two condensate pumps which are driven by Elliott Crocker-Wheeler Sealedpower *TEFC motors.*

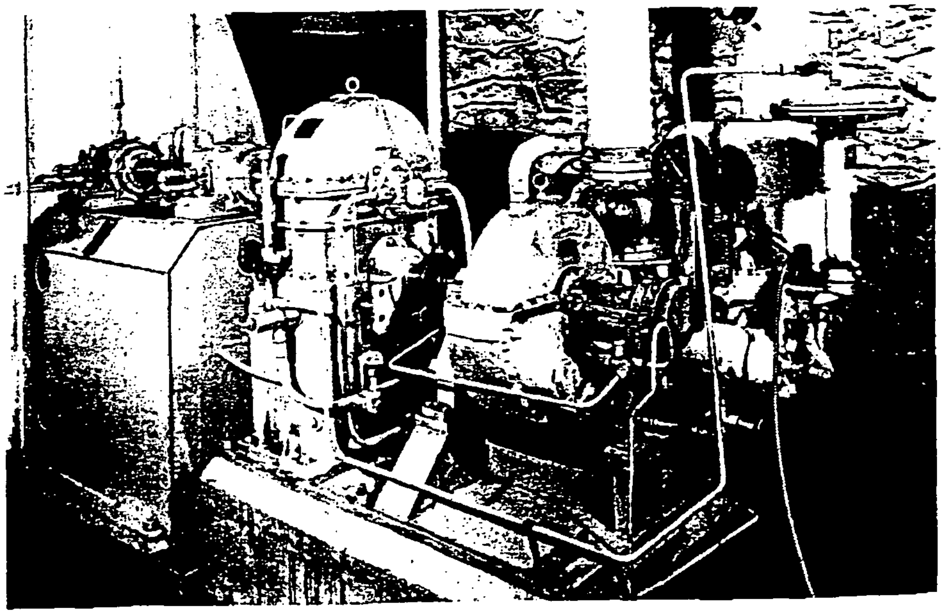


One of the two 400-gpm boiler-feed pumps is driven by this Elliott 200-hp steam turbine, equipped with a built-in pump governor. The other boiler-feed pump is motor driven.

system is installed, together with facilities for burning fuel oil in the event of loss of coal supply. Water treatment is provided by a hot-process lime, soda, and phosphate system, with oil removal filters for conditioning of returned condensate from the mills.

In 1950 the Downingtown Paper Company decided to proceed with the second phase of its steam and electric power program and install the electric-generating system. After a careful study an order was placed with the Elliott Company for one 2500-kw noncondensing turbine-generator, one 2500-kw condensing-extraction turbine-generator, and one 3000-sq ft surface condenser and auxiliaries. The units were designed for inlet steam at 400 psig, 650 F, with the exhaust from the noncondensing unit and the extraction from the condensing unit arranged to discharge directly into the plant's 150-psig steam distribution system. The noncondensing unit is provided with back-pressure control and the con-

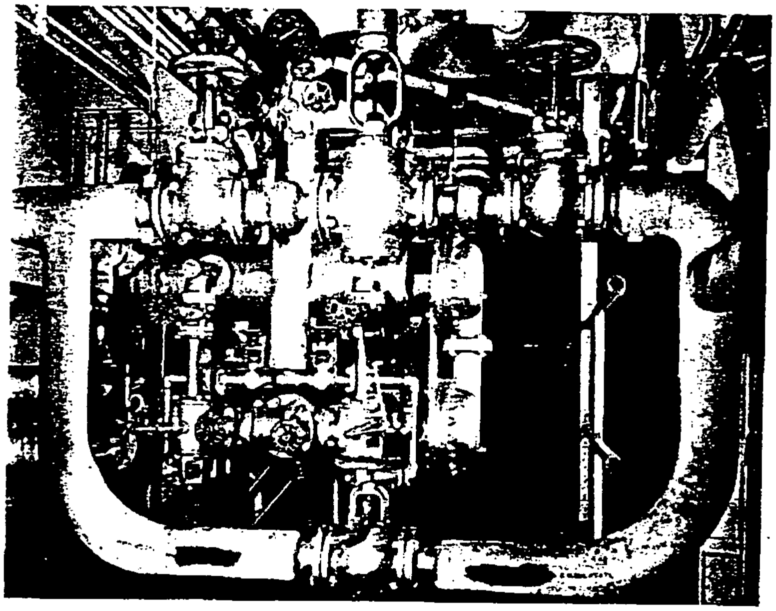
The induced-draft fans are driven by an Elliott 90-hp steam turbine through Elliott speed-reduction gears.



densing extraction unit is provided with compensated speed and pressure control.

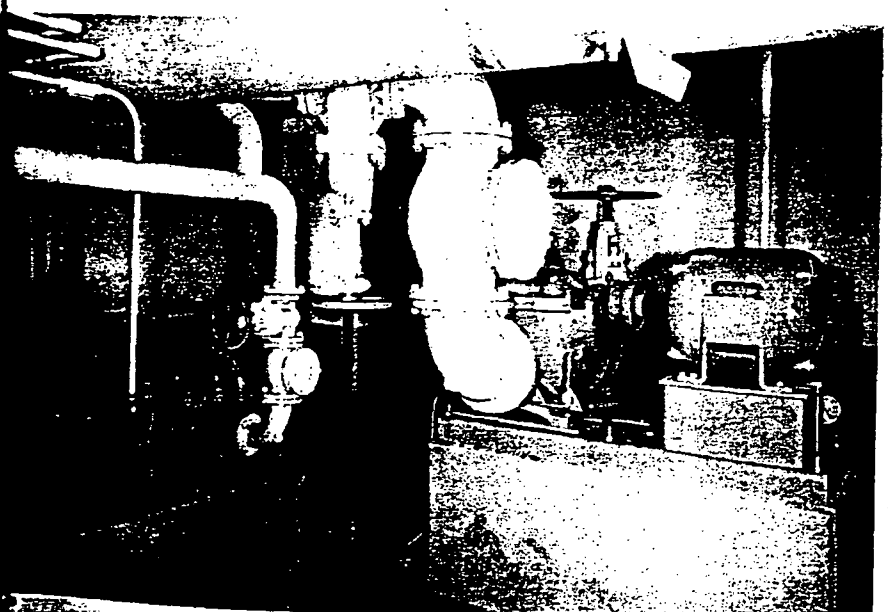
A tandem, high- and low-flow automatic air-operated pressure-reducing-valve station was installed between the main 450-psig steam header and the 150-psig plant steam header to provide any steam make-up for process requirements when necessary. In order to protect the steam engine equipment and certain auxiliaries that were operated from the 150-psig header, all steam from the turbines and pressure-reducing valves passes through a desuperheater which maintains a maximum steam temperature of 450 F.

With the new turbines, electrical energy is generated at 2300 volts to the main switchgear located in an isolated room adjacent to the boiler-turbine room. This main switchgear comprises metalclad units, with 1200-amp breakers for 2300-v supply to the main boiler-feed pump and to four 1000-kva, 2300/440-v substations for low-voltage service to each mill. Control instruments are mounted on the switchgear.



Pipe here frames the Elliott twin two-stage steam jet ejector which serves the condenser.

The new electrical generating facilities have been in operation approximately one year. In this period of time, the operating and economic results have been such as to more than justify the addition and improvements that were undertaken. All design, engineering, procurement of equipment and supervision of construction was carried out by Albert C. Wood Associates, consulting engineers, in close cooperation with the Downingtown Paper Company.

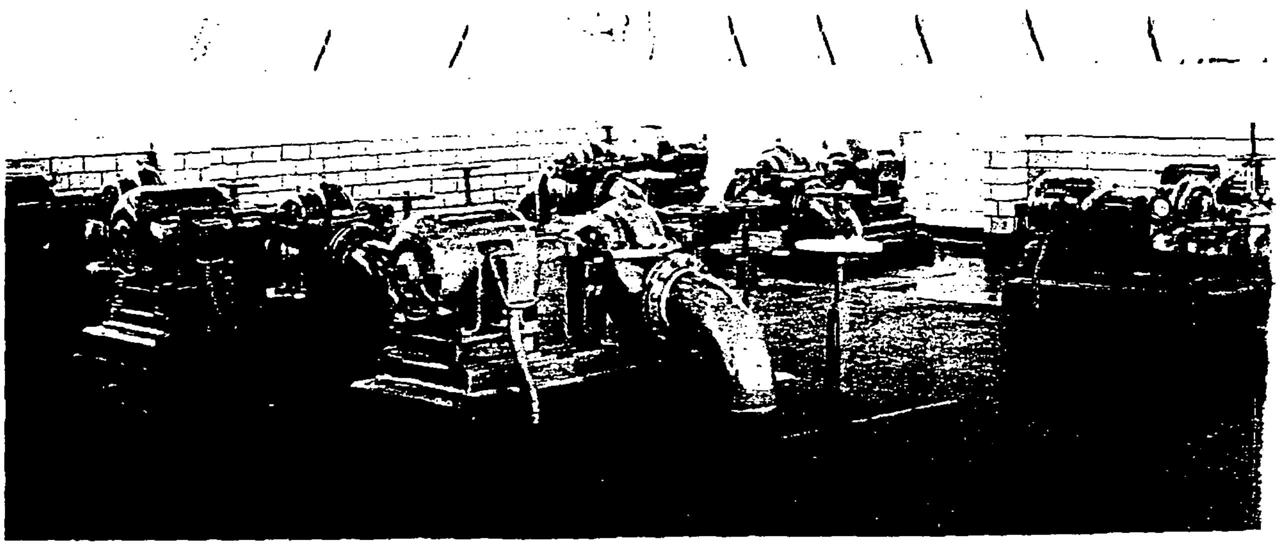


At left is one of two cooling water pumps driven by an Elliott Crocker-Wheeler 30-hp, 1750-rpm motor, and at right is a circulating pump driven by an Elliott C-W 20-hp squirrel-cage motor.

The Oakford Compressor Station, 25 miles east of Pittsburgh on the William Penn Highway, is built on three levels. Dehydration and metering equipment are on the upper level. On the second are two compressor buildings, the main gas piping, and gas scrubbing and cooling elements, and on the lower level are the office and personnel building, the auxiliary building, and the shop and warehouse building.

UNDERGROUND GAS STORAGE AND THE OAKFORD STATION

In the auxiliary building which houses the three gas engine generators, these five jacket water pumps are driven by Elliott Crocker-Wheeler 60-hp, 1760-rpm motors and the two lube-oil cooling water pumps at the right are driven by Elliott C-W 30-hp, 1750-rpm motors

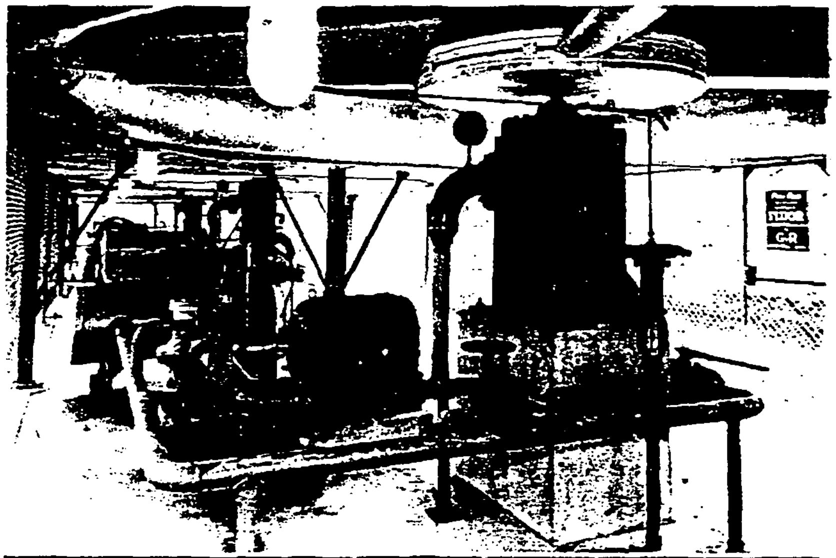


In the past few years there has been a tremendous increase in the demand for natural gas in the Appalachian area, and a large portion of this gas is now supplied from fields in the Southwest. In transporting gas this long distance, it was impractical to build a pipe line large enough to handle the peak winter demands and have it used at less than capacity for the rest of the year. The alternative was to provide a means of storing gas close to the marketing area, and the most satisfactory and economical method of doing this has been to use depleted gas-producing formations as natural gas reservoirs. One of the newest and largest of these underground storage projects is the Oakford Storage Area, about 25 miles east of Pittsburgh, developed jointly by New York State Natural Gas Corporation and Texas Eastern Transmission Corporation.

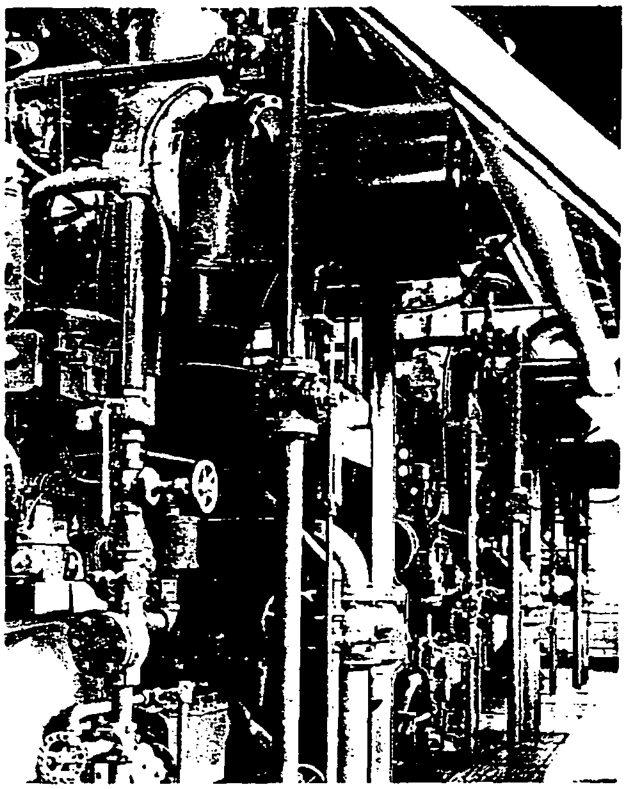
Gas was originally discovered around Oakford about 1895 in the Murrysville sand at an average depth of 1400 ft, and in the fifth sand at about 2200 ft in 1905. In their days of peak production, well flow in the Murrysville sand ranged from 10 to 40 million cu ft a day with a rock pressure of 600 psi, and from 20 to 30 million cu ft a day with a pressure of 1100 psi in the fifth sand.

The two sands have an estimated capacity of 105 million cu ft. Maximum storage pressure in the fifth sand is 1200 psi, and in the Murrysville sand is 600 psi. During the summer, gas normally will flow from transmission lines directly to the sands for storage until the sand pressure builds up to line pressure. Then the compressors, protected by scrubbers which remove pipe scale, sand, and other solids from the gas, take over and bring the sand to full storage pressure. There are twelve 2500-hp, two-cycle gas-engine compressors in two compressor buildings, any one of which can be operated as either a first- or second-stage unit.

Four Elliott C-W 60-hp Sealedpower *motors drive Rockwell "Rotocycle" hydraulic motor and pump units on the jacket water "Fin-Fan" cooler.*



A 30-hp Sealedpower *driving the "Fin-Fan" on the dehydration cooler. This drive is also representative of those used on the gas cooling "Fin-Fans."*



Close-up of the Elliott turbochargers looking at them from the control end of the three Worthington 1445-hp gas engines in the auxiliary building.

The gas, hot as a result of being compressed, is cooled in a battery of 20 Griscom-Russell K-fin air-cooled sections. Air is circulated over these cooling sections by five propeller-type "Fin-Fan" units driven by Elliott C-W 30-hp *Sealedpower* TEFC motors. The hot jacket water from the compressors is also cooled in a similar fin tube section, and its four "Fin-Fan" units are driven by Elliott C-W 60-hp *Sealedpower* TEFC motors through Rockwell "Rotocycle" hydraulic motor and pump units that maintain a constant jacket water temperature by varying the flow of oil through the hydraulic drive, which in turn controls the speed of the fan and the amount of air circulated.

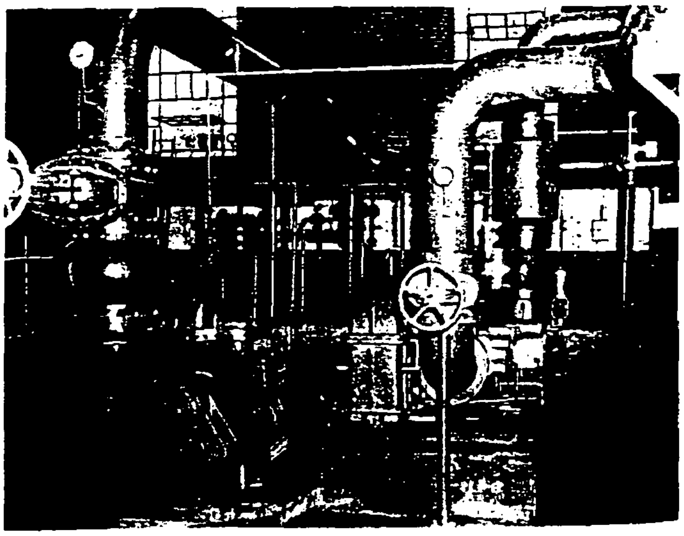
After being cooled the gas passes through separators that remove any oil suspended in the gas, through the dehydration plant which removes any water that the gas might have picked up, and finally into storage.

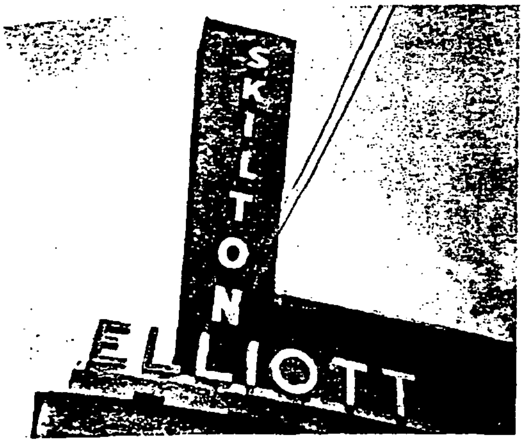
In the winter, gas passes through practically the same operation in reverse as it goes out of storage to market. Leaving the sand, it travels through the dehydration plant and into the transmission lines until the sand pressure comes down to line pressure. Then the compressors again take over to maintain a constant line pressure. The gas is always metered as it enters or leaves the station through the transmission lines and also as it enters or leaves storage.

All electrical power is produced by three 1000-kw gas-engine-driven generators. These engines are equipped with Elliott turbochargers. In the auxiliary building Elliott C-W motors drive jacket water pumps, lube-oil cooling pumps, and air compressors.

TIRE PLANT REFRIGERATION TURBINE

THIS photograph shows an Elliott steam turbine driving through horizontally-offset gears an Ingersoll-Rand pump which handles the condensing water for a water vapor refrigeration system in a rubber tire manufacturing plant. Incidentally, this is but one of several Elliott turbines in the plant.

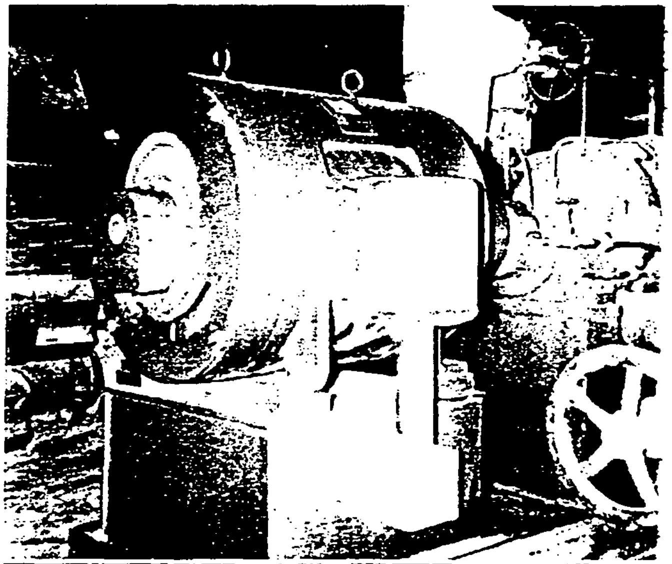




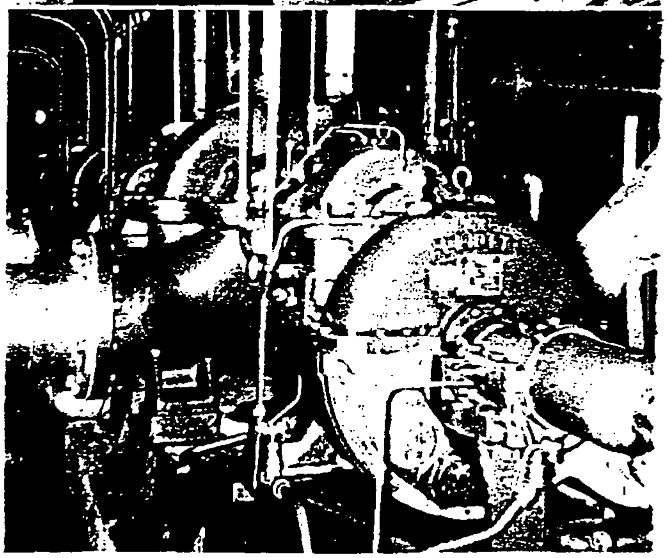
ON THE JOB IN CUBA

COMPANIA IMPORTADORA SKILTON, S.A., who have been Elliott representatives in Havana, Cuba, for many years, sent us the photographs, reproduced below, of typical Elliott geared turbines and motors driving pumps in sugar mills. They also sent the photograph of their new building showing the Elliott sign (left).

This Elliott Crocker-Wheeler 200-hp, 1750-rpm, open dripproof squirrel-cage induction motor drives an Ingersoll-Rand boiler-feed pump in a sugar mill at Central Moron, Pina, Province of Camaguey, Cuba.



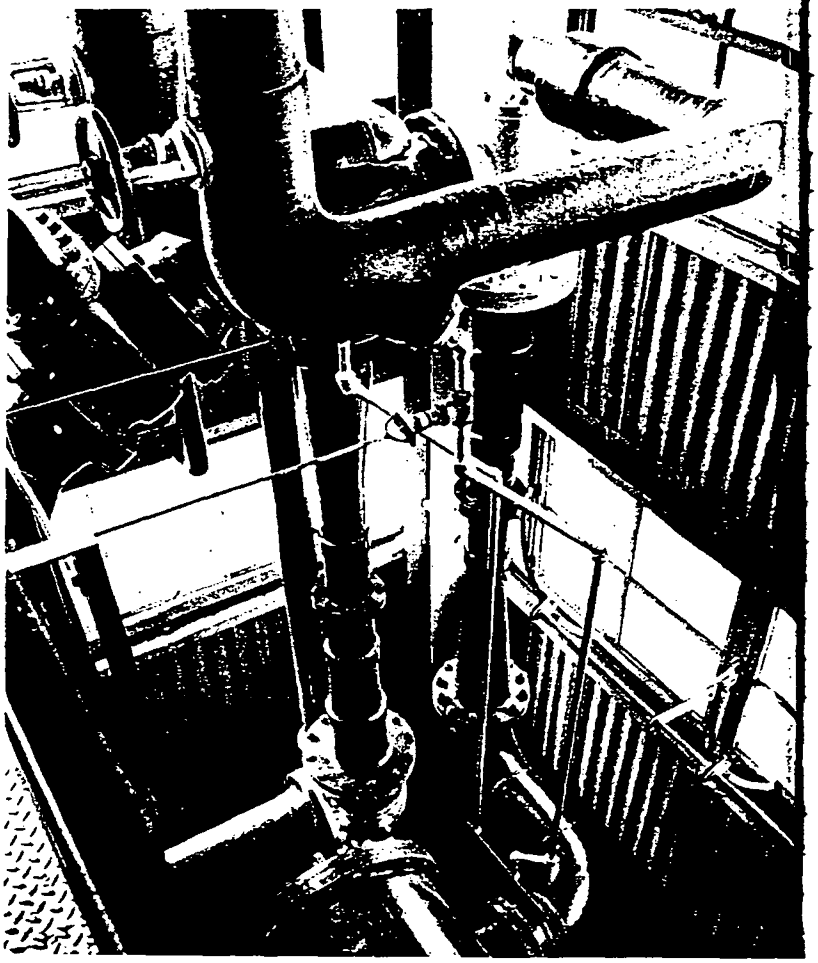
This photograph shows three Elliott 80-hp, 3795/1150-rpm steam turbines driving Ingersoll-Rand 5000-gpm single-stage pumps in the sugar mill of Central Santa Lucia, Oriente, Cuba. These units pump water from the barometric condenser hotwell to the sprayers of the cooling system. When these turbine-driven pumps were installed, the height of the sprayer was increased and a lower water temperature was achieved. Previously the water went direct to the cooling sprayer by gravity.



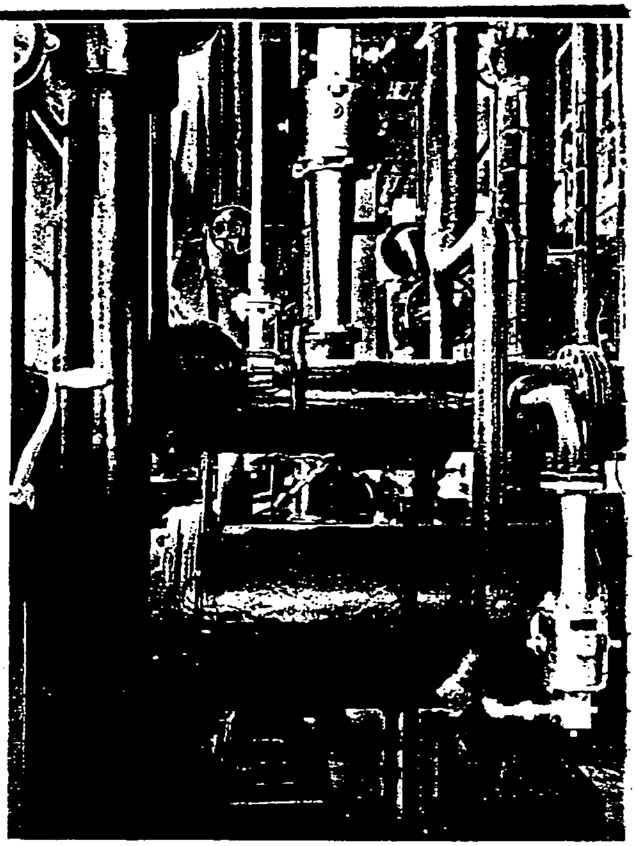
STEAM JET EJECTORS IN THE MANUFACTURE OF ANTIBIOTICS

ALL of the photographs shown here are recent installations of Elliott steam jet ejectors of various types in a new plant of a pharmaceutical manufacturer. This manufacturer has used Elliott steam jet ejectors in large numbers for the past 25 years or more. The ejectors serve process equipment handling material that is usually heat sensitive, which means that the evaporation, concentration, and drying processes must be done under vacuum. In many instances, the concentration processes require the removal of solvents which are quite expensive. Thus surface-type inter- and aftercondensers are used in order to recover these solvents. As with all such installations, the Elliott ejectors are furnished in sizes and types suited to the sort of material handled, the quantity, and the degree of vacuum to be maintained.

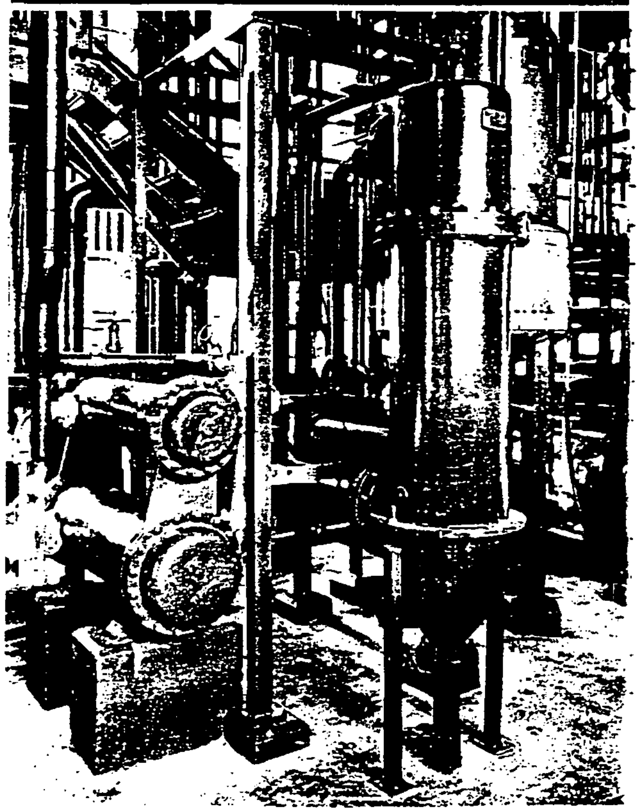
This photograph shows the first two stages and a part of the surface-type intercondenser of a three-stage ejector. The intercondenser is between the second and third stages. The first-stage ejector, at the left, discharges vertically upward into the suction of the second-stage ejector, which discharges vertically downward into the surface-type intercondenser. The third ejector stage and aftercondenser are not shown in the photograph. The first-stage ejector can be by-passed. (By-pass piping and valve are shown.) This unit serves a large evaporator designed to handle a variety of solvents. When handling solvents with a relatively high vapor pressure, only the second- and third-stage ejectors need be operated.



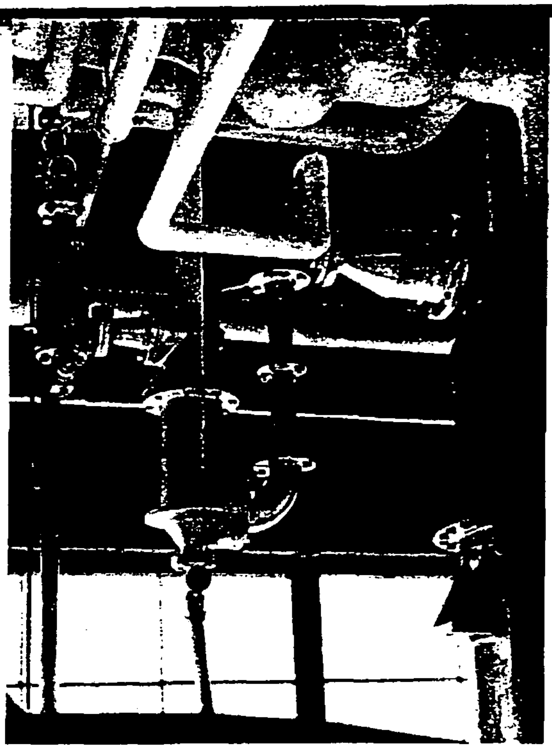
This three-stage ejector with two surface-type intercondensers serves a 200-gal still. The first-stage ejector is in the center of the picture, the second stage in the right foreground, and the third stage is mostly hidden by the second, or smaller, intercondenser. (It discharges vertically upward and the discharge flange can be seen just to the left of the center of the first-stage diffuser.



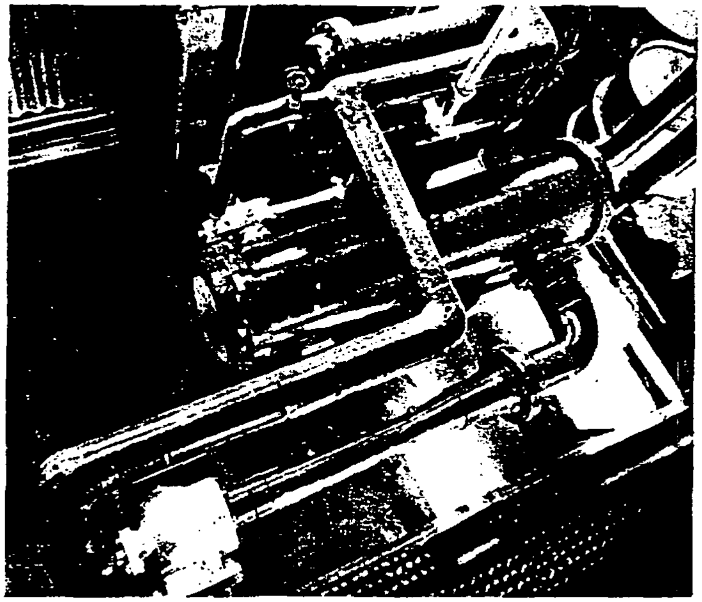
This photograph shows the large first stage and the smaller third stage of a three-stage ejector using three surface-type condensers—two intercondensers and an aftercondenser. The second-stage ejector is out of the picture to the right. In the background to the left is another similar three-stage ejector unit. These units are used in evaporating valuable solvents.



The barometric condenser at the right is served by the two-stage ejector with surface-type inter- and aftercondensers shown at left.

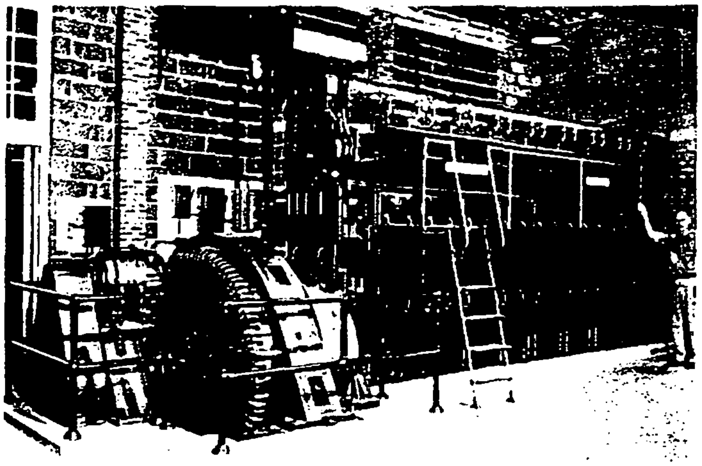


This two-stage steam jet ejector with jet-type intercondenser serves the barometric condenser at the right. This equipment operates with an auxiliary booster and a recompressor booster (not shown in the photograph) to serve a large evaporator handling large quantities of water vapor. The two different boosters and large barometric condenser can be used in various combinations to take advantage of seasonal variation in cooling-water temperature. Since only water is evaporated in the still this equipment serves, there is no need to use a surface-type condenser.

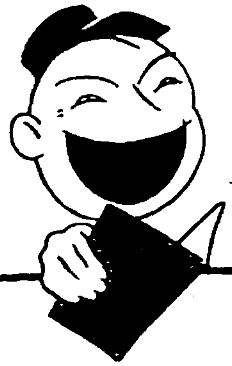


Looking down on a three-stage ejector with surface-type inter- and aftercondensers. The first- and second-stage ejectors are clearly shown while the third stage is out of the picture at the top. This ejector unit serves a still designed to handle a variety of solvents.

ELLIOTT GENERATOR IN MUNICIPAL PLANT



TO keep pace with its always-increasing needs of electric power, the town of Woodsfield, Ohio, must add to the generating capacity of its power house. Most recent unit is this Elliott 600-kw, 327-rpm generator driven by a Superior 875-hp, dual-fuel, diesel engine. This unit carries the entire day load, which peaks at around 520 to 560 kw, while two smaller diesel-generators handle the night load which averages about 170 kw. In the past, when one of the industrial plants served by the system came on the line, lights would dim throughout the community, but since the installation of this unit, oncoming loads are picked up without disturbance to the system's voltage. Good economy is recorded.



powercrax

Wife (on returning from party): "Why is it I buy a beautiful new evening gown and you never even notice it, but you get pop-eyed staring at every other woman in the place?"

Husband (sleepily): "Once you know what's in the package, it doesn't matter how it's wrapped."

●

Dr. Bigbill: "Well, well (as he met a former patient on the street) I'm glad to see you again, Mr. Brown. How are you this morning?"

Brown (cautiously): "First, doctor, does it cost anything to tell you?"

●

Judge: "What do you wish to charge against your husband?"

Wife: "Free love, Your Honor. He ain't supported me for six years."

★

Most of us carry our own stumbling block around with us. We camouflage it with a hat.

●

A mild little man walked into an income tax collector's office, sat down and beamed on everyone. "What can I do for you?" asked the collector. "Nothing, thank you," replied the little man, "I just wanted to meet the people I work for."

●

Next to being shot at and missed, nothing is quite as satisfying as an income tax refund.

★

Would you marry a gal whose face was as pretty as a picture?

Sure, if she had the frame to go with it!

★

Matrimony puts an end to more petting than all the park police put together.

★

Effie says the woman's work that's never done is most likely what she asked her husband to do.

Too many of us are like the old Negro deacon who wound up a long prayer by saying, "Use me, O Lord, use me in thy work—'specially in an advisory capacity."

●

Backward, turn backward, O Time, in thy flight—I've thought of a comeback I needed last night.

★

"Gas overcomes girl while taking bath" reads a headline in a Bowling Green, Ky., paper. Then follows the account of the near-tragedy: "Miss Blank owes her life to the watchfulness of the elevator boy and janitor . . ."

●

Fiance: "Now, tell me the truth, dear. You're sure you never let any other man kiss you goodnight?"

Girl: "Positively. By the time they leave me it's always morning."

★

In the middle of a long, drawn out sermon, the preacher interrupted himself to order a small boy, "Wake up your father, Jimmy!"

The boy replied, "Wake him up yourself, you put him to sleep!"

●

After a long course of treatments had failed, the masseuse sighed to her plump patient: "We can't fight fate. After all, there is a destiny which shapes our ends."

★

Stoop: "They say only one man in a hundred is a leader of men."

Droop: "Yeah, and the other ninety-nine follow women."

●

A newly-made widow called at an insurance company office for money due on her late husband's policy.

Said manager, "I'm very sorry, madam, to hear of your loss."

"That's just like you men," she snapped. "Always sorry when a poor woman gets a chance to make a little money."

Many a man has made a monkey out of himself by reaching for the wrong limb.

★

Wife: "Do you have a good memory for faces, dear?"

Husband: "Of course I have."

Wife: "That's good, I just dropped your shaving mirror."

●

Of course lots of lives have been destroyed by whiskey, but just look at all the boats that have been wrecked by water.

★

Registrar: "Have you been married before, Madam? And if so, to whom?"

Film Star: "Oh, I didn't know this was going to be a memory test!"

●

One evening a young matron was returning from a First Aid class, and she came upon a man sprawled face down on a darkened side street.

"Ah!" thought the girl, "Providence has led me hither to minister to this poor unfortunate." Parking her car nearby, she rushed over and began artificial respiration. Presently the man stirred, looked up, and speaking with difficulty, said: "I'm holding a lantern for a guy working down in this manhole. I ain't sure what you're up to, lady, but this ain't the time or the place."

●

"Dad," asked the small boy, "Why is a man not allowed to have more than one wife?"

"My son," replied the father, "when you are older you will realize that the law protects those who are incapable of protecting themselves."

★

First Street Cleaner: "I hear you made a big killing in the stock market."

Second Street Cleaner: "Not exactly. I just cleaned up a little along the curb."

★

Gardening—An early symptom of lumbago.

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